Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University under Category 'A' by MHRD, Estd., u/s 3 of UGC Act 1956)

Re-accredited with 'A' Grade by NAAC Recognised by UGC Under Section 12B

Coimbatore – 641 043, Tamilnadu, India

B.Sc., Biochemistry & Biotechnology

(For students admitted from 2018-2019 onwards)

Programme Specific Outcomes :

1. The double- major conceptual framework provides a strong foundation in Biochemistry and Biotechnology, building a holistic expertise and providing an edge in facing the National-level competitive examinations
2. The Programme enables the students to find opportunities for higher studies in reputed academic and research Institutions
3. The Programme inculcates critical thinking and analytical skills, which increases their marketability
4. Internships and field visits give a strong exposure to realtime research problems in life science and enable the graduates to launch them in their workplace environment

Scheme of instruction and Examinations

Part	Subject Code	Number of papers and components	Hours of Instructions / Week		Scheme of Examination				
			Theory	Practical	Duration of Exam	CIA	CE	Total	Credit
First Semester									
I	18BLT001 18BLH001 18BLF001	Tamil/Illakayam –I – Illakanam – Illakya varalaru Hindi/Prose and non-detailed text French	5	-	3	50	50	100	4
III		**Core Course - I**							
	18BBCC01	Chemistry of Biomolecules	5	-	3	50	50	100	3
	18BBCC02	Practicals – I Analytical Biochemistry – Qualitative Analysis	-	3	3	50	50	100	2
		Core Course - I							
	18BBTC01	Introduction to Biotechnology and Cell Biology	5	-	3	50	50	100	3
	18BBTC02	Microbiology	4		3	50	50	100	3
		Discipline Specific Elective (DSE) Course							
	18BBCI01	**DSE – I** Chemistry theory for Biochemistry and Biotechnology	4	-	3	50	50	100	3
	18BBCI02	Chemistry practical for Biochemistry and Biotechnology	-	3	3	50	50	100	2
		Games	-	1	-	-	-	-	-

Part	Subject Code	Number of papers and components	Hours of Instructions / Week		Scheme of Examination				
			Theory	Practical	Duration of Exam	CIA	CE	Total	Credit
	Second semester								
I	18BLE002	English – Language II - Literature	5	-	3	50	50	100	4
III		**Core Course - I**							
	18BBCC03	Techniques in Biochemistry	5	-	3	50	50	100	4
	18BBCC04	Chemistry of Proteins	4	-	3	50	50	100	3
		Core Course - II							
	18BBTC03	Biophysics	4	-	3	50	50	100	3
	18BBTC04	Practicals – I Techniques in Biotechnology	-	4	3	50	50	100	2
		Discipline Specific Elective (DSE) Course							
	18BBCI03	**DSE – II** Physics for Biochemistry (Physics)	4	-	3	50	50	100	3
	18BBCI04	Physics – Practicals for Biochemistry (Physics)	-	3	3	50	50	100	2
		Games	-	1	-	-	-	-	-
Third Semester									
III		**Core Course - I**							
	18BBCC05	Intermediary Metabolism - I	4	-	3	50	50	100	3
	18BBCC06	Human Physiology	4	-	3	50	50	100	3
	18BBCC07	Practicals II - Enzymes	-	5	6	50	50	100	3
		Core Course - II							
	18BBTC05	Environmental Biotechnology	4	-	3	50	50	100	3
	18BBTC06	Genetics	4	-	3	50	50	100	3
	18BBTC07	Enzymes and Enzyme Technology	4	-	3	50	50	100	3
		Discipline Specific Elective (DSE) Course							
	18BBCI05	**DSE – III** Computer Applications in Biosciences	2	3	3	50	50	100	4
Fourth Semester									
III		**Core Course - I**							
	18BBCC08	Intermediary Metabolism -II	4	-	3	50	50	100	3
	18BBCC09	Plant Biochemistry	4	-	3	50	50	100	3
	18BBCC10	Drug Biochemistry	4	-	3	50	50	100	3
		Core Course – II							
	18BBTC08	Immunology	4	-	3	50	50	100	3

Part	Subject Code	Number of papers and component	Hours of Instructions / Week		Scheme of Examination				
			Theory	Practical	Duration of Exam	CIA	CE	Total	Credit
	18BBTC09	Microbial Biotechnology	4	-	3	50	50	100	3
	18BBTC10	Practicals II – Microbial Techniques	-	6	6	50	50	100	3
		Discipline Specific Elective (DSE) Course							
	18BBCI06	**DSE – IV** Mathematics for Biological Sciences (Mathematics)	4	-	3	50	50	100	3
III		**Fifth Semester**							
		Core Course - I							
	18BBCC11	Clinical Biochemistry	4	-	3	50	50	100	3
	18BBCC12	Molecular Biology	4	-	3	50	50	100	3
	18BBCC13	Practicals III – Clinical Biochemistry	-	5	3	50	50	100	2
		Core Course - II							
	18BBTC11	Plant Biotechnology	3	-	3	50	50	100	3
	18BBTC12	rDNA technology and Nanobiotechnology	4	-	3	50	50	100	3
	18BBTC13	Practicals III – Methods in Molecular Biology and Plant Tissue Culture	-	5	6	50	50	100	3
	18BBTC14	Antioxidants in Health and Diseases- **Self study Course**	1	-	3	100	-	100	4
	18BBTC15	Biochemistry and Biotechnology - **Computer Based Test**	-	-	1	-	100	100	2
	18BBCC14	Training	-	-	-	100	-	100	6
		Generic Elective Course	2	-	-	100		100	2
		Sixth Semester							
III		**Core Course - I**							
	18BBCC15	Molecular Physiology	5	-	3	50	50	100	3
	18BBCC16	Nutritional Biochemistry	5	-	3	50	50	100	3
	18BBCC17	Practicals IV – Clinical Biochemistry and Food analysis	-	5	6	50	50	100	3

		Core Course - II							
	18BBTC16	Computational Biology	5	-	3	50	50	100	3
	18BBTC17	Animal Cell Culture and Animal Biotechnology	5	-	3	50	50	100	3
	18BBTC18	Project Work	-	5	viva	100	-	100	2
			Total Credits						**132**

*Internship for a period of 30 days during summer vacation

Part	Subject Code	Number of papers and component	Hours of Instruction/ week/ Course		
Part IV Components					
	A. Ability Enhancement Courses ***I. Ability Enhancement Compulsory Course (AECC)***				
2	15BAES01	Environmental Studies	4		4
5	17BSCS01	Communication Skills –I	3	Remarks	2
6	17BSSS01	Soft Skills - I	3	Remarks	2
	II. Skill Enhancement Courses				
3		**Value Added Course (**from a basket of choices offered**)**	40 hrs. duration	Remarks	2
4		**Co- curricular Courses** Add on Certificate/ Quantitative Aptitude/ Certificate Course/ Gandhian Studies/ Women's Studies/ Ambedkar Studies/Verbal and Non-Verbal Reasoning/ General Awareness/ others as per list	Varied duration	Remarks	2
	B. Extra – curricular Course				
1-6	15BXNC01/ 15BXNS01/ 17BXNP01	NCC/NSS/Sports (representing the Institute)		Remarks	6
				Total Credits	**18**

For the first four semesters there will be a minimum of two core courses/ semester.

*internship: minimum 15 days (4 credits) – maximum 30 days (6 credits)

The above may be within the regular working hours or during the vacation of the I year and II year

Total Credits to earn the degree

1. Parts I, II & III Components - 132
2. Part IV Components - 18

Total Credits - 150

Other Courses offered by the Department

Discipline Specific Electives

For B.Sc. Physician Assistant	18BPAI02	Clinical Biochemistry	II Semester
For B.Sc. FSN and B.Sc. Chemistry	18BFNI03/18BCHI03	Chemistry and Metabolism of Biomolecules - Theory	III Semester
For B.Sc. FSN and B.Sc. Chemistry	18BFNI04/18BCHI04	Chemistry and Metabolism of Biomolecules - Practicals	III Semester

- **Generic Elective Course** - Biochemical Parameters in Health and Diseases
- **Value Added Course** - **18BBCV01-** Herbal Home Remedies
- **Co-curricular course** - **17BBCCB1** - Certificate course in Computational Biology

Chemistry of Biomolecules

Semester I **Hours of Instruction /week: 5**

18BBCC01 **No. of Credits: 3**

Objectives:

1. To learn about the structure and function of organic molecules in living system
2. To know about the physical and chemical properties of biomolecules for understanding their biological importance
3. To impart knowledge on the complexity of cell structure

Unit 1 Carbohydrates **15**

Introduction and classification of carbohydrates, structure and reactions of monosaccharides; structure and biological importance of glycosides, amino sugars and deoxy sugars.

Structure and biological importance of sucrose, maltose, isomaltose, lactose, cellobiose and raffinose.

Structure and biological importance of storage polysaccharides (starch, glycogen and inulin) and structural polysaccharides (cellulose, chitin and pectin).

Unit 2 Lipids **15**

Definition and classification of lipids based on backbone structure - chemistry and characterization of simple lipids- triacylglycerol - classification, structure and chemistry of phospholipids and non phosphorylated lipids – sulpholipids - Eicosanoids.

Unit 3 Complex polysaccharides and complex lipids **15**

Structure and biological importance of glycosaminoglycans - blood group polysaccharides -bacterial cell wall polysaccharides - peptidoglycans, teichoic acid and lipopolysaccharides.

Chemistry of biologically important steroids - cholesterol, mycosterol, phytosterol and bile acids. Brief account of lipoproteins.

Terpenes - structure of mono-, di-, tri- and tetraterpenes

Structure of fat- and water- soluble vitamins.

Unit 4 Nucleic acids **15**

Structure of bases, nucleosides and nucleotides. Biologically important nucleotides.

Deoxyribonucleic acid – base composition, structure and forms, denaturation and renaturation of DNA helix.

Ribonucleic acid – base composition, classes -structure of major ribonucleic acid mRNA, tRNA and rRNA.

Unit 5 Amino acids **15**

Structure and classification of standard amino acids - rare amino acids and non- protein amino acids - physical and electrochemical properties -reactions of amino acids - due to amino groups, carboxyl groups and R groups - colour reactions of amino acids. Brief

introduction to peptides and proteins.

Total Hours: 75

Course Outcomes:

At the end of the course students will be able to

1. Understand the structure and functions of biomolecules in a cell
2. Assess the nature of lipids based on their structure and functions
3. Relate the properties of biomolecules to their role in living systems
4. Understand the structure, properties and reactions of nucleic acids and aminoacids
5. Distinguish the biomolecules present in the structural composition of a cell

Text Books:

1. ***Berg, J.M.,Tymoczko, J.L. and Stryer, L.*****(2015)*****Biochemistry***, EigthEdition, W.H. Freeman and Company, NewYork.
2. ***Boyer, R.F.*** **(2010)*****Biochemistry – Laboratory Modern theory and technique,***Second Edition, Prentice Hall Publishers,UK.
3. ***Nelson, D.L. and Cox, M.M.*** **(2013)** ***Lehninger Principles of Biochemistry***, Sixth Edition, W.H. Freeman and Company, New York.

Reference Books:

1. ***Cambell, M.K. and Farrell, S.O***. (2018) ***Biochemistry,*** Eight Edition, Cangage Learning
2. ***Voet, D., Voet, J.G. and Pratt, C.W.*****(2013)*****Fundamentals of Biochemistry – Life at the Molecular level***, Fouth Edition, John Wiley & Sons. Inc, New York.
3. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.*****(2012)*****Harpers Illustrated Biochemistry,***Twenty ninth Edition, Tata McGraw Hill Companies' Publication, New Delhi.

Practicals-I Analytical Biochemistry – Qualitative Analysis

Semester I **Hours of Instruction /week: 3**

18BBCC02 **No. of Credits: 2**

Objectives:

1. Toacquire basic lab skills, concepts and use of scientific method
2. To understand the basic principle and methodology for the qualitative analysis of biomolecules
3. To learn the basic techniques involved in the biochemical methods for the isolation and analysis of biological molecules

Unit 1 Reactions of monosaccharides **9**

Pentose, Glucose, Fructose, Galactose and Mannose

Unit 2 Reactions of disaccharides and polysaccharides **9**

Sucrose, Maltose, Lactose, Starch, Dextrin and Glycogen

Unit 3Reactions of proteins and amino acid **9**

Reactions of amino acids Tyrosine, Tryptophan, Histidine, Arginine,, Cysteine and Methionine

Unit 4Group experimentI **9**

Characterization of fats – acid number, iodine number, saponification number and RM number

Unit 5 Group experiment II **9**

Colour reactions of cholesterol

Preparation of starch

Extraction of total lipids by Soxhlet apparatus

Total Hours: 45

Course Outcomes :

At the end of the course, students will

1. Analyze and identify the given sugar/amino acid
2. Characterize the given fat
3. Isolate starch and glycogen
4. Analyse the reactions of cholesterol

References:

1. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.*****(2012)H*****arpers Illustrated Biochemistry,***Twenty ninth Edition, Tata McGraw Hill Companies' Publication, New Delhi.
2. ***Wilson, W. and Walker, J*****. (2002)*****Practical Biochemistry***, Fifth Edition, Cambridge University Press, UK.

3. ***Sadasivam, S. and Manickam, A***. (2005) ***Biochemical Methods***, Second edition, New Age International Pvt. Ltd.
4. ***Jayaraman, J.***(2011)***Laboratory Manual in Biochemistry,*** New Age International Pvt. Ltd.

Introduction to Biotechnology and Cell Biology

Semester I **Hours of Instruction /week: 5**

18BBTC01 **No. of Credits: 3**

Objectives:

1. To understand the origin of biotechnology and the difference between ancient and modern biotechnology
2. To build strong basics of cellular architecture, its components and their organization
3. To inculcate the knowledge of the varied functions of cells, their interactions and development

Unit 1 Introduction **15**

Time line of Biotechnology - History and industrial development of Biotechnology – Green, yellow, white, blue and other colors of Biotechnology

Cell as the basic unit of living systems – the cell theory – pre-cellular evolution – Stanley Miller's experiment to understand the artificial creation of cells

Broad classification of cell types - mycoplasma, bacteria, eukaryotic microbes, plant and animal cells (general discussion of cell architecture)

Detailed classification of cell types within an organism – cell, tissue, organ and organism as different levels of organization of otherwise genetically similar cells

Unit 2 Structure and functions of cell organelles **15**

Ultrastructure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, mitochondria, chloroplasts, lysosomes, peroxisomes, glyoxisomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin)

Unit 3 Cell division and interactions **15**

Cell division - mitosis and meiosis.Cell cycle – stages of interphase and M-phase – cell synchrony and its applications (regulatory aspects not needed)

Cell-cell interactions - Metabolic cooperation, electrical coupling, contact inhibition, autocrine, paracrine and endocrine signaling (discussion on individual hormones not needed)

Ecological amplitude of cells in high altitude, sediments, arctic, hot springs, arid, brackish and fresh water environments

Unit 4 Cell locomotion

Cytoskeletal elements - Microtubules, microfilaments (actin and myosin), intermediary filaments - cell locomotion (amoeboid, flagellar and ciliary) – muscle and nerve cells as terminally differentiated cells – muscle cells – general structure of skeletal and smooth muscles – microfilament organization in skeletal and smooth muscles – sliding filament mechanism of contraction (energy aspects and regulation not needed) – nerve cells – general structure of a neuron – synapses – types (electrical and chemical) (mechanism and regulation of nerve impulse generation and transmission not needed) **15**

Unit 5 Cell differentiation, senescence and death **15**

Cell differentiation in plants: Fertilization, initial divisions, seed formation, germination, primordial layer formation, organogenesis (only sources of organs from each layer)

Cell differentiation in animals: fertilization, implantation, blastula formation, gastrulation, primordial germ layers, organogenesis (only sources of organs from each layer)

Cell senescence: Biochemical changes during senescence – role of telomere and telomerase.

Cell death – necrosis and programmed cell death (apoptosis, paraptosis and autophagy)

Total Hours : 75

Course Outcomes:

The students will be able to

1. Compare the advantages of traditional and modern Biotechnology
2. Classify cell types within an organism at all levels of differentiation
3. Illustrate the different stages of cell division and cell-cell interactions
4. Interpret the different modes of cell death
5. Distinguish cellular differentiation in plants and animals

Text Books:

1. ***Karp, G.*(2013)*Cell and Molecular Biology - Concepts and Experiments***, Seventh Edition, John Wiley and Sons, Inc, New York.
2. ***Verma, P.S. and Agarwal, V.K.* (2010)*Cell Biology, Genetics, Molecular Biology, Evolution and Ecology***, Ninth Edition, S. Chand and Co. Ltd, New Delhi.

3. ***Cooper, G.M. and Hausman, R.E.*****(2013)*****The Cell – A Molecular approach***, Seventh Edition,Sinauer Associates Inc, US.

Reference Books:

1. ***Nelson, D.L. and Cox, M.M.*****(2013).*****Lehninger Principles of Biochemistry,*** Sixth Editon, W.H. Freeman and Company, New York.
2. ***Berg, J.M., Tymoczko, J.L. and Stryer, L.*****(2012).*****Biochemistry,*** Seventh Edition, W.H. Freeman & Company, New York.
3. ***Lodish, H., Berk, A., Matsudair, P., Kaiser, C.A., Krieger, M., Scott, P.M., Bretscher, A., Ploegh, H. and Matsuaira, P.*** **(2014)*****Molecular Cell Biology***, Seventh Edition, W.H Freeman and Company, New York.

Microbiology

Semester I **Hours of Instruction /week: 4**

18BBTC02 **No. of Credits: 3**

Objectives:

1. To understand the discovery of microorganisms, their classification and structures
2. To know the methods in microbiology and sterilization techniques
3. To give an idea about the various diseases caused by pathogenic microorganisms

Unit 1 Scope and history of microbiology **12**

Discovery of microorganisms - spontaneous generation controversy – germ theory of disease - microbial effects on organic and inorganic matter

Microscopy - light microscopy- dark field, phase contrast, fluorescence microscopy, electron microscopy-SEM, TEM.

Unit 2 Classification and Structure of microorganisms **12**

Microbial taxonomy, Structure of bacterial cells- capsule, flagella, fimbriae or pili; Cell wall- chemical composition and characteristics of Gram positive and Gram negative bacteria. Classification and morphology of fungi, algae, protozoa and viruses.

Unit 3 Methods in microbiology **12**

Staining- principle and types

Microbial growth – Growth curve. Culture media– types, preparation and characteristics; Methods of isolation of pure culture. Culture cultivation and preservation.

Unit 4 Control of microorganisms **12**

Sterilization and Disinfection.

Physical methods- dry and moist heat, Pasteurization, Tyndalization, radiation, ultrasonication, filtration.

Chemical methods – phenols, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, sterilizing gases. Mechanism of action of antimicrobial agents

Unit 5 Medical microbiology **12**

Bacterial diseases – tuberculosis, diptheria, cholera, typhoid, leprosy; Viral diseases – Dengue fever, measles, mumps, rubella, AIDS, hepatitis B; Fungal diseases – mycosis, candidiasis; Protozoan diseases – malaria, sleeping sickness.Antimicrobial agents. Antibiotics and antibiotic resistance (brief account).

Total Hours : 60

Course Outcomes :

At the end of the course, the students will

1. Gain an insight into the classification of microorganisms.
2. Identify microorganisms based on their ultrastructure.
3. Acquire the theoretical knowledge for the various methods used in microbiology.
4. Understand how microorganisms cause various diseases.

Text Books:

1. ***Talaro, K.P. and Talar, A.*** **(2012).*Foundations in Microbiology***, Eight Edition, The McGraw Hill Publishing Company, New York.
2. ***Prescott, L.M., Harley, J.P. and Klein, D.A.*****(2010).*Microbiology***, Eight Edition, The McGraw Hill Publishing Company, New York.
3. ***Pelczar, M.J., Chan, E.C. and Krieg, N.R.*** **(2006).*Microbiology***, Sixth Edition, Tata McGraw Hill Publishing Company, New Delhi.

Reference Books:

1. ***Sumbali, G. and Mehrotra, R.S.*****(2009).** ***Principles of Microbiology***, Tata McGraw-Hill Publication, New Delhi.
2. ***Casida, J.R.*** **(2009).*Industrial Microbiology***, Fifth Edition, New Age International Publishers, New York.
3. ***Tortora, J.G., Funke, K.B. and Case, L.C.*** **(2006).*Microbiology – An Introduction***, Eleventh Edition, Beryamin-Cummings Publishing Company, New York.

Chemistry theory for Biochemistry and Biotechnology

Semester I **Hours of Instruction /week: 4**

18BBCI01 **No of Credits: 3**

Objectives:

1. To acquire knowledge and understanding chemical bonding
2. To learn nomenclature, classification and structure of Coordinate compounds
3. To gain insights on fundamental Organic chemistry and stereoisomerism
4. To understand fundamental concepts of physical chemistry
5. To develop basic laboratory skills and lab safety

Unit 1 Basic Lab Practices And Laboratory Safety **12**

Eye safety and other personal protection equipment, Handling flammable, volatile, health hazardous, and corrosive chemicals –maintenance of reagents and antioxidants Nature of solvents, acids, bases, salts- Emergency response, Waste Chemical Handling, Glassware and Equipment - Description – Cleaning glassware - Glassware safety,

Concentration expressions - Normality, molarity, molality, mole fractions, Principles of titrimetric analysis – acid-base and redox titrations - use of burette, pipette, Significance of meniscus – measuring, making up and transferring liquids, diluting solutions - Weighing solids –Chemical balance

Unit 2 Chemical bonding and attractive forces **12**

Structure of atoms and molecules – Basic concepts of bonding in organic chemistry– Types of chemical bonds – ionic, covalent, coordinate covalent bonds – Hybridisation and geometry of molecules - methane, ethane, ethylene, acetylene. Cleavage of bonds - homolytic and heterolytic fission of carbon - carbon bond - reaction intermediates - carbocations carboanions and free radicals - their stability.

Weak forces –Vanderwal's forces, hydrogen bonding, hydrophobic interactions

Structure and polarity of water –Hydrogen bonding in water – Ionisation of water, ionic product of water and its pH, buffer solution- preparation

Unit 3 Periodic Properties And Co-Ordination Chemistry **12**

Periodic table – Classification of elements into s, p, d and f block and their general characteristics –electronic configuration, size, density, melting point, boiling point, flame colour atomic radius, atomic volume, ionization potential , electro negativity, electron affinity –trends in periodic properties

Ligands, chelates, co-ordination number, classification of ligands, nomenclature of coordination compounds, Werner's coordination theory, Sidgwick's electronic interpretation of coordination compounds and the concept of effective atomic number (EAN), Preliminary concepts of valence bond theory and crystal field theory

Unit 4 Organic Chemistry And Stereoisomerism **12**

Chemistry of Carbon - Introduction to organic compounds – Classification – Nomenclature – Structural representation, Suitability of organic molecules for biomolecule formation.

Stereoisomerism - definition - classification into optical and geometric isomerism

Optical isomerism - optical activity - optical and specific rotations - conditions for optical activity - asymmetric centre -- chirality - achiral molecules - meaning of (+) and (-) and D and L notations - Elements of symmetry –axis,centre and plane of symmetry

Unit 5 Physical Chemistry **12**

Electrochemistry – Electrolytes - conductance, equivalent conductance, specific conductance, molar conductance, effect of dilution in conductance, Kohlrausch's law - dissociation of electrolytes and determination of dissociation constant

Surface Chemistry – Adsorption –adsorbent and adsorbate, adsorption and absorption, sorption and occlusion, physisorption and chemisorption -Colloids, Gels, Emulsions - electrophorosis, electro osmosis, synerisis, thixotropy, imbibition, swelling of gels -, Gold number

Chemical Kinetics - Rate of chemical reaction , definition of rate and rate constant, factors influencing rate of reaction - order and molecularity - Theories of reaction rates, effect of temperature on rate constant, Arrehenius equation- interpretation of Arrehenius parameters, activation energy –exothermic and endothermic reactions**.**

Total Hours : 60

Course Outcomes :

At the end of the course, students will be well equipped in

1. Observing safety norms and Good Laboratory Practices
2. The theoretical basis of preparing solutions, reagents, buffers
3. Differentiating different types of chemical bonds.
4. Fundamental principles of Organic chemistry, Inorganic Chemistry and stereoisomerism
5. Basic concepts of physical chemistry

Text Books:

1. W.U.Malik, G.D.Tuli and R.D.Madan**.** *(2005),*Selected topics in Inorganic Chemistry***, 6th edition, S.Chand and Co. Ltd.***
2. Puri, Sharma and Pathania, Vishal**.** *(2003),*Principles Of Physical Chemistry***, Publishing and Co.***
3. Arun Bahl and B.S.Bahl, *(2003),*Advanced Organic Chemistry, ***17th edition, Chand & Co.***

Reference Books:

1. ***Geoff Rayner-Canham***, **(2004),** ***Descriptive Inorganic Chemistry,***4th edition, Freeman &Co
2. ***Paula Bruice,*** (2010), ***Organic Chemistry,*** 6th International edition , Pearson & Co.
3. ***B.S.Bahl arur Bahl and G.D.Tuli***, **(2009),** ***'Essentials of physical Chemistry',*** S.Chand and company Ltd.

Chemistry Practical for Biochemistry and Biotechnology

Semester I **Hours of Instruction /week: 3**

18BBCI02 **No of Credits: 2**

Objectives:

1. To develop skills in testing and analyzing organic compounds
2. To be able to identify the functional groups of organic compounds
3. To learn principles and procedure involved in volumetric analysis

Unit 1 Systematic analysis of organic compounds containing single functional Groups **15**

Diamide, primary amine, monoamide, aromatic aldehyde, aromatic ketone, carbohydrates, monocarboxylic acid and dicarboxylic acid, monohydric phenol and nitro compounds

30

Unit 2 Volumetric analysis

Acidimetry and alkalimetry

1. Estimation of sodium hydroxide.
2. Estimation of oxalic acid
3. Estimation of sodium carbonate

Permanganimetry

1. Estimation of ferrous sulphate
2. Estimation of ferrous ammonium sulphate
3. Estimation of oxalic acid.

Iodometry (Class work only)

1. Estimation of copper sulphate.
2. Estimation of potassium dichromate.

Total Hours : 45

Course Outcomes :

At the end of the course, the students will be equipped to systematically

1. Analyse functional groups in organic molecules
2. Carry out acidimetry and alkalimetry
3. Perform permanganimetry
4. Undertake iodometry
5. Understand the methodology of analyzing organic molecules.

Reference Books:

1. ***P.K. Mani and A.O.Thomas,*****(1993),*****Textbook for practical chemistry for B.Sc. main students***, Xavier Press, Cannanore.
2. ***V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu,*****(1995),** ***Basic principles of practical chemistry***, Sultan Chand & Sons.

Techniques in Biochemistry

Semester II **Hours of Instruction /week: 5**

18BBCC03 **No of Credits: 4**

Objectives:

1. To impart knowledge on the concepts related to the characterization of biomolecules.
2. To enable students to understand the basic principles and applications of biochemical techniques
3. To provide a strong theoretical base for practical application

Unit 1 Buffers and Centrifugation techniques **15**

Definition, derivation of Henderson- Hasselbalch equation and its application. Buffer systems of body fluids and pH maintenance. Determination of pH by hydrogen electrode and glass electrode.

Introduction, basic principles of sedimentation, desktop centrifuges, and large capacity refrigerated centrifuges – analytical and preparative ultracentrifugation. Applications of ultracentrifuge-separation of cell organelles. Basic principles of density gradient centrifugation.

Unit 2 Chromatography I **15**

Definition, principles and types of chromatography

Paper chromatography – separation of amino acids by ascending chromatography.

Thin layer chromatography - principle and separation of phospholipids.

Adsorption chromatography - principle and separation of carotenoids.

Ion exchange chromatography- principle and different types of resins, separation of amino acids

Unit 3 Chromatography II **15**

Affinity chromatography – Principle and separation of an enzyme.

Gas chromatography - principle and separation of fatty acids.

Gel filtration - principle, estimation of molecular size and molecular weight of a bio macromolecule.

HPLC – Elementary concepts only

Unit 4 Electrophoresis **15**

Principles and types of electrophoresis – Agarose gel electrophoresis
Separation of serum proteins by paper electrophoresis
Polyacrylamide gel electrophoresis, Immunoelectrophoresis, Elementary concepts of Isoelectric focusing

Unit 5 Spectrophotometry and isotopes **15**

Principle, Beer and Lamberts Law, description of the instrument and technique. Absorption spectrophotometry - Principle and applications, description of the instrument – Colorimetry, UV-Visible and atomic absorption spectroscopy. Fluorimetry - Principles and description of the instrument.

Definition, Important stable and radioactive isotopes used in biochemical research. Use of radioactive isotopes in clinical diagnosis and therapy. Principle of radio-immuno assay. Radiation hazards and precautions to be taken in handling radioactive isotopes. Measurement of radioactivity by scintillation counters.Autoradiography.

Total Hours : 75

Course Outcomes:

At the end of the course students will be able to

1. Understand the theoretical basis for the practical experiments.
2. Recognize the importance of buffer systems in pH maintenance.
3. Appreciate the principle, operation, and applications of various techniques for analyzing biomolecules.
4. Design suitable techniques for the separation of biomolecules
5. Interpret the results of analytical techniques.

Text Books:

1. ***Wilson, K. and Walker, J.*****(2018)*****Practical Biochemistry – Principles and Techniques,*** Eigth Edition, Cambridge University Press, India
2. ***Sharma, B.K.*** **(2014).*****Instrumental Methods of Chemical Analysis***,Krishnaprakashan Media (P) Ltd, New Delhi.
3. ***Upadhyay, U and Upadhyay, N. (2010***) Biophysical Chemistry principles and Techniques.Himalaya Publ. 2010.

Reference Books:

1. ***Subramanian, M.A.*** **(2006)*****Biophysics, Principles and Techniques***, MJP Publishers, Chennai, Tamil Nadu.

2. ***Plummer, D.*** **(2004)*****An Introduction to Practical Biochemistry***, Fifth Edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
3. ***Katoch, R*****(2011)*****Analytical Techniques in Biochemistry and Molecular Biology***, Springer Science.

Chemistry of Proteins

Semester II **Hours of Instruction /week: 4**
18BBCC04 **No. of Credits: 3**

Objectives:

1. To understand the hierarchical organization of protein structure.
2. To understand the classification and properties proteins.
3. To learn the methods of isolation, purification and sequence analysis of proteins

Unit 1 Amino acid sequence in proteins **12**

Determination of amino acid composition
N- terminal and C- terminal amino acids – determination of amino acid sequence of proteins by chemical and enzymatic methods

Unit 2 Peptides **12**

The peptide bond- formation and its conformation
Structure of biologically active small peptides- glutathione, oxytocin and vasopressin
Chemical synthesis of peptides- in solution and solid phase - Forces involved in protein conformation

Unit 3 Classification and properties of proteins **12**

Classification based on solubility and functions, acid-baseproperties and color reactions of proteins- denaturation and coagulation.

Unit 4 Structure and conformation of proteins **12**

Primary, secondary, supersecondary (brief account)tertiary and quaternary

structure
Structure of proteins citing insulin, collagen and hemoglobin as examples.

12

Unit 5 Proteins Extraction and Characterization

Isolation and extraction
Separation and purification of proteins based on molecular size, solubility differences, electric charge, selective absorption and ligand specificity.
Characterization and criteria of purity -Estimation of proteins

Total Hours : 60

Course Outcomes:

At the end of the course students will be able to

1. Appreciate the hierarchical organization of protein structure
2. Understand the classification, properties and functions of proteins.
3. Relate the structural complexity of proteins with their biological activity
4. Apply the appropriate techniques for purification and characterization of proteins
5. Analyse the amino acid sequence of proteins and relate the same to the functions of proteins

Text Books:

1. ***Berg, J.M., Tymoczko, J.L. and Stryer, L.*** **(2012).*Biochemistry***, Seventh Edition, W.H. Freeman and Company, New York.
2. ***Gupta, P.K.*** **(2012).*Biotechnology and Genomics***, First Edition, Sixth reprint, Rastogi Publications, Meerut.
3. ***Dubey, R.C.*** **(2010).*A Text Book of Biotechnology***, Fifth Edition, S. Chand and Company, Ltd., New Delhi.

Reference Books:

1. ***Nelson, D.L. and Cox, M.M.*** **(2013).*Lehninger Principles of Biochemistry***, Sixth Edition, W.H. Freeman and Company, New York
2. ***Voet, D., Voet, J.G., and Pratt, C.W.*** **(2013).*Fundamentals of Biochemistry – Life at the Molecular level***, Fourth Edition, John Wiley & Sons. Inc, New York.
3. ***Ratledge, C. and Kristiansen, B.*** **(2003).*Basic Biochemistry***, Second Edition, Cambridge University Press, New York.

Biophysics

Semester II **Hours of Instruction /week: 4**
18BBTC03 **No. of Credits: 3**

Objectives:

1. To comprehend the basic concepts of regulation of body temperature and nerve action potential.
2. To understand the basic principles and applications of instruments used to analyze the structure of biomolecules
3. To understand the designing and functioning of modern biomedical equipment.

Unit 1 Bioenergetics **12**

Energetics of the living body – basic concepts of thermodynamics, bioenergetics, role of ATP as energy currency of the cell, forms of energy, metabolic rate and factors affecting, BMR, body temperature – regulation, limits to temperature, heat dissipation and conservation, abnormalities of body temperature regulation

Unit 2 Light perception strategies **12**

Light perception strategies in humans - receptor and neuronal functions of retina, photochemistry of vision, regulation of retinal sensitivity, errors of refraction and correction of vision faults

Unit 3 Membrane potential and hearing perception **12**

Electrical properties of biological compartments – basic physics of membrane potential, resting potential, nerve action potential, propagation of nerve potential.
Generation and reception of sonic vibrations - physical aspects of hearing, hearing abnormalities, hearing aids – mechanism of working and types

Unit 4 Techniques for molecular structure determination **12**

Basic concept, principle and application of spectroscopic techniques in structure – infrared, fluorescence, Raman spectra, X-ray crystallography, mass spectroscopy and NMR.

Unit 5 Imaging techniques **12**

Methods of imaging intact biological structures – Ultrasound scan, MRI, Electrocardiogram, Electroencephalogram, CAT scan, PET scan, X- ray

Total Hours : 60

Course Outcomes:

At the end of the course students will be able to

1. Understand the concept of bioenergetics and mechanism of body temperature regulation
2. Grasp the mechanism of signal transmission in neuronal cells
3. Comprehend the mechanism of light perception in eye

4. Appreciate the various spectroscopic methods used to study the biomolecular structure
5. understand the designing and functioning of modern biomedical equipment

Text Books:

1. ***Guyton, C.A.*** **(2015)** ***Text Book of Medical Physiology***, Thirteen Edition, Saunders Publishing Company, New York.
2. ***Khandpur, R.S***. **(2014)** ***Biomedical Handbook of Biomedical Instrumentation***, Third Edition, McGraw Hill Publishing Company, New York.
3. ***Wilson, W. and Walker, J***. **(2002)** ***Practical Biochemistry***, Fifth Edition, Cambridge University Press, UK.
4. ***Upadhyay, U and Upadhyay, N. (2010***) ***Biophysical Chemistry principles and Techniques.*** Himalaya Publ.

Reference Books:

1. ***Cromwell, L., Welbel, F.J. and Pfeiffer, E.A.*** **(2010)** ***Biomedical Instrumentation and Measurement***, Narosa Publishing House, Second Edition, New Delhi.
2. ***Srivastava, P.K.*** **(2005)** ***Elementary Biophysics - An Introduction***, Narosa Publishing House, New Delhi.
3. ***Chatwal, G.R. and Anand, S.K.*** **(2011)** ***Instrumental Methods of Chemical Analysis***, Himalaya Publishing House, Chennai.

Practicals I – Techniques in Biotechnology

Semester II **Hours of Instruction /week: 4**

18BBTC04 **No. of Credits: 2**

Objectives:

1. To develop laboratory skills in handling biological samples
2. To get hands on experience in various techniques in biotechnology and immunotechniques

Unit 1 Individual Experiments **12**

Biometric observations in plants

1. Germination Percentage
2. Root Length
3. Shoot length
4. Fresh Weight
5. Dry Weight
6. Moisture Content
7. Vigour index
8. Nodule number

Unit 2 *Spectrophotometric techniques* **12**

1. Estimation of total proteins
2. Estimation of phosphorus
3. Estimation of iron

Unit 3 *Titrimetric analysis* **12**

1. Estimation of ascorbic acid
2. Estimation of calcium

Group Experiments/Demonstrations

Unit 4 *Separation techniques* **12**

1. Chromatography : Gel filtration, ion exchange
2. Electrophoresis : PAGE (Poly acrylamide gel electrophoresis)

Unit 5 *Immunotechniques* **12**

1. Blood grouping
2. Immuno diffusion
3. Immuno electrophoresis

Total Hours : 60

Course Outcomes :

1. Students will be able to analyse some of the biometric characteristics in plants
2. Students will be able to examine and predict the concentration of compounds in unknown solutions
3. Students will be able to explain the principles behind major separation techniques such as chromatography and electrophoresis
4. Students will be able to infer the blood grouping of different individuals and be familiar with the methods and applications of immunotechniques

References:

1. ***Wilson, K. and Walker, J.*(2010).*Practical Biochemistry – Principles and Techniques***, Seventh Edition, Cambridge University Press, India.
2. ***Burtis, C.A. and Bruns, D.E.*(2007).*Fundamentals of Clinical Chemistry***, Sixth Edition, W.B Saunders Co, Philadelphia, London, Toronto.

Intermediary Metabolism – I

Semester III **Hours of Instruction /week: 4**
18BBCC05 **No. of.Credit: 3**

Objectives:

1. To help the students to understand the fate of dietary constituents after digestion and absorption
2. To help the students to understand the basic metabolic pathways
3. To help the students to understand the interrelationship between major food stuffs

Unit 1 **12 hrs**

Introduction to metabolism - Anabolism, catabolism

***Metabolism of Carbohydrates*-**Glycolysis, metabolism of fructose, galactose and mannose, TCA Cycle, Glyoxalate cycle.

Unit 2 **12 hrs**

Glycogen metabolism- Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose mono phosphate shunt and Glucuronic acid pathway

Unit 3 **12 hrs**

Metabolism of Lipids - Fatty acid oxidation- oxidation of even carbon and odd carbon fatty acids and unsaturated fatty acids, α-oxidation and ω-oxidation

Unit 4 **12hrs**

Fatty acid synthesis - synthesis of saturated and unsaturated fatty acids, synthesis of essential fatty acids, chain elongation

Unit 5 **12 hrs**

***Metabolism of Protein*-**General breakdown of protein, deamination, transamination, decarboxylation and urea cycle

Total 60 hrs

Course Outcomes :

1. Students will be able to **understand** the fate of dietary constituents after digestion and absorption.
2. Students will be able to **recognize** the role of vitamins and mineral in intermediary metabolism
3. Students will be able to **explain** how diet and hormonal signaling regulate major human metabolic pathways.
4. Students will be able to **recognize** the role of vitamins and mineral in intermediary metabolism.

5. Students will be able to **relate** the role distinct metabolic pathways used by cells to harvest the energy.

Text Book:

1. ***Bery, J.M., Tymoezko, J.L. and Stryer, L.*** (2002), ***Biochemistry***, 5th Ed, W.H.Freeman and Company, New York.
2. ***Deb, A.C*** (2004), ***Fundamentals of Biochemistry***, 8th Ed, New Central Book Agency.
3. ***Jain, J.L and Jain, S*** (2005), ***Fundamentals of Biochemistry***, 6th Ed, S. Chand & Company, New Delhi.

Reference Books:

1. ***Mathews, C.K and Vanholde, K.E*** (1996), ***Biochemistry***, 2nd Ed, The Benjamin/ Cummings Publishing company, Menlo Park.
2. ***Murray, K.R., Granner, K.D., Mayes, P.A. and Rodwell, W.V.*** (2000), ***Harper's Biochemistry,*** 25th Ed, Appleton & Lange Stamford, Connecticut.
3. ***Nelson, D.L and Cox, M.M*** (2002), ***Lehninger Principles of Biochemistry***, 3rd, Worth Publishers, New York.

Human Physiology

Semester III **Hours of Instruction /week: 4**

18BBCC06 **No. of Credits: 3**

Objectives:

1. To acquire knowledge of the various physiological systems and organs in the human body
2. To understand the functioning of the various human body systems

Unit 1 Digestive and Excretory system **12**

Functional anatomy of digestive tract, functions of salivary gland, stomach, small intestine, large intestine, liver and pancreas. Digestion and absorption of carbohydrates, proteins and lipids

Structure of kidney, mechanism of urine formation. Role of kidney in maintaining acid-base balance. Micturition

Unit 2 Cardiovascular system **12**

Blood- properties, composition and functions of blood and blood elements, erythropoiesis, blood groups, blood transfusion, blood coagulation.

Heart- Structure and functions of heart, cardiac output, blood pressure and blood circulation-systemic and pulmonary. Factors affecting blood pressure. Cardiac cycle and electrocardiogram

Unit 3 Respiratory system **12**

Functional anatomy of respiratory system, mechanics of respiration, diffusion of gases - mechanism of respiration, regulation of respiration, hypoxia

Unit 4 Muscular system **12**

Classification – structure of skeletal and smooth muscles. Mechanism of muscle contraction and relaxation. Disorders of skeletal muscles

Nervous system- divisions, structure and functions of brain, spinal cord and neuron, transmission of nerve impulse. Autonomic nervous system. Cerebrospinal fluid and its functions

Unit 5 Reproductive system **12**

Development of gonads and genitalia, testis and spermatogenesis, female reproductive system-oogenesis, physiological changes and hormones during menstruation, pregnancy, parturition and lactation

Total Hours : 60

Course Outcomes:

At the end of the course, the student will gain in depth knowledge of

1. The various physiological systems in the human body.
2. The functional anatomy of different organs in each system.
3. The complex mechanisms of the processes of digestion, absorption, excretion, gas exchange, reproduction and neuromuscular coordination.
4. Integrated System physiology that will enable understanding of the biochemical basis of disease.

Text Books:

1. ***Guyton, A.C. and Hall, J.E*. (2010).*Textbook of Medical Physiology,*** Twelfth Edition, Saunders Company Publishers, New York.
2. ***Sembulingam, K. and Sembulingam, P.* (2010).*Essentials of Medical Physiology,*** Fifth Edition, J.P. Medical Publishers (P) Ltd, New Delhi.
3. ***Tortora, G.J. and Graabowski, S.R.* (2009).*Principles of Anatomy and Physiology***, Twelfth Edition, John Wiley & Sons, New York.

Reference Books:

1. ***Chandramouli, R.*(2010).*Textbook of Physiology***, Third Edition, Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.
2. ***Fox, S.* (2010).*Human Physiology***, Twelfth Edition, WCB McGraw- Hill Publications, New York.
3. ***Davies, A., Blackely, A.G.H. and Kidd, C.* (2001).*Human Physiology***, Churchill Livingstone, Toranto, Harcourt Publishers Ltd, New York.

Practicals – II Enzymes

Semester III **Hours of Instruction /week: 5**

18BBCC07 **No. of Credits: 3**

Objectives:

1. To enable students to understand the methods of isolation and purification of enzymes
2. To understand the factors affecting enzyme activity
3. To learn the techniques of determination of enzyme activity

Unit 1 **15**

Titration curve of an amino acid
Formol titration
Ammonium sulphate precipitation of protein and dialysis

Unit 2 **15**

Effect of pH on the activity of catalase
Effect of temperature on the activity of catalase

Unit 3 **15**

Effect of enzyme concentration on the activity of catalase
Effect of substrate concentration on the activity of catalase

Unit 4 **15**

Effect of pH on the activity of acid phosphatase
Effect of temperature on the activity of acid phosphatase

Unit 5 **15**

Effect of enzyme concentration on the activity of acid phosphatase
Effect of substrate concentration on the activity of acid phosphatase

Total Hours : 75

Course Outcomes :

At the end of the course, students will be able to

1. Identify the sources of enzymes.
2. Analyse/apply the techniques to extract and quantify the enzymes.

3. Understand the influence of Enzyme concentration, Substrate concentration, pH and Temperature on the activity of enzymatic reactions.
4. Learn the kinetics of enzyme catalyzed reactions

Reference Books:

1. *Sadasivam, S. and Manickam, A.* **(2005)** *Biochemical Methods*, **Second edition, New Age International Pvt. Ltd.**
2. *Jayaraman, J.***(2011)***Laboratory Manual in Biochemistry*, **New Age International Pvt. Ltd.**

Environmental Biotechnology

Semester III **Hours of Instruction /week: 4**

18BBTC05 **No. of Credits: 3**

Objectives:

1. To understand the sources of energy and need for conservation of natural resources
2. To understand the principles of bioremediation and use of biofertilisers
3. To understand the methodologies available for treatment of solid wastes

Unit 1 Energy sources **12**

Renewable and non-renewable resources - fossil fuels, conventional fuels and their environmental impacts – fire wood, plant, coal, gas and animal waste – solar energy converters, conservation of energy.

Unit 2 Biomass energy **12**

Hydrocarbons from plant sources- plant based petroleum industry, biogas production, photobiological process of hydrogen production, production of ethanol from fermentable substrates.

Cellulose degradation for combustible fuel

Unit 3 Bioremediation **12**

In situ, intrinsic and *ex situ* – bioremediation of dyes, heavy metals, xenobiotics, bioremediation using genetically engineered microbes (GEM), bioleaching – direct and indirect methods. Biomining – Enrichment of ores by microorganisms

Unit 4 Biofertilizers and Biopesticides **12**

Bacterial inoculants- Nitrogen biofertilizers and phosphate biofertilizers- Green manuring- Azolla, Mycorrhizaland Bacteria (*Pseudomonas, Bacillus*) as biofertilizers. Biopesticides- *Bacillus thuriengenesis*. Biodegradable plastics. Biofilms.

Unit 5 Waste water treatment **12**

Physical, chemical and biological methods for waste water treatment. Activated sludge, oxidation ponds. Anaerobic processes. C.O.D. and BOD. Treatment schemes for municipal waste and industrial effluents.

Total Hours : 60

Course Outcomes :

At the end of the course students will be able to

1. Comprehend the various biotechnological approaches to environmental management.
2. Learn the strategies for obtaining energy from various natural sources and for energy conservation.
3. Understand the concept of bioremediation to handle environmental toxins.
4. Recognise the importance of biofertilisers and biopesticides
5. Analyze the harmful effects of waste water disposal to the environment and the biotechnological solutions.

Text Books:

1. ***Dubey, R.C.*** **(2010).** A ***Textbook of Biotechnology***, S. Chand and Company Ltd, New Delhi.
2. ***Horan, N.J.*****(1993).*****Biological Waste Water Treatment systems***

Reference Books:

1. ***Wang, L.K.*** **(2010).*****Environmental Biotechnology***, First Edition, A Product of Human Press.
2. ***Jadasson, T.B., Reddy, K.N., Henrykelly and Williams, R.H.*** **(1993).*****Renewable Energy,*** Prentice Hall International Inc, USA.

Genetics

Semester III **Hours of Instruction /week: 4**

18BBTC06 **No. of Credits: 3**

Objectives:

1. To make students understandthe basics of Mendelian genetics, linkage and chromosome mapping
2. To provide students with a comprehensive understanding of cytogenetics, quantative genetics and its influence on phenotypes.
3. To help students to understand the importance of population and developmental genetics.

Unit 1 Classical Mendelian Genetics **12**

Mendelian principles and laws of heredity – monohybrid, dihybrid cross, test cross
And back cross, Multiple alleles, Sex chromosomes, sex influenced and sex limited traits

Unit 2 Genetic Linkage, Chromosome Mapping and recombination **12**

Linkage and Crossing over
Two factor and three factor linkage analysis
Genetic Recombination in bacteria - Transformation, Transduction and Conjugation
Mapping of the chromosome
Chromosomal determination of sex, sex linked inheritance
Dosage compensation and X chromosome inactivation

Unit 3 Cytogenetics **12**

Structure of chromosomes, Polytene and lampbrush chromosomes. Karyotyping
Banding pattern of chromosomes
Variations in chromosome number and structure – ploidies, deletion, duplication, inversion and translocation
Chromosomal aberrations in humans – Non-dysjunction

Unit 4 Quantitative Genetics **12**

Variations in the concept of dominance, penetrance and expressivity
Polygeneic inheritance in beans
Inhereitance in human beings – skin colour and IQ
Genetic analysis: Complementation test in gene identification
Traits determined by genes: pleiotropy and epistasis

Unit 5 Population Genetics and Developmental Genetics **12**

Gene frequency and gene pool
Hardy Weinberg Equilibrium
Genetic control of development in *Drosophila melanogaster*

Total Hours: 60

Course Outcomes :

Students will be able to

1. Explain the key concepts of Classical mendelian genetics its deviations and relationship between genotype and phenotype
2. Comprehend the relationship between linkage and chromosome mapping, and its influence on phenotype
3. Relate the structural variations of chromosomes to phenotype
4. Differentiate chromosomal structure by simple banding techniques
5. Explain the key concepts of population genetics, hardy Weinberg equilibrium, and factors influencing evolution

Text Books:

1. ***Tamrind***, ***R.H.*** **(2008)** ***Principles of Genetics***, Seventh Edition, The McGraw Hill Publishing, New Delhi.
2. ***Pierce, B.A.*** **(2008)** ***Genetics: A Conceptual Approach,*** Third Edition, W.H Freeman and Company Publishing, New York.
3. ***Gardner, E.J., Simmons, M.J. and Snustad, D.P.*** **(2006)** ***Principles of Genetics***, Eight Edition, Wiley Publication, India.

Reference Books:

1. ***Alice, M.*** **(2010).*****Human Genetics: An Overview***, Narosa Publishing House, NewDellhi.
2. ***Alice, M.*** **(2009)** ***Genetics,*** MJP Publishers, Chennai
3. ***William, S.K. and Michael, C.R.*** **(2009)** ***Concepts of Genetics,*** Ninth Edition, Pearson Education, Singapore.

Enzymes and Enzyme Technology

SemesterIII **Hours of Instruction /week: 4**

18BBTC07 **No. of Credits: 3**

Objectives:

1. To understand enzyme classification, structure, mechanisms of catalysis, metabolic regulation and kinetic
2. To study the use of enzymes in industrial processes
3. To understand some of the experimental approaches used for large scale production of enzymes

Unit 1 Introduction **12**

Definition and history of enzymes

Classification and nomenclature of enzymes- brief account of classification of enzymes by IUB system

Enzyme kinetics- Michaelis-Menten equation, Line Weaver Burk plot, Hanes plot, Hofstee plot.Effect of pH, temperature and enzyme concentration on the rate of enzyme reaction

Enzyme inhibitors - competitive, non-competitive and un-competitiveinhibition - allosteric enzymes and isoenzymes (kinetics not required)

Unit 2 Mechanism of enzyme action **12**

Mechanisms of catalysis - acid base catalysis, electrostatic catalysis, proximity and orientation effect

Mechanism of action of lysozyme and chymotrypsin

Unit 3 Measurement of enzymatic reactions **12**

Titrimetric, colorimetric, spectrophotometric, manometric and enzyme coupled reaction, enzyme units, turnover number, katal

Vitamins and trace elements in the function of enzymes

Unit 4 Enzyme – Substrate complex formation and regulation **12**

Active site- theories proposed – lock and key hypothesis and induced fit hypothesis

Enzyme specificity

Enzyme mediated regulation of metabolism - enzyme compartmentalization; feedback

inhibition, reversible covalent modification of regulatory enzymes- multiple cascade system

Unit 5 Enzyme engineering

Immobilization of enzymes – methods of immobilization.

Rationale of enzyme engineering - basic assumptions of protein engineering - site directed mutagenesis. Key biocatalyst properties that are altered through protein engineering.

Enzyme electrodes, Enzyme Biosensors

Applications of enzymes in industry – food processing, textiles, detergents and leather industries. Medical diagnosis (ELISA), therapy (thrombolytic agents and digestive aids). **12**

Total Hours **60**

Course Outcomes :

At the end of the course, students will be able to

1. Distinguish enzymes based on their classification and properties.
2. Optimize the conditions for the maximum activity of enzymes.
3. Understand themechanism of action of enzymes.
4. Acquire theoretical knowledge on methods of production, purification, characterization and immobilization of enzymes.
5. Appreciate the industrial and medical applications of enzymes.

Text Books:

1. ***Berg, J.M., Tymoczko, J.L. and Stryer, L.*** **(2012)** ***Biochemistry***, Seventh Edition, W.H. Freeman and Company, New York.
2. ***Palmer, T (1995) Understanding Enzymes***, fourth edition Ellis Horwood Ltd, New York
3. ***Nelson, D.L. and Cox, M.M.*** **(2013)** ***Lehninger Principles of Biochemistry***, Sixth Edition, W.H. Freeman and Company, New York.

Reference Books:

1. ***Palmer, T. and Bonner, P. (2008)Enzymes: Biochemistry, Biotechnology, Clinical Chemistry,***Second Edition, Woodhead Publishing, New York
2. ***Voet, D., Voet, J.G., and Pratt, C.W.*** **(2013)** ***Fundamentals of Biochemistry – Life at the Molecular level***, Fourth Edition, John Wiley and Sons. Inc, New York.
3. ***Copeland, R. A. (2008) Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis,***Wiley-YCH Publisher

Computer Applications in Biosciences

Semester III **Hours of Instruction /week: T+P: 2+3**

18BBCI05 **No. of Credit: 4**

Objectives:

1. To impart basic knowledge on computers and its fundamentals
2. To develop conceptual understanding of MS-Office and Internet

Unit 1 Introduction to Computers **6**

Introduction, characteristics of computers, classification of computers: micro, mini, mainframe, super computers. Components of computers: central processing unit, input unit, output unit, storageunit.OperatingSystem:
Functions and classification of operating system, Types: DOS, LINUX, UNIX, MS Windows

Unit 2 MS Windows **6**

Working with MS windows - My Documents, My Computer, Recycle Bin: Open, Close, Resize, Minimize, Move and Customize Windows, Start Menu, Search programs and files: move, copy, save, name, rename, delete and backup files and folders. Windows help and support.

Unit 3 Networks and Internet **6**

Computer networks: LAN, WAN, MAN. Internet - search engines, browser, website, URL, web server, getting connected to the internet, TCP/IP, ISP, modem, types of internet connection. Internet applications: e mail, www, FTP, telnet, video conferencing, newsgroups.

Unit 4 MS Word and Power Point **6**

MS word - create a document, format and organize text, word with graphics - picture, objects, chart etc. Tabs and tables, applying special text, paragraph, and document formats.
MS Power point: getting started, formatting a presentation, presenting data using graphics, tables, charts, and animation.

Unit 5 MS Excel and Access **6**

MS Excel - creating and enhancing a worksheet, construct formulas and functions, charts, Manage multiple worksheets in a workbook - using excel functions and tables.
MS Access - creating a table, navigating a table, queries. Creating forms and reports.

Total Hours : 30

Practical

Unit 1 **9**

Operating systems: DOS, WINDOWS

Unit 2 **9**

Working with MS Windows

Unit 3 **9**

Internet browsing, Search Engines, search strategies, working with E-mail

Unit 4 **9**

MS Word and PowerPoint

Unit 5 **9**

MS Excel and Access

Total Hours : 45

Course Outcomes :

At the end of the course, students will be able to

1. Understand the types and functioning of computers
2. Apply in creation of folder, copying, renaming, deleting, searching, creating shortcuts, backup files using MS Windows.
3. Understand the components in data communication, compare and contrast types of networking and apply in maintenance applications of networking
4. Create their own documents and presentations using MS Word and Power Point
5. Create their own worksheet and creation of functions in Excel. Students will be able to create database tables, queries, forms and reports using Access

Text Books:

1. ***David, C., Orr, J. A. and Vaz, R.F.*** **(2009).** ***Introduction to Information Technology,*** Pearson Education Asia, India.
2. ***Karp, D.A., O'Reilly, T., Mott, T. and Cobbett, R.*** **(2005).*****Windows XP in a Nutshell: A Desktop Quick Reference,*** Orielly Publishers, USA.
3. ***Bansal, S.K.*****(2002).*****Fundamentals of Information Technology,*** APH Publishing, New Delhi.

Reference Books:

1. ***Peterson, L.L. and Davie, S.B.*****(2007).** C***omputer Networks – A Systems Approac***h Morgan Kaufmann, San Francisco.
2. ***Bott, E. and Leonhard, W.*** **(2003).*****Using Microsoft Office 2003***, Paul Boeger Publisher, India.
3. ***Jeffloate, J.*****(2003).*****Multimedia in practice***, PHI Publications, Bangalore.

Intermediary Metabolism II

Semester - IV **Hours of Instruction /week: 4**

18BBCC08 **No. of Credits: 3**

Objectives:

1. To enable students to understand the fate of dietary constituents after digestion and absorption
2. To understand the basic metabolic pathways
3. To enable students to understand the interrelationship between major food stuffs

Unit 1 **12**

Lipid Metabolism - Biosynthesis and degradation of triglycerides and phospholipids (Lecithin, cephalin, sphingomyelin) and glyco lipids (cerebrosides, sulfatides, globosides and gangliosides).

Unit 2 **12**

Cholesterol Metabolism - Biosynthesis of Cholesterol and its regulation

Breakdown of cholesterol – synthesis of progesterone, corticosterone, aldosterone, testosterone , estrogens, bile acids and vitamin D_3

Unit 3 **12**

Metabolism of amino acids- glycine, phenylalanine and tyrosine.

Metabolism of Nucleic acids - Biosynthesis of purine and pyrimidine nucleotides. Salvage pathway Degradation of purine and pyrimidine nucleotides

Unit 4 **12**

Integration of metabolism– interconversion of major food stuffs. Metabolic profile of the liver, adipose tissue and brain. Altered metabolism in starvation.

Unit 5 **12**

Respiratory Chain - Electron transport chain, oxidative phosphorylation, High and low energy phosphates.

Methods of investigating intermediary metabolism- *In vivo* studies – Analysis of excretion, respiratory exchange, removal of organs and perfusion studies

In vitro studies – Tissue slice techniques, homogenates and isotopic tracer studies

Total hours 60

Course Outcomes:

Students will be able to

1. Understand the fate of dietary constituents after digestion and absorption.
2. Recognize the role of vitamins and mineral in intermediary metabolism
3. Explain how diet and hormonal signaling regulate major human metabolic pathways.

4. Relate the role distinct metabolic pathways used by cells to harvest the energy.

Text Book:

1. ***Bery, J.M., Tymoezko, J.L. and Stryer, L.*** (2015), ***Biochemistry***, 8th Ed, W.H.Freeman and Company, New York.
2. ***Nelson, D.L. and Cox, M.M.*****(2013).*****Lehninger Principles of Biochemistry*****,** Sixth Editon, W.H. Freeman and Company, New York.
3. ***Boyer, R.F*****. (2010)** ***Biochemistry – Laboratory Modern theory and technique,*** Second Edition, Prentice Hall Publishers, UK

Reference Books:

1. ***Mathews, C.K and Vanholde, K.E*** (2001), ***Biochemistry***, 3rdEd, The Benjamin/ Cummings Publishing company, Menlo Park.
2. ***West, E.S., Todd, W.R., Mason, H.S. and Van Brugge, T.J.*** (2001), 4th Ed***, The textbook of Biochemistry***, Macmillan Company, London.
3. ***Rodwell, V.***W., Bender, D., Botham, K.M., Kennelly, P.J. and Neil, P.A. (2015) ***Harpers Illustrated Biochemistry,*** thirtieth Edition, Tata McGraw Hill Companies' Publication, New Delhi.
4. ***Zubay, G*** (1998), ***Biochemistry***, Fourth Ed, WCB. Mcgraw-Hill, New York.

Plant Biochemistry

Semester IV **Hours of Instruction /week: 4**

18BBCC09 **No. of Credits: 3**

Objectives:

1. To provide students with fundamental knowledge of biochemical pathways taking place in plants
2. To provide an insight into biochemical mechanisms of stress management in plants

Unit 1 Photosynthesis **12**

Introduction and importance of photosynthesis, photosynthetic apparatus, light harvesting complexes, reaction centers for photosynthesis, mechanism of photosynthesis, light and dark reactions, cyclic and non-cyclic photophosphorylation

Unit 2 Respiration and photorespiration **12**

Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, photorespiratory pathway

Unit 3 Transpiration and photo assimilation **12**

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates

Unit 4 Stress physiology and secondary metabolites **12**

Responses of plants to biotic (pests and pathogens) and abiotic (water, temperature and salt); Biosynthesis of terpenes, phenols and nitrogenous compounds and their role

Unit 5 Plant hormones **12**

Biosynthesis, storage, breakdown and transport, physiological effects and mechanism of action

Total Hours : 60

Course Outcomes:

At the end of the course, students will

1. Understand the basic concepts of photosynthesis
2. Explain the role of respiration and photorespiration
3. Discuss the importance of transpiration and photo assimilation biofuels.
4. Describe about stress physiology and secondary metabolites
5. Infer the different types of plant hormones.

Text Books:

1. ***Srivastava, H.S. and Shankar, N. (2008) Plant physiology and Biochemistry,*** First Edition,Rastogi Publications, Meerut.
2. ***Pandey, S.N. and Sinha, B.K.(2008) Plant Physiology,*** Fourth Edition, VIKAS publishing House Pvt Ltd, New Delhi.
3. ***Buchanan, B., Gruissem, W. and Jones, R (2002).Biochemistry and Molecular Biology of Plants,***First Edition, Wiley-Blackwell Publishers, USA.

Reference Books:

1. ***Heldt, H. and Piechulla, B*.(2011) *Plant Biochemistry,*** Fourth Edition, Academic Press, USA.
2. ***Taiz, L. and Zeiger, E.*** (***2003***) ***Plant Physiology***, Third Edition, Panome Publishing Corporation, New Delhi.
3. ***Kumar, A. and Purohit, S.(2003) Plant Physiology- Fundamentals and Applications***, Second Edition, Agrobios, India.

Drug Biochemistry

Semester IV **Hours of Instruction /week: 4**

18BBCC10 **No. of Credits: 3**

Objectives:

1. To make the students to understand the fundamentals in pharmacology
2. To make the students to understand the mechanism of action of drugs
3. To make the students to understand the pharmacokinetic and dynamics properties of drugs

Unit 1 Introduction to drugs **12**

Definition - pharmacology, drug, chemotherapy, pharmacy. The nature and source of drugs. Routes of drug administration. Factors affecting drug absorption

Unit 2 Classification of drugs **12**

Sources of drugs - plant, animal and microbial. Classification of drugs – the mode of action based on drugs acting on enzymes, anti-metabolites

Based on therapy – cardiovascular, anti tubercular, anti hypertensive, antimicrobial drugs

Unit 3 Metabolism of drugs **12**

Oxidation, reduction, hydrolysis and conjugation reactions (Phase I and Phase II reactions). Biotransformation - synthetic and non-synthetic reactions

Unit 4 Mechanism of action of drugs **12**

Principles of drug action. Drug and receptor interactions. Non-receptor mechanisms Factors modifying the drug responses – Combined effects of drugs.

Unit 5 Pharmacokinetics **12**

Absorption, distribution and bioavailability of drugs. Excretion of drugs. Adverse drug reactions

Total Hours : 60

Course Outcomes:

At the end of the course, the student will be able

1. Understand basics terms in drugs, routes of administration, and the classification of drugs.
2. Understand how body responds to drugs and drug responds to body.
3. Interpret the pharmacokinetics of drugs
4. Explain the biotransformation of drugs

Text Books:

1. ***Satoskar, R.S. and Bhandarkar, S.D.*** **(2013).*Pharmolocology and Pharmacotherapeutics,*** Twenty third Edition, Vol. I and II, Popular Prakasam Pvt. Ltd, Mumbai.

2. ***Tripathi, K.D.*** **(2010).*Essentials of Medical Pharmacology***, Seventh Edition, Jay Pee Brothers Medical Publishers, New Delhi.

Reference Books:

1. ***Mycek, M.J., Harvey, R.A. and Champe, P.C*.(2010).*Pharmacology***, Fifth Editon, Lippincotts Illustrated reviews, Lippincott Williams & Wilkins publishers, North America.

Immunology

Semester IV **Hours of Instruction /week: 4**

Unit 1 Lymphoid organs and cells, immunity and immune Response **12**

Organs and cells of the immune system - organs - primary and secondary lymphoid organs. Cells - lymphoid and myeloid lineages. Differentiation and maturation of B-cells and T-cells.

Immunity and immune response – innate and acquired immunities: Humoral and cell – mediated immunities. Primary and secondary immune responses. Phagocytosis, inflammation, NK activity, ADCC, fever, chemical defences

18BBTC08 **No. of Credits: 3**

Objectives:

1. To expose students to the basic principles of immunology
2. To use these principles to understand how the immune system combats infections
3. To study the interaction of the various components of the immune system

Unit 2Antigens, antibodies and complement **12**

Antigens - types of antigens and their features. Requirement for antigenicity. Antigen processing and presentation. TCRs and BCRs.Antibodies - general structure of immunoglobulins (IgG). Classes of immunoglobulins, their properties and functions

Complement – Outlines of classical and alternative pathways, intermediates formed and biological functions

Unit 3 Disorders of the Immune System **12**

Hypersensitivity – elementary concepts of hypersensitivities – Types I-IV

Autoimmunity – basic concepts, causes and types of auto immune diseases. Organ specific and systemic autoimmune diseases with special reference to Hashimoto's thyroiditis and Systemic Lupus Erythematosis. Add a note on HIV cycle.

Unit 4 Immunization practices and Transplantation **12**

Immunization procedures - active and passive immunization. Vaccines – killed, attenuated, toxoids, recombinant, DNA, synthetic peptide vaccines. General principles involved in the production of monoclonal and polyclonal antibodies. Transplantation types.General organisation of MHC genes. Class I, II and III molecules.

Unit 5 Immunotechniques **12**

Immunotechniques – Features of antigen–antibody interactions. Precipitation reactions – immunodiffusion, immunoelectrophoresis. Agglutination reactions – blood grouping, haemagglutination. Assays with tagged antigen/antibody – RIA, ELISA, immunoblotting, immunofluorescence. Separation of lymphocytes.

Total Hours : 60

Course Outcomes :

At the end of the course, students will

1. Gain an insight on the various cells and organs involved in the immune system.
2. Understand the molecular mechanisms of antigen-antibody interactions.
3. Appreciate the molecular mechanisms behind the immune response evoked after infection by various pathogens
4. Learn the theoretical basis for the various immunological techniques.

Text Books:

1. ***Roitt, I., Brostoff, J. and Male, D.*** **(2012).** ***Essential Immunology***, Twelfth Edition, Wiley Blackwell Publishers, New York.
2. ***Tizard, I.R.*** **(2005).** ***Immunology – An Introduction***, Fourth Edition, Saunders College Publishing, New York.
3. ***Rao, C.V.*** **(2006).** ***An Introduction to Immunology***, Second Edition, Narosa Publishing House, Delhi, Chennai, Mumbai, Kolkata.

Reference Books:

1. ***Owen, J., Punt, J. and Stranford, S*. (2012) *Immunology***, Seventh Edition, W.H. Freeman and Company Publishers, New York.
2. ***Prescott, L.M., Harley, J.P. and Klein, D.A.* (2010) *Microbiology***, Eight Edition, The McGraw Hill Companies Publishers, New York.
3. ***Sawhney, S.K. and Singh, R.* (2005) *Introductory Practical Biochemistry***, Second Edition,Narosa Publishing House, New Delhi.

Microbial Biotechnology

Semester IV **Hours of Instruction /week: 4**

18BBTC09 **No. of Credits: 3**

Objectives:

1. To discuss the significant role of microorganisms in the production of industrially important compounds
2. To understand the basic principle and procedures in fermentation process with examples
3. To describe the technologies that use microbes

Unit 1 Isolation and screening of industrially important microbes **12**

Improvement of strains for increased yield and other desirable characteristics using conventional and modern technologies- significance of auxotrophic mutants- replica plating technique

Unit 2 Basic principles of fermentations **12**

Batch, fed-batch and continuous fermentation- types of fermenters – design and operation – air-lift, continuous stirred tank reactor, bubble column, packed tower bioreactor; media formulation, sterilization, aeration, agitation and downstream processing.

Unit 3 Food and dairy technology **12**

Factors influencing microbial growth in food. Composition and spoilage of food. Control of microorganisms by retarding growth- low temperature, drying, heat, radiation. Elementary idea of canning and packing. Basic principles of food fermentation. Fermented foods- yoghurt, cheese, bread.

Unit 4 Beverage technology **12**

Alcoholic beverages (beer, wine) – non alcoholic beverages (tea, coffee)

Production of antibiotics (penicillin), organic acids (vinegar), enzymes (amylase), polysaccharides (xanthane)

Unit 5 Microbial products **12**

Primary and secondary metabolites, mushroom cultivation, SCP production, Baker's yeast production

Total Hours : 60

Course Outcomes :

At the end of the course the students will be able to

1. Understand the importance of industrially important microbes
2. Acquire knowledge of food microbiology, packaging and fermentation industry .
3. Isolate and screen industrially important microbes.

4. Learn how beverages are made using biotechnological approaches.
5. Appreciate the economic importance of biotechnology.

Text Books:

1. ***Kango, N.*** **(2010)** ***Textbook of Microbiology***, I.K. International Publishing House, New Delhi.
2. ***Talaro, K.P. and Talaro, A.*****(2012)*****Foundations in Microbiology***, Eight Edition, McGraw Hill Publishing Company, New York.
3. ***Srivastava, M.*** **(2010)** ***Industrial Microbiology***, Shree Publishers and Distributors, New Delhi.

Reference Books:

1. ***Gupta, P.K.*** **(2012)*****Biotechnology and Genomics***, First Edition, Sixth Reprint, Rastogi Publication, Meerut.
2. ***Prescott, L.M., Harley, J.P. and Klein, D.A.*** **(2010)** ***Microbiology***, Eight Edition, The McGraw Hill Companies Publishers, New York.
3. ***Casida, J.R.*** **(2009)** ***Industrial Microbiology***, Fifth Edition, New Age International Publishers, New York.

Practicals-II Microbial Techniques

Semester IV **Hours of Instruction /week: 6**

18BBTC10 **No. of Credits: 3**

Objectives:

1. To learn the various sterilization techniques and to maintain aseptic conditions
2. To acquire skills in various microbiology techniques
3. To isolate and identify microorganisms from various sources

Unit 1 **18**

Orientation and safety in the microbiology laboratory-Sterilization techniques
Microscopy- cell counting and average cell size determination
Smear preparation and staining techniques- simple staining, Gram staining, negative staining, flagellar staining

Unit 2 **18**

Plating techniques – spread plate, pour plate and streak plate methods
Enumeration of bacteria from soil, water and air

Unit 3 **18**

Isolation of microorganisms from urine and sputum
Isolation of bacteriophage from sewage sample

Unit 4 **18**

Microbial growth determination
Bacteriological examination of water (MPN)
Antibiotic sensitivity test

Unit 5 **18**

Identification of bacteria by biochemical tests
Demonstration of wine production

Total Hours : 90

Course Outcomes :

At the end of the course the students will be able to acquire skills in

1. Sterilization procedures
2. Isolating microorganisms from various sources and analyzing their morphology.
3. Microscopy
4. Analysis of bacterial contamination of water
5. Biochemical analysis and fermentation techniques.

References:

1. ***Cappuccino, J. and Sherman, N.*(2013*) Microbiology: A Laboratory Manual,*** Tenth Edition, Benjiamin Cummings Publishers, USA.

2. ***Dubey, R.C. and Maheswari, D.K.*****(2010)*****Microbiology,*** Third Edition, S.Chand and Company Publishers, New Delhi.

Mathematics for Biological Sciences

Semester IV **Hours of instruction per week: 4**
18BBCI06 **No of Credits: 3**

Objectives:

1. To understand the basic concepts of Differential Calculus
2. To learn fundamenta for applications
3. To grasp the fundamentals of Statistics

Unit 1 Sets, Relations Functions and Matrices **12**

Sets, Relations Functions and Matrices: Sets - Types of sets - set operations - Relations - Functions - Types of functions - Binary operation - Counting principle - Permutations and combinations - Eigen values

Unit 2 Solution of Algebraic and Transcendental Equations

The Bisection method - The Iteration method - Newton-Raphson Method - System of simultaneous linear equations - Gauss elimination method**.** **12**

Unit 3 Differentiation and Partial Differentiation

Logarithmic differentiation - Differentiation of one function with respect to another - Differentiation of functions in parametric form - Differentiation of implicit functions - Successive partial derivatives - Function of function rule - Total Differential coefficient - Implicit functions - Homogeneous functions. **12**

Unit 4 Integrationand Ordinary Differential Equations

Bernoulli's formula - Evalution of integrals using Bernoulli's formula - Variable separable - Homogeneous equations - Linear equations**.** **12**

Unit 5 Measures of central tendencyand Measures of Dispersion

Mean - Median - Mode - Relationship between mean - median and mode - Range - Mean deviation - Quartile deviation - Standard deviation - Coefficient of variation. **12**

Total Hours : 60

Course Outcomes :

On completion of the course, the students will be able to

1. Demonstrate the various types of sets, functions and relations.
2. Find Eigen values and Eigen vectors of a given matrix.
3. Find solutions for algebraic, transcendental equations.
4. Apply differential equation techniques in scientific field.

5. Calculate various measures of central tendency required to analyze research project.

Text Books:

1. *U. Rizwan (2002). "**Mathematical Foundation"**,*SCITECH publications Pvt., Ltd., Chennai. (Unit I)
2. *S. Narayanan, R. Hanumantha Rao, T. K. Manicavachagom Pillay and* P. *Kandaswamy (2008). **"Ancillary Mathematics for Allied Mathematics Course of B.Sc Physics, Chemistry and Computer science major, Volume –I"**,* S. Viswanathan (Printers and Publishers) Pvt., Ltd., Chennai. (Unit I)
3. *S. S. Sastry (2009). **"Introduction Methods of Numerical Analysis"**,* Prentice- Hall of India Private., New Delhi. (Unit II)
4. *S. Narayanan and T. K. Manicavachagom Pillay (2009). **"Calculus Volume I Differential Calculus"**,* S. Viswanathan (Printers and Publishers), Pvt., Ltd., Chennai. (Unit III)
5. *S. Narayanan, R. Hanumantha Rao, T. K. Manicavachagom Pillay and P. Kandaswamy (2008). **"Ancillary Mathematics for Allied Mathematics Course of B.Sc Physics, Chemistry and Computer science major, Volume –II"**,*S. Viswanathan (Printers and Publishers) Pvt., Ltd., Chennai. (Unit IV)
6. *K. Senthamarai Kannan and D. Venkatesan (2006). **"Introduction to Statistical Methods"**,*SCITECH Publications Pvt., Ltd. (Unit V)

Clinical Biochemistry

Semester V **Hours of Instruction /week: 4**

18BBCC11 **No. of Credits: 3**

Objectives:

1. To understand the biochemical aspects of diseases.
2. To acquire theoretical basis for conducting tests for organ functions
3. To correlate biochemical findings with clinical conditions

Course Outcomes :

At the end of the course, students will

1. Understand the biochemical basis of various diseases.
2. Learn the appropriate tests to assess organ function.
3. Correlate biochemical findings with disease onset and progression.

Unit 1 Kidney functions and disorders **12**

Tests that measure GFR- creatinine clearance, tests measuring secretion and tubular functions.Abnormal constituents of urine.

Diagnosis and screening for renal disease. Types of renal failure, uremia, glomerular diseases–nephritis and nephrosis

Analysis of Urinarycalculi:

Elementary principles of dialysis (artificial kidney)

Unit 2 Liver function tests and disorders **12**

Metabolism of bilirubin. Excretory, detoxification and metabolic liver function tests Plasma enzymes in liver disease.

Liver diseases- cirrhosis, hepatitis and types of jaundice.

Blood glucose regulation, diabetes mellitus – types, metabolic changes and complications, Glucose tolerance test, ketosis

Glycogen storage diseases

Unit 3 Abnormalities of lipid metabolism **12**

Plasma lipids and lipoproteins - hypo and hyper lipoproteinemia, fatty liver, atherosclerosis, sphingolipidosis,

Hypertension and its complications

Unit 4 Abnormalities of plasma proteins and blood coagulation **12**

Plasma proteins and their variations in diseases.

Inborn errors of metabolism - phenyl ketonuria, albinism, alkaptonuria, cystinosis, maple syrup urine disease, gout.

Blood coagulation, bleeding time, clotting time, prothrombin time.

Unit 5 Clinical Enzymology and electrolyte imbalance **12**

Clinical significance of phosphatases, γ-glutamyltransferase, amylase, lactate dehydrogenase, transaminases and creatine phosphokinase.

Electrolyte Imbalance - hyper and hyponaterimia, hypo and hyperkalemia.

Total Hours : 60

4. Appreciate the importance of biochemical tests in clinical practice.

Text Books:

1. ***Chatterjea, M.N.*** **(2011).*Text Book of Medical Biochemistry,*** Eight Edition, Jaypee Brothers Medical Publishers, New Delhi.
2. ***Chawla, R.*****(2008).*Practical Clinical Biochemistry - Methods and Interpretations,*** Third Edition, Jaypee Brothers Medical Publishers, New Delhi.
3. ***Bhagavan, N.V.*** **(2004).*Medical Biochemistry***, Fourth Edition, Academic Press, Calfornia.

Reference Books:

1. ***Voet, D., Voet, J.G., and Pratt, C.W.*** **(2013).*Fundamentals of Biochemistry – Life at the Molecular Level***, Fourth Edition, John Wiley & Sons. Inc, New York.
2. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.*** **(2012).*Harpers Illustrated Biochemistry,*** Twenty ninth Edition, Tata McGraw Hill Companies Publication, New Delhi.
3. ***Burtis, C.A. and Bruns, D.E.*****(2007).*Fundamentals of Clinical Chemistry,*** Sixth Edition, W.B Saunders Co, Philadelphia, London, Toronto.

Molecular Biology

Semester V **Hours of Instruction /week: 4**
18BBCC12 **No. of Credits: 3**

Objectives:

1. To comprehend the hierarchical organization of genomes.
2. To gain an insight into the flow of genetic information from DNA through RNA to protein.
3. To understand the mechanisms of replication, transcription and translation.
4. To appreciate the regulation of gene expression.
5. To learn about DNA damage, repair and recombination.

Unit 1 Genome organization **12**

The central dogma of molecular biology. Concept of gene and genome. Colinearity of the gene and polypeptide. Organisation of the E. coli chromosome. Mitochondrial and chloroplast genomes. Organisation of the eukaryotic genome- histones and nucleosomes, higher order chromatin structure.

Unit 2 DNA Replication **12**

DNA replication in bacteria *(θ and rolling circle model)*
Enzymes and proteins involved replication, steps (initiation, elongation, termination). Brief account of DNA damage and repair (photoreactivation, excision repair).

Unit 3 Transcription and Post-transcriptional processing **12**

Transcription: RNA polymerase, transcription signals, steps (initiation, elongation and termination). Post-transcriptional processing of mRNA, rRNA and tRNA. Reverse transcription. Inhibitors of transcription – miRNA, siRNA

Unit 4 Genetic code and Translation **12**

Genetic code- general features. Mutations – Point (transversion, transition), frame-shift. **Protein biosynthesis- amino acid activation,** initiation, elongation, termination. Post-translational modifications. Inhibitors of protein synthesis. Brief account of protein degradation.

Unit 5 Gene expression and Recombination **12**

Definition of housekeeping genes, inducible genes, up/downregulation. Regulation of gene expression in prokaryotes with lac operon as model.
Brief account of homologous and site-specific recombination. Transposition: Structure and functions of insertion sequence (IS) elements, transposons and transposition events

Total Hours : 60

Course Outcomes :

Course Outcomes :

At the end of the course, the students will be able to

1. Understand the concept of gene, genome, and genome organization.
2. Appreciate the intricate molecular mechanisms of the various steps in replication, transcription and translation.
3. Distinguish the processing of RNA and proteins after synthesis.
4. Gain an insight into how gene expression is regulated.
5. Understand the mechanism of DNA damage, repair and recombination.

Text Books:

1. ***Ajoy, P.***(2009) ***Textbook of Cell and Molecular Biology***, Second Edition, Books and Allied Publication, Mumbai.
2. ***Jeyanthi,G.P.*** **(2009)** ***Molecular biology***, MJP Publishers, Chennai.***Ramamurthi, K.S.*****(2009)** ***Gene flow and molecular biology***, Alfa Publications, New Delhi.

Reference Books:

1. ***Watson, J.D.*** (2017) ***Molecular Biology of the Gene***, Seventh Edition, Pearson Publisher**.**

Practicals III-Clinical Biochemistry

Semester V **Hours of Instruction /week: 5**

18BBCC13 **No. of Credits: 2**

Objectives:

1. To learn the procedures and precautions for collection and storage of biological samples
2. To analyse urine and blood samples for disease diagnosis

Unit 1 Collection of urine samples **15**

Random,12 hours, 24 hours
Preservatives for urine
Volume of urine
Collection of blood samples
Collection by fingertip and venipuncture
Whole blood, Serum, plasma, RBC

Unit 2 Routine analysis of urine (Qualitative) **15**

Colour, appearance, pH, specific gravity, albumin, glucose, fructose, pentose, ketone bodies, blood, urinary deposits and bile salts-bilirubin

Unit 3 Urine analysis (Quantitative) **15**

Titrable acidity, true acidity, organic acids

Unit 4 Calculi analysis **15**

Appearance, systematic analysis for carbonate, oxalate, phosphate, urate, xanthine, magnesium, calcium, non-oxalate calcium, ammonium, cystine, cholesterol

Unit 5 Blood Analysis (Kit Methods) **15**

Acid phosphatase, alkaline phosphatase, aspartate transaminase, alanine transaminase, total cholesterol and HDL cholesterol

Total Hours : 75

Course Outcomes :

At the end of the course, the students will acquire essential practical skills for

1. Collecting and preserving biological samples.
2. Separation of serum and plasma for analysis.
3. Analyses of urine and blood for various diseases.
4. Interpreting biochemical data and correlating with clinical data.

Text Books:

1. ***Chatterjea, M.N.*** **(2011).*Text Book of Medical Biochemistry,*** Eight Edition, Jaypee Brothers Medical Publishers, New Delhi.
2. ***Chawla, R.*** **(2008).*Practical Clinical Biochemistry - Methods and Interpretations,*** Third Edition, Jaypee Brothers Medical Publishers, New Delhi.
3. ***Bhagavan, N.V.*** **(2004).*Medical Biochemistry***, Fourth Edition, Academic Press, Calfornia.

Reference Books:

1. ***Voet, D., Voet, J.G., and Pratt, C.W.*** **(2013).*Fundamentals of Biochemistry – Life at the Molecular Level***, Fourth Edition, John Wiley & Sons. Inc, New York.
2. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.*** **(2012).*Harpers Illustrated Biochemistry,*** Twenty ninth Edition, Tata McGraw Hill Companies Publication, New Delhi.
3. ***Burtis, C.A. and Bruns, D.E.*** **(2007).*Fundamentals of Clinical Chemistry,*** Sixth Edition, W.B Saunders Co, Philadelphia, London, Toronto.

Plant Biotechnology

Semester V **Hours of Instruction /week: 3**

18BBTC11 **No. of Credits: 3**

Objectives:

1. To understand the organisation of the plant genome and techniques to analyse the plant genome.
2. To explain the importance of molecular markers in plant breeding.
3. To employ the concepts of plant tissue culture and genetic engineering for crop improvement.

Unit 1 Plant tissue culture

Laboratory organization, lab equipment and their working, various sterilization and preparation techniques **9**

Tissue culture methods - terms and definitions, concept of totipotency, media components – macro, micro and growth regulators (auxin, cytokinin, gibberellins, ethylene and abscisic acid

Unit 2 Embryogenesis and organogenesis **9**

Introduction to the process of embryogenesis and organogenesis and their practical applications.

Clonal multiplication of elite species – micropropagation – auxillary bud, shoot tip and meristem culture; limitations

Haploids and their applications (ovary, ovule and anther culture)

Triploid production (endosperm culture)

Invitro pollination and fertilization, embryo culture, wide hybridization and embryo rescue

Unit 3 Commercialization of tissue culture technology **9**

Concept of commercialization- need and design of a typical tissue culture laboratory and its management

Commercial production of plants using tissue culture– floriculture, horticulture, olericulture

Commercial production of secondary metabolites using cell cultures – use of bioreactors, immobilized cells, biotransformation, applications and limitations

Commercial production of forest trees, fruit trees – problems in propagating trees namely systemic contaminates, phenolic leaching, seasonal variation in response, genotypic recalcitrance

Artificial seeds, cryopreservation and *ex situ* conservation of germplasm

Unit 4 Plant transformation methods **9**

Introduction to plant transformation and development of transgenic crops.

Plant transformation vectors – Agrobacterium biology, Ti plasmid vectors and T-DNA transfer

Physical methods of transformation – biolistics, electroporation, lipofection

Selection and propagation of transformants – selectable markers, reporter genes and promoters

Unit 5 Genetic improvement of plants through Transgenic Technology **9**

Development of Virus resistance, pest resistance, and herbicide tolerance in plants by transgenic technology. Antisense RNA technology for delayed fruit ripening.

Terminator technology (brief account) Ethical issues in plant genetic engineering.

Total Hours : 45

Course Outcomes :

At the end of the course, the students will

1. Interpret the concept of gene families and its role in plant breeding
2. Explain the steps involved in photosynthesis and its regulation.Integrate genetic and physical maps of plants to create genome viewer toolsCriticise the advantages and disadvantages of genetically modified plants Devise new methods for biotransformation of plants to produce useful metabolites

Text books:

1. ***Ramawat, K.G.*****(2008).*****Plant Biotechnology***, S.Chand and Company Ltd, Ram Nagar, New Delhi.
2. ***Chawla, H.S*****.(2004).*****Introduction to Plant Biotechnology***, Second Edition, Science Publishers Inc, Enfield, USA.
3. ***Bojwani, S.S. and Rhazdan, M.K.*****(1989).*****Plant Tissue Culture: Theory and Practice***, Elsevier Science Publishers, Mumbai.

Reference Books:

1. ***Glick, B.R., Pasternak, J.J. and Patten, C.L.*****(2009)*****Molecular Biotechnology: Principles and application of recombinant DNA technology***, Fourth Edition, ASM Press, USA.
2. ***Hopkins, E.G.*****(2007)*****Plant Biotechnology***, Chelsea House, Infobase Publishing, New York.
3. ***Fossard, R.A*****.(2006)*****Commercial Micropropagation CD***, Agritech Publications, USA.

rDNA Technology and Nanobiotechnology

Semester V **Hours of Instruction /week: 4**

18BBTC12 **No. of Credits: 3**

Objectives:

1. To understand the basics principles and applications of rDNA technology

Unit 1 Introduction to recombinant DNA technology **12**

Basic principles of rDNA technology. Type II Restriction endonucleases- nomenclature, and types of cleavage. Cloning vectors- plasmids (pBR322) and phages (λ phage) vectors. Cosmids. Brief introduction to high-capacity cloning vectors (BACs and YACs). Cloning vectors for Yeast, plants (Agrobacterium). Viral vectors – SV40. Expression vectors.

Unit 2 Gene transfer methods and rDNA screening **12**

Transformation, preparation of competent cells and selection. calcium phosphate coprecipitation, electroporation, lipofection, viruses, biolistics, microinjection. Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony hybridization, immunological screening.

Unit 3 Cloning strategies and expression of cloned genes **12**

Cloning strategies: Construction of genomic and cDNA libraries. Differences between genomic and cDNA libraries. Chromosome walking, chromosome Jumping, HRT and HART. Reporter genes – CAT, GFP, luciferase.

Expression of eukaryotic genes in bacteria with insulin as an example. Basic concept of fusion proteins.

Unit 4 Techniques and Applications of rDNA technology **12**

Isolation and purification of nucleic acids. Probe preparation. Blotting techniques. Basic principle and application of PCR – DNA Polymorphism – RFLP, RAPD and AFLP.

DNA sequencing and fingerprinting. DNA microarrays. Applications of rDNA in medicine, agriculture. The Human Genome Project- brief account of goals, results, ethical, legal and social issues. Biosafety regulations, bioethics, intellectual property rights and patenting issues.

Unit 5 Nanobiotechnology **12**

Introduction - nanotech - enabled products and possibilities - nano manufacturing- health and safety issues - biosensors of cellulose nano fibrils - tools for characterization of biosensors and nanometer scale - poly electrolyte multilayers for fiber engineer. Hemicellulose at interfaces - lignin, cellulose, chitin and nanoscience - as nanoscopic biomaterials- Bacterial cellulose and its polymeric nano composites -

Bone tissue engineering

Total Hours : 60

2. To understand the basic principles of nanobiotechnology

Course Outcomes:

At the end of the course students will

1. Understand the basic steps in a cloning experiment.
2. Acquire knowledge about how to isolate a DNA segment, clone it into a suitable vector, introduce into a host and identify the recombinant from nonrecombinants.
3. Know the theoretical basis for selection, screening, construction of libraries and expression of genes.
4. Learn the principles of various genetic engineering techniques as well as their applications.
5. Acquire a fundamental understanding of the basic principles of nanobiotechnology.

Text Books:

1. ***Brown, T.A.*****(2010).*****Gene cloning - An Introduction,*** Sixth Edition, Wiley Publishers, USA.
2. ***Lucia, L.A. and Rojas O.J.*****(2009).*****The Nanoscience and Technology of Renewable Biomaterials***, Wiley and Sons Publishers, New York.
3. ***Primrose, S.B., Twyman, R.M. and Old, R.W.*** **(2006).*****Principles of Gene Manipulation***, Seventh Edition, Blackwell Publishing Company, USA.

Reference Books:

1. ***Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Gelbart, W.M., Sazuki, D.T. and Miller, J.H.*** **(2010).*****Introduction to Genetic Analysis***, Tenth Edition, W.H. Freeman and Company, New York.
2. ***Freifelder, D.*****(2006).*****Molecular Biology***, Second Edition, Narosa Publishing House, New Delhi.
3. ***Kreuzer, H. and Mausey, A.*****(2001).*****Recombinant DNA and Biotechnology – A Guide for Student***, Second Edition, ASM Press, Washington.

Practicals III - Methods in Molecular Biology and Plant Tissue Culture

Semester V **Hours of Instruction /week: 5**
18BBTC13 **No. of Credits: 3**

Objectives:

1. To describe protocols for sample preparation to observe the stages of cell division, isolation and estimation procedures used to quantify biomolecules
2. To explain the methods and techniques involved in rDNA technology
3. To understand the principles and methodology of Plant and Animal tissue culture

Unit 1 Cytological preparations **15**

Fixation, dehydration and staining – embedding and sectioning – preparation of squash stain of onion root tip – observation of different stages of mitosis
Separation of cell components – separation of cell organelles by ultracentrifugation - Isolation and estimation of DNA- UV and diphenyl amine method. Isolation and estimation of RNA - orcinol method.Isolation and estimation of protein - Lowry's method

Unit 2 Restriction digestion of Lambda DNA **15**

Agarose gel electrophoresis, Restriction mapping
Southern blotting (demo)
Growth of bacterial cells
Preparation of competent cells, restriction and ligation of pBR322
Transformation of pBR322 plasmid
Plating and selection

Unit 3 Plant tissue culture **15**

Initiating plant tissue culture-media preparation, surface sterilization-callus culture-Micropropagation

Unit 4 Animal cell culture **15**

Culture of lymphocytes from blood samples
Preparation of media, filter sterilization, initiation of primary culture from chick embryo fibroblasts - checking for viability

Unit 5 Field visits **15**

Visit to a commercial plant tissue culture laboratory – Demonstration / operation of large scale fermenters

Total Hours : 75

Course outcomes:

At the end of the course students will

1. Illustrate various experiments to observe the stages of cell division
2. Examine the isolated genetic material from various sources
3. Compare the functions of restriction enzymes and analyse the restricted fragments
4. Discuss how the genes are cloned and selected
5. Distinguish the importance of various techniques involved in plant tissue culture

Text Books:

1. ***Mathur, S.*****(2012).*****Animal Cell and Tissue Culture***, Agrobios Publications, India.
2. ***Freshney, R.I.*****(2006).*****Culture of Animal Cells – A Manual of Basic Technique***, Fifth Edition, A John Wiley and Sons Publication, New York.
3. ***Masters, J.R.W.*****(2000).*****Animal Cell Culture – A Practical Approach***, Third Edition, Oxford University Press, London.

Antioxidants in Health and Diseases (Self Study)

Semester V **Hours of Instruction /week: 1**

18BBTC14 **No. of Credits: 4**

Objectives:

1. To have knowledge of what free radicals are, how they are generated and how they react
2. To understand what antioxidants are and the role of antioxidants in health and disease
3. To understand about the many interactions between oxidants and antioxidants, and how such substances may act as natural protectants and/or natural toxicants

Unit 1 Free radicals **3**

Oxygen toxicity - derivatives – reactive oxygen species – reactive nitrogen species – reactive chlorine species – reactive sulphur species – sources

Unit 2 Types of free radicals **3**

Chemistry of biologically important radicals – transition metals, hydroxyl radical, superoxide, peroxyl and alkoxyl, sulphur and nitric oxide – non-radicals – hydrogen peroxide, hypochlorous acid, singlet oxygen, peroxynitrite – formation of free radicals

Unit 3 Oxidative stress **3**

Damage to cellular targets – consequences – oxidative stress in disease – cancer, diabetes mellitus, cardiovascular diseases, neurodegenerative diseases

Unit 4 Antioxidant defenses **3**

Enzymic antioxidants – superoxide dismutase, catalase, peroxidase, glutathione S-transferase, other antioxidant defense enzymes – non-enzymic antioxidants – ascorbic acid, vitamin E, carotenoids, polyphenols, trace elements

Unit 5 Antioxidants in health and disease **3**

Concept of health, disease and well being – health and oxidative stress – prevention of diseases – concept of health indicators. Antioxidants in health and diseases. Dietary antioxidants – herbal antioxidants – antioxidants in treatment of diseases

Total Hours : 15

Course Outcomes :

At the end of the course students will be able to

1. Understand the different types of free radicals
2. Explain oxidative stress associated diseases and disorders
3. Interpret the role of antioxidants in combating diseases
4. Understand the importance and types of antioxidant

Text Books:

1. ***Satynarayana, U. and Chakrapani, U.*** **(2009).*Biochemistry***, Third Edition, Books and Allied (P) Ltd, Kolkata
2. ***Halliwell, B. and Gutteridge, J.M.C.*****(2008).*Free radicals in biology and Medicine***, Fourth Edition, Oxford University Press, London.

Reference Books:

1. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A*****.(2012).*Harper's Illustrated Biochemistry,*** Twenty ninth Edition, Tata McGraw Hill Companies Publication, New Delhi.
2. ***Prasad, K.N*****.(2010).*Micronutrients in Health and Disease***, CRC Press, USA.
3. ***Bao, Y. and Fenwick, R*****.(2004).*Phytochemicals in Health and Disease***, CRC Press, USA.

Molecular Physiology

Semester VI **Hours of Instruction /week: 5**

18BBCC15 **No. of Credit: 3**

Objectives:

1. To impart knowledge on the functioning of all the organs of the body
2. To understand the principles underlying the interaction among the various organs
3. To study the cellular mechanisms involved in diseased conditions

Unit 1 Membrane transport **15**

Membrane architecture - functions, structural features and chemical composition of membranes. Molecular models of plasma membranes.

Membrane transport – Transport of small molecules - passive transport – simple diffusion, facilitated diffusion, active transport - sodium- potassium pump, calcium pump, glucose and water transport across intestinal epithelial cells, bacterial lactose permease system. Transport of large molecules – exocytosis and endocytosis

Unit 2 Neurotransmission **15**

Organisation of nerve cells. Propagation of nerve impulse along axon and synapse Role of neurotransmitters – acetylcholine, epinephrine, norepinephrine

Unit 3 Molecular motors **15**

Types of muscles and their functions. Structure of muscle cells – sarcomere. Thick and thin filaments. Muscle proteins – actin, myosin, troponin, tropomyosin, accessory proteins. Molecular events involved in muscle contraction and relaxation. Energy sources involved

Unit 4 Hormones **15**

Introduction. Characteristic features. Classification. General mechanism of action of hormones. Intracellular messengers – cAMP, cGMP, phosphoinositide cascade and calcium. Specific hormones in signal transduction – signalling devices – endocrine, paracrine and autocrine signalling

Unit 5 Sensory transduction **15**

Visual, olfactory, taste, auditory and touch transductions.

Total Hours : 75

Course Outcomes :

At the end of the course students will

1. Understand the membrane architecture, different models and various transport systems.
2. explain the organization of nerve cells and neurotransmitters

3. Understand the role of molecular motors, types of muscles and muscle proteins.
4. Explore the hormonal system and how it regulates the activities of organs by signal molecules
5. Understand the concepts of sensory organs.

Text Books:

1. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.*****(2012).*****Harpers Illustrated Biochemistry,***Twenty ninth Edition, Tata McGraw Hill Companies Publication, New Delhi.
2. ***Devlin, T.M.*****(2010).*****Textbook of Biochemistry with Clinical Correlations,***Seventh Editin, John Wiley and Sons Inc Publications, New York.
3. ***Lohar, P.S.*****(2007).*****Endocrinology Hormones and Human Health,***Second Edition, MJP Publishers, Chennai.

Reference Books:

1. ***Karp, G.*** **(2013).*****Cell and Molecular Biology,***Seventh Edition, John Willey and Sons Inc Publishers, New York.
2. ***Owen, J., Punt, J. and Stranford, S.*** **(2012).*****Immunology,*** Seventh Edition, W.H. Freeman and Company Publishers, New York.
3. ***Rastogi, S.C.*****(2012).*****Cell and Molecular biology,***Third Edition, New Age International Publishers, New Delhi.

Nutritional Biochemistry

Semester VI **Hours of Instruction /week: 5**

18BBCC16 **No. of Credits: 3**

Objectives:

1. To impart the knowledge on historical overview of nutrition, essential nutrients for metabolism
2. To provide an overview of the major macro and micronutrients relevant to human health
3. To discuss the scientific rationale for defining nutritional requirements in healthy individuals and populations, with reference to specific conditions such as pregnancy, lactation, and older age

Unit 1 Introduction **15**

Nutrition – concepts - role of nutrition in maintaining health, basic food groups - energy yielding, body building and protective foods. Basic concepts of energy expenditure, unit of energy – Kcal - energy requirements of different categories of people - RQ of foods - Body Mass Index (BMI) - Basal Metabolic Rate (BMR) – determination and factors influencing

Unit 2 Nutritional significance of dietary components **15**

Physiological role and nutritional significance of carbohydrates, lipids, proteins, vitamins (water soluble and fat soluble) minerals and fiber. Dietary sources. Functions. Digestion, absorption and storage, metabolism of carbohydrates – lipids – proteins.

Unit 3 Nutritive value of proteins **15**

Essential amino acids, biological values of proteins (animal and plant proteins). Evaluation of proteins by nitrogen balance method-DC, BV, NPU and NAP of animal and plant proteins, single cell proteins, factors influencing protein requirements, ffect of excess protein intake

Unit 4 Protein calorie malnutrition **15**

Protein malnutrition (Kwashiorkor) and under nutrition (marasmus) their preventive and curative measures – composition of balanced diet and RDA for infants, children, adolescent, adult male and female, pregnant, lactating women and geriatrics

Unit 5 Nutrition and body defenses **15**

Effect of drugs on food and nutrients, drug - nutrient interaction - nutritional therapy,

food preparation and management. Role of diet and nutrition in the prevention and treatment of diseases – Diabetes mellitus, hypertension, infections, CVD, liver and kidney disorders

Total Hours : 75

Course Outcomes :

At the end of the course students will

1. Assess the nutritional status of community in order to determine the type magnitude and distribution of malnutrition.
2. Describe the biochemical and physiological functions of the nutrients and their integrated role.
3. Evaluate the therapeutic role of key nutrients in maintaining health.

Text Books:

1. ***Srilakshmi, B.*** **(2013)** ***Nutrition Science*** Revised Fourth Edition, New Age International Publishers, New Delhi.
2. ***Paul, S.*** **(2005)** ***A Textbook of Bio-nutrition – Curing Diseases through Diet,*** First Edition, CBS Publishers and Distributors, New Delhi.
3. ***Swaminathan, M.*****(2004)** ***Advanced Textbook of Food and Nutrition***, Volume II, Second Edition, The Bangalore Printing and Publishing Co. Limited, India.

Reference Books:

1. ***Geissler, C. and Powers, H.*****(2010)*****Human Nutrition,*** Twelfth Edition, Churchill Livingstone, USA.
2. ***Brody, T.*** **(2006)** ***Nutritional Biochemistry***, Second Edition, Academic Press, USA.
3. ***Eastwood, M.*** **(2003)** ***Principles of Human Nutrition***, Second Edition, Wiley - Blackwell Science Ltd Publishers, USA.

Practicals IV-Clinical Biochemistry and Food Analysis

Semester VI **Hours of Instruction /week: 5**

18BBCC17 **No. of Credits: 3**

Objectives:

1. To learn important procedures in blood/serum analysis
2. To analyze the food sample for the presence of nutrients/ vitamins
3. To know more about the pathological samples

Unit 1 ***Blood Analysis (Whole Blood)*** **15**

Iron and Hemoglobin, urea, glucose

Unit 2 ***Serum Analysis*** **15**

Creatine, creatinine, chloride, uric acid, phosphorus, calcium, total protein, albumin:globulin ratio

Unit 3*Urine Analysis* **15**

Creatine, creatinine, chloride, uric acid, phosphorus, calcium

Unit 4 ***Food Analysis*** **15**

Wheat flour/Bengal gram flour analysis for ash content, moisture content, crude fibre content, oxalate, phytate, calcium, iron, phosphorus

Unit 5 ***Vitamins in food samples*** **15**

Ascorbic acid, riboflavin, thiamine

Total Hours : 75

Course Outcomes:

At the end of the course students will

1. Importance of clinical enzymology.
2. Know more about various tests associated with different organs and tissues
3. Apply their clinical knowledge to investigations in human diseases.

4. Apply their knowledge gained to understand more about calculi and its components

Text Books:

1. ***Burtis, C.A. and Bruns, D.E.*(2007).*Fundamentals of Clinical Chemistry,*** Sixth Edition, W.B Saunders Co, Philadelphia, London, Toronto.
2. ***Chawla, R.* (2008).** ***Practical Clinical Biochemistry - Methods and Interpretations,*** Third Edition, Jaypee Brothers Medical Publishers, New Delhi

Computational Biology

Semester VI **Hours of Instruction /week: 5**
18BBTC16 **No. of Credits: 3**

Objectives:

1. To expose students to the interdisciplinary computational biology course and its applications
2. To expose the students to various biological databases
3. To understand algorithms and tools in biological sequence analysis

Unit 1 Introduction to bioinformatics **15**

Definition, history, knowledge discovery and data mining; opportunities in Bioinformatics; Bioinformatics and pharmaceutical industry; problems faced in Bioinformatics area

Unit 2 Introduction to biological databases **15**

Sequence and structure databases; nucleotide sequence databases – GenBank, EMBL, DDBJ – data retrieval tool – Entrez. Protein databases: Swiss-Prot / TrEMBL, PIR, structural databases –PDB, SCOP, CATH; specialized databases – KEGG, TIGR

Unit 3 Sequence analysis **15**

Pair wise alignment – dot plot, global and local alignment (details of algorithm not required); similarity searches - FASTA and BLAST.

Unit 4 Multiple sequence alignment and phylogenetic analysis **15**

Progressive alignment method – Clustal; phylogenetic tree construction – PHYLIP.

Unit 5 Molecular visualization of biomolecules **15**

3D structural analysis of biomolecules, obtaining atom co-ordinate files from databases; molecular visualization tools – RasMol.

Total Hours : 75

Course Outcomes :

At the end of the course students will be able to

1. Understand bioinformatics and its applications in pharmaceutical industry.
2. Familiar with biological databases, data storage and querying.
3. Understand algorithms and applying tools in sequence analysis.
4. Apply bioinformatics tools and interpret results

Text books:

1. ***Attwood, T., Parry, D. and Phukan, S.*****(2009)*****Introduction to Bioinformatics***, Pearson Education, Asia, India.
2. ***Kothekar, V. and Nandi, T.*****(2007)*****An Introduction to Bioinformatics***, Duckworth Press, Bioscience Publishers, New York.
3. ***Xiong, J***. **(2006).*****Essential Bioinformatics***, Cambridge University Press, Australia.

Reference Books:

1. ***Baxevanis, A.D. and Ouellette, B.F.F.*****(2009).*****Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins***, Third Edition, Wiley Publishers, New York.
2. ***Lesk, A.M.*****(2007).*****Introduction to Bioinformatics***, Oxford University Press, London.
3. ***Mount, D.W.*****(2005).*****Bioinformatics – Sequence and Genome Analysis***, Second Edition, CBS Publishers and Distributors, Chennai.

Animal Cell Culture and Animal Biotechnology

Semester VI **Hours of Instruction /week: 5**

18BBTC17 **No. of Credits: 3**

Objectives:

1. To explain the principles of aseptic techniques of culturing tissues under *invitro* conditions,
2. To develop understanding of techniques for cell line, cell strain development, maintenance
3. To apply the concepts of cell culture techniques for molecular pharming.

Unit 1 History and scope of cell culture **15**

Requirements for animal tissue culture- Laboratory layout - cellular growth requirements-qualitative and physiological factors

Culture media- natural and defined - serum free media - Constituents of serum and its role. Importance of the growth factors in serum. Growth factors promoting proliferation of animal cells- EGF, FGF, PDGF, IL-I IL- II, NGF and erythropoietin

Unit 2 Primary cultures **15**

Anchorage dependence of growth - Non anchorage dependent cells. Secondary cultures- transformed animal cells. Established / continuous cell lines- commonly used cell lines- origin and characteristics- Propagation and maintenance of cell lines

Growth kinetics of cells in culture- types of tissue culture- cell culture, primary explant culture- slide / coverslip - single and double - flask culture and organ culture.3D cultures (elementary details)

Unit 3 Embryo culture **15**

Whole embryo culture- transfection of animal cells- selectable markers-HAT selection- Antibiotic resistance

Somatic cell fusion- production of monoclonal antibodies- transplantation of cultured cells- cell differentiation

Unit 4 Metabolism of animal Cells **15**

Metabolism of animal cells in culture - special secondary metabolite production - insulin, growth hormones, interferons, t-plasminogen activator and factor VIII

Expression of cloned proteins and production of vaccines in animal cells - tissue engineering

Unit 5 Embryo transfer **15**

Artificial insemination. *In vitro* fertilization and Embryo transfer- super ovulation and embryo transfer in farm animals –Somatic cell cloning of Dolly - methods and utility - gene transfer methods - transgenic animals - molecular pharming

Bioreactors for large - scale culture of cells – monolayers - suspension culture- immobilized bioreactors

Total Hours : 75

Course Outcomes:

At the end of the course students will

1. Describe the requirements to initiate cell culture facility
2. Compare and contrast different methods of embryo transfer
3. Conceive suitable methods for organ culture and tissue engineering
4. Devise the methods for improved development of therapeutic proteins
5. Apply her expertise for large scale production of metabolites

Text Books:

1. ***Gupta. P.K.*** **(2012)*Biotechnology and Genomics***, First Edition,Sixth reprint, Rastogi Publication, Merut.
2. ***Brown, T.A.*****(2010)*Gene cloning- An Introduction,*** Sixth Edition, Wiley Publishers, USA.
3. ***Ranga, M.M.*** **(2008)*Animal Biotechnology***, Student Edition, SaraswatiPurohitPublications, Jodhpur.

Reference Books:

1. ***Probnee. R***. **(2007)*Animal cell biotechnology, Methods and Protocols***, Second Edition, Humana press, New Jersey.
2. ***Freshney, R.I.*****(2006)*Culture of Animal Cells – A manual of Basic Technique***, Fifth Edition, A John Wiley and Sons Publication, New York.
3. ***Freshney, R.I.*****(2005)*Animal Cell Culture-A Practical Approach***, Fourth Edition, IRL Press, New York.

DSE - Chemistry and Metabolism of Biomolecules

Semester III **Hours of Instruction/week:4**

18BCHI04 **No. of Credit: 3**

18BFNI04

[For Food Science and Nutrition and Chemistry]

Objectives:

1. To understand the basics of biomolecules.
2. To learn the properties of biomolecules and their significant role in living systems.
3. To learn about the metabolism of biomolecules.

Unit 1 ***Carbohydrates and carbohydrate metabolism*** 12 hrs

Introduction and classification of carbohydrates, Reactions of monosaccharides, disaccharides and polysaccharides – structure and function of sucrose, maltose, lactose starch, glycogen and cellulose. Glycosaminoglycans and glycoproteins (elementary concepts only).

Metabolism of carbohydrates - Glycolysis, TCA cycle, electron transport chain, glycogenesis, glycogenolysis.

Unit 2 ***Lipids and lipid metabolism*** 12 hrs

Definition and classification based on backbone structure. Fatty acids – saturated, unsaturated - essential fatty acids. Phospholipids – structure, occurrence, function of lecithin, cephalin and sphingomyelins. Glycolipids – cerebrosides, galactocerebrosides and gangliosides. Sterols – structure, occurrence and functions of cholesterol and bile acids.

β oxidation of fatty acids.

Unit 3 ***Amino acids, proteins and protein metabolism*** 12 hrs

Structure and classification of amino acids. Reaction of proteins and amino acids, Classification of proteins, plasma proteins and immunoglobulins. Transamination, deamination and urea cycle (elementary concepts only)

Unit 4 ***Nucleic acids and Nucleic acid metabolism*** 12 hrs

Bases, nucleotides, structure of DNA and types of RNA.

Metabolism of purine and pyrimidine nucleotides (degradation pathway only)

Unit 5 ***Enzymes*** 12 hrs

Definition of enzymes, elementary idea of classification (IDBA). Factors influencing enzymes activity pH, temperature, enzyme concentration and

substrate concentration. Enzymes of clinical importance: ALT, AST, LDH, CK.

Total 60 hrs

Course Outcomes:

After completing this course, the student will:

1. Understand the structure and functions of biomolecules in a cell.
2. Relate the properties of biomolecules and their significant role in living systems.
3. Understand the fate of dietary constituents after digestion and absorption.
4. Relate the role distinct metabolic pathways used by cells to harvest the energy.

Text Books:

1. ***Jain J.L., Jain, S and Jain, N.*** (2005),***Fundamentals of Biochemistry,*** 1st ed, S. Chand and Company Ltd, Ram Nagar, New Delhi.
2. ***Satyanarayana, U.***(2009)***Essential of Biochemistry,***4th ed, Books and Allied Pvt. Ltd, New Delhi.
3. ***Khan, M.Y. and Khan, F***. (2015) ***Principles of Enzyme Technology***, PHI Learning.

Reference Books:

1. ***Nelson D. L. and Cox, M. M.***(2013),***Lehninger Principles of Biochemistry,***6th ed, W. H. Freeman and Company, New York.
2. ***Murray, R.K., Bender, D.A., Bootham, K.M., Kennlley, P.J., Rodwell, V.W. and Weil, P.A.***(2012),***Harper's Biochemistry,*** 29th Ed, Tata McGraw Hill Companies Publication, New Delhi.
3. ***Voet, D and Voet, G.*** (2012),**Fundamentals of *Biochemistry,***John Wiley and Sons, New York.

DSE - Clinical Biochemistry

Semester II **Hours of Instruction/week:T+P: 4+3**

18BPAI02 **No. of Credit: T+P: 3+2**

Objectives:

1. To understand and learn the collection of biological samples and preservation
2. To know about the clinical significance of abnormalities in metabolism of carbohydrate, protein and lipid.
3. To learn about the clinical importance of enzymes.

Unit 1 Specimen collection

Blood, urine, feces, cerebrospinal fluid and amniotic fluid.
Preservation of the specimens - anticoagulants and normal values of biochemical parameters. 12

Unit 2 Abnormalities of carbohydrate metabolism

Diabetes mellitus - complications, types and metabolic changes, glucose tolerance test, glycosuria, ketone bodies, ketoacidosis and glycosylated hemoglobin. Fructose and lactose intolerance, galactosemia, lactiacidosis, alcoholism and glycogen storage disease. 12

Unit 3 Abnormalities of Lipid Metabolism

Plasma lipids and lipo proteins, fatty liver, obesity, atherosclerosis, hyper and hypo lipoproteinemia. 12

Unit 4Abnormalities of Protein Metabolism

Plasma proteins and their variations in diseases.
Inborn errors of metabolism - phenyl ketonuria, albinism, alkaptonuria, cystinosis, maple syrup urine disease, gout. 12

Unit 5 Clinical Enzymology

Clinical significance of phosphatases, γ-glutamyltransferase, amylase, lactate dehydrogenase, transminases and creatine phosphokinase. 12

Total 60

PRACTICAL I

Unit 1 Collection of Urine samples Collection of random and 24 hour's urine samples and use of preservatives.	10
Unit 2 Collection of blood samples Collection of blood samples Collection by fingertip and venipuncture Whole blood, Serum, plasma, RBC	10
Unit 3 Routine analysis of urine (Qualitative) Colour, appearance, glucose, proteins, ketone bodies, blood, urinary deposits and bile salts-bilirubin	10
Unit 4 Urine analysis (Quantitative) Estimation of urea, uric acid, creatinine and calcium in urine.	10
Unit 5 Lipid Profile in Serum Estimation of total cholesterol, HDL, LDL, VLDL cholesterol and triglycerides by kit method.	5
Total	45

Course Outcome:

After completing this course, the student will:

1. Familiarize with collection of biological samples and preservation.
2. Clinical significance of metabolic disorder of carbohydrate, protein and lipid.
3. Know the importance of clinical enzymology

Text Books:

1. ***Chatterjee, M.N.*** **(2011).** ***Text Book of Medical Biochemistry,*** Eight Edition, Jaypee Brothers Medical Publishers, New Delhi.
2. ***Chawla, R.*** **(2008).** ***Practical Clinical Biochemistry - Methods and Interpretations,*** Third Edition, Jaypee Brothers Medical Publishers, New Delhi.
3. ***Bhagavan, N.V.*** **(2004).** ***Medical Biochemistry***, Fourth Edition, Academic Press, Calfornia.

References:

1. ***Gaw, A., Murphy, M.J., Cowan, R.A., Rectly, D.S., Stewart, M.J. and Shepherd, J.*** (2008), ***Clinical Biochemistry***, 4th ed,Churchill Livingstone, New Yor
2. ***Gowenlock, A.H., Murray, J.R. and Lauchlan, D.M.*** (2006), ***Practical clinical Biochemistry,*** **6th ed, CBS Butterworth publishers, New Delhi.**
3. ***Nayak, B.*** **(2002),** ***Manipal Manual of Clinical Biochemistry,*** **1st ed, Jay Pee brothers, New Delhi.**