COURSE STRUCTURE

for

B.Sc. (Biochemistry)
(Eight Semester 2020-21)

Programme

Based on

UGC-CBCS System
(As per Ordinance-14A)

STUDY CENTRE FOR BIOCHEMISTRY

AWADHESH PRATAP SINGH UNIVERSITY, REWA (M.P.)

Semester Course

B.Sc. (Hon's) Biochemistry

PROGRAMME OBJECTIVES & STRUCTURE

PO #	PROGRAMME OUTCOME
PO 1	**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and look at our ideas and decisions (intellectual, organizational, and personal) from different Perspectives.
PO 2	**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and Technology.
PO 3	**Social Interaction**: Elicit views of others, mediated is agreements and help reach conclusions in group settings.
PO 4	**Effective Citizenship**: Demonstrate empathetic social concern and equity-centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5	**Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6	**Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO 7	**Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAMME SPECIFIC OUTCOME

PSO #	PROGRAMME SPECIFIC OUTCOME
PSO 1	To gain a functional knowledge of theoretical concepts and experimental aspects of Biochemistry and their applications in the day-to-day life.
PSO 2	To integrate the gained knowledge with various contemporary and evolving areas in biological sciences like Enzymes, Hormones, Vitamins, DNA, RNA, instrumental etc.
PSO 3	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in biological sciences.
PSO 4	Provide opportunities to excel in academics, research or Industry.

Course Outcome (COs)

S.No.	Course Name	Course Code
Semester-I		
	Bio-molecules	**101**
	Course Outcome	
CO1	Understand carbohydrates	
CO2	Understand amino acids	
CO3	Discuss lipids	
CO4	Explain nucleic acids	
CO5	Understand vitamins	
	Inorganic Chemistry-I	**102**
	Course Outcome	
CO1	Understand atomic structure	
CO2	Understand periodicity of elements	
CO3	Discuss ionic bonds	
CO4	Understand covalent bond	

CO 5	Concept of metallic bond and weak chemical forces	
Techniques in Biochemistry		**103**
Course Outcome		
CO1	Explain physical properties of water	
CO2	Discuss chromatography	
CO3	Understand centrifugation	
CO4	Discuss electrophoretic techniques	
CO5	Explain spectroscopy	
English Communication		**104**
Course Outcome		
CO1	To enhance all the four communication skills in the students-- listening, speaking, reading and writing	
CO2	To familiarize the students with the nature and importance of effective communication skills in their professional life	
CO3	To make the students capable of actively participating in various individual/group communications such as group discussion, debate, meeting, presentation etc	
CO4	To enrich the vocabulary of the students to make them efficient communicators	
CO5	To strengthen the Grammar of the students	
Inorganic Chemistry Lab		**105**
Course Outcome		
CO1	Estimation of carbonate and hydroxide present together in mixture	
CO2	Estimation of free alkali present in different soaps/detergents	
CO3	Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution	
CO4	Estimation of oxalic acid and sodium oxalate in a given mixture	
CO5	Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator	

Bio-molecules		**106**
Course Outcome		
CO1	Qualitative analysis of biomolecules	
CO2	Carbohydrates-Molisch, Benedict's, Fehling's, picric acid, Barfoed's, Bial's, Seliwanoff's, osazone tests	
CO3	Proteins- Precipitation reactions of proteins, colour reactions of proteins, colour reactions of amino acids like tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine	
CO4	Colour reactions of proteins- Biuret, xanthoproteic, Millon's	
CO5	Lipids-solubility, acrolein test, Salkowski test, Lieberman-Burchard test	
Semester-II		
Cell Biology		**201**
Course Outcome		
CO1	Understand introduction of cell	
CO2	Understand structure and function of sub-cellular organelles	
CO3	Explain cell fraction techniques	
CO4	Understand cell wall	
CO5	Explain cell cycle and cell division	
Bio-organic Chemistry		**202**
	Course Outcome	
CO1	Discuss Introduction of organic chemistry	
CO2	Explain aliphatic hydrocarbons	
CO3	Discuss alkyl halides and organometallic compounds	
CO4	Understand Amines	
CO5	Understand Stereochemistry	
Biochemical basis of Diseases		**203**
Course Outcome		

CO1	Understand Inborn errors of metabolism	
CO2	Understand disorders of carbohydrate metabolism	
CO3	Explain disorder of lipids	
CO4	Explain disorders of liver and kidney	
CO5	Understand the infectious diseases	
Environmental Science		**204**
	Course Outcome	
CO1	Have knowledge of the Modern fuels and their environmental impact – Methanogenic bacteria	
CO2	Comprehend the Structural and Functional dynamics of microbes, their diversity	
CO3	Have knowledge of treatment of municipal waste and Industrial effluents, Biofertilizers	
CO4	Have basic understanding of Enrichment of ores by microorganisms	
CO5	know about Methanogenesis: methonogenic, acetogenic and fermentive bacteria	
Cell Biology Lab		**205**
	Course Outcome	
CO1	Understand microscope	
CO2	Cytochemical staining of proteins	
CO3	Study of stages of mitosis	
CO4	Study of stages of meiosis	
CO5	Study of cell organelles	
Bio-organic Chemistry Lab		**206**
	Course Outcome	
CO1	Systematic qualitative analysis of the organic compounds	
CO2	Organic preparations: Aspirin from salicylic acid	
CO3	Organic preparation: Benzoic acid from benzaldehyde	
CO4	Organic preparation: p- and m-dinitrobenzene from nitobenzene	

CO5	Qualitative analysis of chlorobenzene	
Biochemical basis of Diseases Lab		**207**
Course Outcome		
CO1	Estimation of blood glucose	
CO2	Estimation of serum cholesterol	
CO3	Estimation of Haemoglobin	
CO4	Estimation of Calcium	
CO5	Gram staining of bacteria and identification of bacteria	
Semester-III		
Human Physiology		**301**
Course Outcome		
CO1	Discuss the Nervous System	
CO2	Discuss Excretory System	
CO3	Understand Body Fluids	
CO4	Understand Endocrine System	
CO5	Understand Digestive System	
Applied Zoology & Animal Behaviour		**302**
Course Outcome		
CO1	Discuss Invertebrates	
CO2	Discuss Chordata	
CO3	Discuss Developmental biology & evolution	
CO4	Explain Origin of life	
CO5	Explain animal behavior & applied zoology	
Biostatistics		**303**
Course Outcome		
CO1	Explain data collection and presentation	
CO2	Discuss sampling schemes	
CO3	Explain collection of data	
CO4	Discuss probability and hypothesis testing	
CO5	Understand Regression and Correlation	

Nutrition Biochemistry		**304**
Course Outcome		
CO 1	Explain concept of food and nutrition	
CO 2	Discuss energy measurement	
CO 3	Explain Diet in Pregnancy & Lactation	
CO 4	Understand Protein energy malnutrition	
CO 5	Understand Planning and preparation of diet in hypertansion	
Human Physiology Lab		**305**
Course Outcome		
CO 1	Preparation of blood smear and differential leucocyte count.	
CO 2	Estimation of Hemoglobin	
CO 3	Estimation of Uric acid	
CO 4	Understand Iron by Wong's method	
CO 5	Understand qualitative analysis of Urine-detection of urea	
Applied Zoology & Animal Behaviour Lab		**306**
Course Outcome		
CO 1	Identify and comment upon spots	
CO 2	Preparation of blood film	
CO 3	Study of LS and TS of different human organs	
CO 4	Study of living animals	
CO 5	Demonstration of different developmental stages of embryo of frog by prepared slides	
Semester-IV		
Biochemistry of Enzymes		**402**
Course Outcome		
CO 1	Explain Enzymes and Classification	
CO 2	Discuss Characterization of Enzymes	
CO 3	Discuss Mechanism and Allosteric Enzymes	

CO 4	Understand Isoenzymes	
CO 5	Understand Applications of Enzymes	
Molecular Biology		**402**
	Course Outcome	
CO1	Discuss basic concepts of genetic information	
CO2	Understand DNA replication	
CO3	Discuss Translation	
CO4	Understand Regulation of gene expression	
CO5	Discuss Mutations	
Research Methodology		**403**
Course Outcome		
CO 1	Explain research methods	
CO 2	Understand Tools in Research	
CO 3	Understand Research Designs	
CO 4	Understand Research Reports	
CO 5	Discuss Bio-Ethics	
Gene and Recombinant DNA Technology		**404**
Course Outcome		
CO 1	Understand Concept of Gene	
CO 2	Discuss Genetic Linkage and Crossing over	
CO 3	Learn Outline of Techniques of Genetic Engineering	
CO 4	Understand Gene Techniques	
CO 5	Discuss Recombinant DNA Technology	
Biochemistry of Enzymes Lab		**405**
Course Outcome		
CO 1	Isolation of urease and demonstration of its activity	
CO 2	Purification of urease	
CO 3	Time course of urease reaction	
CO 4	Determination of initial velocity of salivary amylase	
CO 5	Determination of optimum temperature of salivary amylase	

Molecular Biology Lab		**406**
Course Outcome		
CO 1	Extraction and estimation of DNA from coconut endosperm	
CO 2	Extraction of RNA from spinach leaves and its estimation by Orcinol Method	
CO 3	Determination of absorption maxima of nucleic acids	
CO 4	Extraction of total nucleic acids from plant tissues	
CO 5	Isolation of total RNA from bacteria/yeast	
Semester-V		
Metabolism		**501**
Course Outcome		
CO1	Discuss Biological Oxidation	
CO2	Understand Digestion and absorption of carbohydrates	
CO3	Discuss Digestion, absorption and mobilization of lipids	
CO4	Understand Digestion, absorption and mobilization of proteins and amino acids	
CO5	Discuss Haem Metabolism	
Plant Biochemistry		**502**
Course Outcome		
CO1	Explain Introduction of plant kingdom	
CO2	Understand electron transport system in plants	
CO3	Understand photosynthesis	
CO4	Understand secondary plant metabolites	
CO5	Discuss Nitrogen metabolism	
Bioinformatics		**502**
Course Outcome		
CO1	Discuss Introduction to Bioinformatics	
CO2	Understand Biological databases and data retrieval	
CO3	Understand sequence alignment & phylogeny	
CO4	Understand Genomics	

CO5	Discuss protein sequence, structure prediction and analysis	
Genetic Engineering		**503**
Course Outcome		
CO1	Understand principles of Heredity	
CO2	Understand Genetics of Bacteria and Viruses	
CO3	Understand Linkage, Crossing over	
CO4	Understand Population and Evolutionary Genetics	
CO5	Discuss Chromosomal aberrations	
Metabolism Lab		**505**
	Course Outcome	
CO1	Preparation of acidic and basic buffers	
CO2	Determination of pH	
CO3	Estimation of blood glucose by DNS method	
CO4	Estimation of serum cholesterol	
CO5	Assay of salivary amylase	
Semester-VI		
Microbial Biochemistry		**601**
	Course Outcome	
CO1	Discuss Introduction of Microorganisms	
CO2	Understand Viruses and Bacteriophages	
CO3	Explain Culture Media	
CO4	Understand Microorganisms and Industry	
CO5	Explain Microbial Pathology	
Advance Techniques in Biochemistry		**602**
	Course Outcome	
CO1	Understand Enzyme and Pigments purification methods	
CO2	Understand Methods for protein analysis	
CO3	Explain methods for nucleic acid analysis	
CO4	Explain Cytological techniques	
CO5	Understand Labeling methods	

Microbial Techniques		602
	Course Outcome	
CO1	Discuss development of microbiology	
CO2	Understand microbial nutrition and growth	
CO3	Discuss control of microorganisms by physical and chemical methods	
CO4	Explain bacterial, fungal and algal cell organization and staining	
CO5	Discuss introduction of viruses	
Biology of Infectious Diseases		**603**
	Course Outcome	
CO1	Understand Infectious Diseases	
CO2	Understand Bacterial Diseases	
CO3	Understand Viral Diseases	
CO4	Discuss Parasitic Diseases	
CO5	Explain Fungal Diseases	
Industrial Biochemistry		**603**
	Course Outcome	
CO1	Understand Plant & Pigment	
CO2	Understand Pulp & Paper	
CO3	Explain Cement Industries	
CO4	Discuss Fertilizers	
CO5	Understand Soap and Detergents, Fats, Oil & Wax Soap and Detergents	
Microbial Biochemistry Lab		**605**
Course Outcome		
CO1	Preparation and sterilization of culture media	
CO2	To perform gram staining for identification of bacteria	
CO3	Isolation of microbes from soil and sewage water	
CO4	To prepare growth curve of bacteria	
CO5	To prepare temporary mount of algae	

Semester-VII		
Immunology		**701**
	Course Outcome	
CO1	Discuss Immunity	
CO2	Discuss Antigens and Antibodies	
CO3	Discuss Specificity & activation of immune system	
CO4	Discuss Autoimmunity and hypersensitivity	
CO5	Explain Immunological disorders	
Biochemistry of Hormones		**702**
	Course Outcome	
CO1	Discuss chemical classification of hormones	
CO2	Discuss Pituitary	
CO3	Discuss Thyroid gland	
CO4	Explain Hormones of adrenal gland	
CO5	Explain Hormones in digestion	
Environmental Biochemistry		**702**
	Course Outcome	
CO1	Discuss Environment	
CO2	Discuss Hydrosphere	
CO3	Understand Purification & treatment of water	
CO4	Understand Soil composition	
CO5	Understand Atmosphere	
Biochemistry of Drugs		**703**
Course Outcome		
CO 1	Explain general pharmacology	
CO 2	Discuss Dosage form consideration in preformulation	
CO 3	Mechanism of action of a drug	
CO 4	Understand Drugs in GIT	
CO 5	Understand Chemotherapy	

Immunology Lab		**705**
Course Outcome		
CO 1	Isolation of lymphocytes from blood / spleen	
CO 2	Purification of antibodies of immunoglobulins	
CO 3	Demonstration of antigen antibody interaction or binding reaction	
CO 4	Assays based on agglutination reactions	
CO 5	Enzymes linked immunosorbent assay (ELISA)	
Semester-VIII		
Clinical Biochemistry		**801**
Course Outcome		
CO 1	Understand water and electrolyte balance and imbalance	
CO 2	Discuss functions of liver	
CO 3	Explain clinical significance of enzymes assay	
CO 4	Discuss blood sugar	
CO 5	Understand biochemistry of cancer cells	
Biotechnology		**802**
	Course Outcome	
CO1	Discuss principles of gene cloning	
CO2	Discuss plant genetic engineering	
CO3	Discuss protein engineering	
CO4	Discuss transgenic plants and animals	
CO5	Explain fermentation technology	
Nursing and Hygeine		**802**
Course Outcome		
CO1	Discuss scope and concept of nursing	
CO2	Explain documentation and reporting	
CO3	Explain temperature and pulse	
CO4	Discuss needs of patient	

CO5	Understand Nutrition	
Clinical Biochemistry Lab		**801**
Course Outcome		
CO1	Qualitative and quantitative analysis of Urine	
CO2	Qualitative analysis of abnormal constituents in Urine	
CO3	Pigments, bile salts and ketone bodies	
CO4	Experiments on Blood	
CO5	Gel Electrophoresis of serum proteins	

A.P.S. University, Rewa
B.Sc. (Honors/Research) Biochemistry
Course Structures and Scheme of Examination
(UGC-CBCS System as per ordinance 14A)
2021-22

Semester -I		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
101: Biomolecule	Major	4	2	40	60	40	60
102: Inorganic Chemistry-I	Minor	4	2	40	60	40	60
103: Techniques in Biochemistry	GEC-I	4	NA	40	60	NA	NA
104: English Communication	AEC-I	4	NA	40	60	NA	NA
SEMISTER TOTAL		20		400		200	

Semester -II		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
201:Cell Biology	Major	4	2	40	60	40	60
202: BioorganicChemistry	Minor	4	2	40	60	40	60
203: Biochemical basis of Disease	GEC-II	4	NA	40	60	NA	NA
204: Environmental Science	AEC-II	4	NA	40	60	NA	NA
SEMISTER TOTAL		20		400		200	

A.P.S. University, Rewa
B.Sc. (Honors/Research) Biochemistry
Course Structures and Scheme of Examination
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2022-23

Semester -III		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
301: Human Physiology	Major	4	2	40	60	40	60
302: Applied Zoology and Animal Behavior	Minor	4	2	40	60	40	60
303:Nutritional Biochemistry	GEC-III	4	NA	40	60	NA	NA
304:Biostatices	SEC-I	4	NA	40	60	NA	NA
SEMISTER TOTAL		20		400		200	

Semester -IV		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
401: Biochemistry of Enzyme	Major	4	2	40	60	40	60
402: Molecular Biology	Minor	4	2	40	60	40	60
403: Gene and Recombinant DNA Technology	GEC-IV	4	NA	40	60	NA	NA
404: Research Methodology	SEC-II	4	NA	40	60	NA	NA
SEMISTER TOTAL		20		400		200	

B.Sc. (Honors/Research) Biochemistry
Course Structures and Scheme of Examination
(UGC-CBCS System as per ordinance 14A)
2023-24

Semester -V		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
501: Metabolism	Major	4	2	40	60	40	60
502: Plant Biochemistry Or Bioinformatics	DSE-I	4	NA	40	60	NA	NA
503: Genetic Engineering	SEC-III	4	NA	40	60	NA	NA
504: Field Project/Internship/Apprenticeship	FP/IS/AS	4	2	NA	NA	40	60
SEMISTER TOTAL		20		400		200	

Semester -VI		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
601: Microbial Biochemistry	Major	4	2	40	60	40	60
602: Advance Techniques in Biochemistry Or Microbial Techniques	DSE-II	4	NA	40	60	NA	NA
603: Biology of Infectious disease Or Industrial Chemistry	DSE-III	4	NA	40	60	NA	NA
604: Field Project/Internship/Apprentices hip	FP/IS/AS	6	NA	NA	NA	40	60
SEMISTER TOTAL		20		400		200	

B.Sc. (Honors/Research) Biochemistry
Course Structures and Scheme of Examination
(UGC-CBCS System as per ordinance 14A)
2024-25

Semester -VII		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
701: Immunology	Major	4	2	40	60	40	60
702: Biochemistry of Hormones Or Environmental Biochemistry	DSE-IV	4	NA	40	60	NA	NA
703: Biochemistry of Drug	Minor	4	NA	40	60	NA	NA
704: Field Project/Internship/Apprenticeship/Research Project	FP/IS/AS	4	2	NA	NA	40	60
SEMISTER TOTAL		20		400		200	

Semester -VIII		Credits Allocated		Distribution of Theory Marks		Distribution of Practical marks	
	Course type	Theory	Practical	Internal (Through CCE)	External (End Semester Exam)	Internal	External (End semester Practical Examination)
801:Clinical Biochemistry	Major	4	2	40	60	40	60
802:Biotechnology Or Nursing and Hygiene	DSE-V	4	NA	40	60	NA	NA
803:Dissertation	Minor	4	NA	40	60	NA	NA
804: Field Project/Internship/Apprenticeship/Research Project	FP/IS/AS	4	2	NA	NA	40	60
SEMISTER TOTAL		20		400		200	

Subject I
Major
Semester-I
Core
Bio-molecules

Course Objective

- Exposure with the nature of various biomolecules present in living cells.
- Get exposed to key contributions of scientists such as Hans Kreb, G. N. Ramachandran, Melvin Calvin, Louis Pasteur, HarGobind Khorana, Watson and Crick and Venky Ramakrishnan, etc.in order to create scientific interest amongst students in life processes.
- To understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems.
- To understand the process of fermentation and manufacture of Biodiesel.
- To develop skills to determine amino acid and nucleotide sequences of proteins and DNA respectively.

Unit-1: Carbohydrates

Definition, empirical formulae, classification, biological importance. Monosaccharide: Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, phenyl hydrazine reaction. Inter-conversion of aldoses and ketoses. Isomerism in monosaccharides, (+) and (-), D and L, epimers, anomers, and stereoisomers. Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acid.

Disaccharides: Establishment of structures of sucrose and lactose, biological importance and structure of isomaltose, trehalose and maltose.

Polysaccharides: Partial structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitin, and pectin.

Glycosaminoglycans: Occurrence, importance and the structure, Bacterial cell wall polysaccharide, peptidoglycans.

Unit-2: Amino acids

Structure and classification of amino acids based on polarity. Reactions of the amino groups due to amino and carboxylic group, Zwitterionic properties. Peptides: Peptide bond, biologically active peptides.

Proteins: Classification of proteins based on solubility, structure and functions with examples. Primary Structure of proteins, methods of determining N- and C- terminal aminoacids, amino acid composition. Sequencing by Edman's degradation method. Secondary Structure-α Helix. β-sheet, β-bend. Tertiary of myoglobin and quaternary structure of hemoglobin, denaturation and renaturation of proteins.

Unit-3: Lipids

Classification and biological role. Fatty acids- Nomenclature of saturated and unsaturated fatty acids. Physiological properties of fatty acids.

Acylglycerols: Mono, di and triglycerols. Saponification, saponification value, iodine value, acid value and significance.

Phosphoglycerides: Structure of lecithin, cephalins, phosphotidylinosital, plasmalogens, and cardiolipin. Biological role of phosphoglycerides.

Sphingolipids: Structure and importance of sphingomyelin. Glycosphingolipids: Structure and importance of gangliosides and cerebrosides.

Unit-4: Nucleic acids

DNA: Composition of DNA. Nucleosides and nucleotides. Chargaff's rule. Watson and Crick model of DNA. Types of DNA.

RNA: Composition, types (mRNA, tRNA and rRNA), secondary structures of tRNA-clover leaf model. Chemical reactions of RNA and DNA with acid and alkali, colour reactions of DNA and RNA.

Unit-5: Vitamins

Introduction and biological significance of vitamins, Water soluble vitamins, their occurrence, functions, structure, diseases, Fat soluble vitamins, their occurrence, functions, structure, diseases.

Recommended Books/References:

1. A.L., Lehninger, principles of biochemistry (1982), Worth Publishers, Inc. New York.
2. E.E. Conn and P.K. Stumpf. Outlines of Biochemistry (1976) Wiley Eastern, New Delhi.
3. Biochemistry by L. Stryer (1995) W.H. Freeman Press, San Francisco, USA.
4. Biochemistry, by Voet, D. and Voet, J.G. (2004). 3rd Edition, John Wiley & Sons, Inc. USA.

Course outcomes

- Students will be exposed to the history of Biochemistry and key contributions of scientists such as Hans Kreb, G. N. Ramachandran, Melvin Calvin, Louis Pasteur, Hargobind Khorana, Watson and Crick and Venky Ramakrishnan.
- They will study the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolysis and their importance in biological systems.
- They will understand the process of fermentation and manufacture of Biodiesel.
- They will understand the methods of determination of amino acid and nucleotide sequence of proteins and DNA respectively.

Semester - I
Subject I
Practical

Course Objective

- Exposure to basic reactions of biomolecules.
- Determine presence of biomolecules like carbohydrates, proteins, lipids, etc. in known and unknown samples.
- Determine the extent of adulteration in samples containing biomolecules.

Practical content

1. Qualitative analysis of biomolecules
2. Carbohydrates-Molisch, Benedict's, Fehling's, picric acid, Barfoed's, Bial's, Seliwanoff's, osazone tests.
3. Glucose, fructose, lactose, maltose and sucrose.
4. Proteins- Precipitation reactions of proteins, colour reactions of proteins, colour reactions of amino acids like tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine.
5. Colour reactions of proteins- Biuret, xanthoproteic, Millon's.
6. Lipids-solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
7. Qualitative tests for nucleic acid.

Course outcomes

- The student will gain awareness about basic reactions of biomolecules and their utility in identification of adulterants.
- The student will known Glucose, fructose, lactose, maltose and sucrose.
- Student will gain the skill of qualitative tests for nucleic acid and other biomolecules

Subject II
Minor
Semester I
Inorganic Chemistry-I

COURSE OBJECTIVES

On completion of this course, the students will be able to understand:

- Atomic theory and its evolution.
- Elements in periodic table; physical and chemical characteristics, periodicity.
- Identity of given element, relative size, charges of proton, neutron and electrons and their assembly to form different atoms.
- Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in periodic table.
- Characterize bonding between atoms, molecules, interaction and energetic, hybridization and shapes of atomic, molecular orbitals, bond parameters, bond-distances and energies.
- Valence bond theory incorporating concepts of hybridization predicting geometry of molecules.
- Importance of hydrogen bonding, metallic bonding.

Unit-1: Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de' Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Unit-2: Periodicity of Elements

s, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block.

Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. Atomic radii (van'der Waals), Ionic and crystal radii. Covalent radii (octahedral and tetrahedral), Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling,

Mullikan, electronegativity and bond order, partial charge, hybridization, group electronegativity.

Unit-3: Ionic Bonding

General characteristics, definition of ionic bonds, examples, formation of ionic bond, strength of ionic bonds, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation, expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Unit-4: Covalent bond

Lewis structure, Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, sigma and pi-bond approach, Valence Bond theory, (Heitler-London approach). Hybridization containing s, p and s, p, d atomic orbitals, shapes of hybrid orbitals, Bents rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of simple homonuclear and heteronuclear diatomic molecules, MO diagrams of simple tri and tetra-atomic molecules, e.g., N_2, O_2, CO, NO, and their ions; HCl, BeF_2, CO_2, Covalent character in ionic compounds, polarizing power and polarizability. Fajan rules, polarization. Ionic character in covalent compounds: Bond moment and dipole moment.

Unit-5: Metallic bonding and Weak chemical forces

Metallic Bond: Definition of metallic bond, properties and examples of metallic bonds, qualitative idea of free electron model, Semiconductors, Insulators.

Weak Chemical Forces: van'der Waals, ion-dipole, dipole-dipole, induced dipole dipole-induced dipole interactions, Lenard-Jones 6-12 formula, hydrogen bond, effects of hydrogen bonding on melting and boiling points, solubility, dissolution, intermolecular and intramolecular hydrogen bonding.

Recommended Books/References:

1. J. D. Lee, *Concise Inorganic Chemistry,* Wiley, 5th Edn.
2. B. E. Douglas, D. H. McDaniel, J. J. Alexander, *Concepts & Models of Inorganic Chemistry, (Third Edition)* John Wiley & Sons,1999.
3. P. W. Atkins, J. DePaula, *Physical Chemistry*, Tenth Edition, Oxford University Press, 2014.
4. G. E. Rodger, *Inorganic and Solid State Chemistry*, Cengage Learning, 2002.
5. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.

COURSE OUTCOMES

The students will be able to

- know the concept of wave function and wave mechanics.
- know the physical and chemical properties of elements in various groups and periods in the Periodic Table.
- Demonstrate and understanding of VSEPR theory

- To predict the atomic structure, chemical bonding and molecular geometry based on accepted models.
- To understand atomic theory of matter, composition of atom.
- Get knowledge about importance of metallic bonding and weak chemical forces.

Subject II
Semester I
Practical

COURSE OBJECTIVES

- The students will learn
- The basics of estimation of carbonate and free alkali
- Oxidation-reduction titrimetry

Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Recommended Books/References:

1. J. Mendham, A. I. Vogel's *Quantitative Chemical Analysis* Sixth Edition, Pearson, 2009.
2. G. Svehala, I. B. Sivasankar, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

COURSE OUTCOMES

The students will be able to

- Estimate cations and free alkali
- Estimate the Fe(II) and oxalic acids

Subject III
Generic Elective Course
Semester - I
Biochemical Techniques

Course Objective

- Develop competence in handing various chromatographic techniques and apply them in isolating and characterizing different biological molecules.
- Understanding the applications of centrifugation and chromatography in biological investigations.
- Purify proteins by affinity chromatography using epitope tags such as histidine tag, GST tag, Flag tag etc.
- Understanding the principles of Electrophoresis, Spectrophotometry and ELISA and their applications in biological investigations/experiments.

Unit-1: Physical properties of water

Physical properties and structure of water, hydrogen bonding, ionization of water, pH scale, cocept of acid-bases and buffers, behavior of amino acids and proteins, Handerson-Haselbalch equation, Biological buffering system, Principle of osmosis, Electroendosmosis, Donan-membrane equilibrium & its biological applications.

Unit-2: Chromatography

Principles of partition chromatography; paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography.

Unit-3: Centrifugation

Principles of centrifugation, concepts of RCF, preparative, differential and density gradient centrifugation, ultra-centrifugation, subcellular fractionation.

Unit-4: Electrophoretic techniques

Principles of electrophoretic separation. Different types of electrophoresis including paper, cellulose acetate/nitrate and gel. PAGE and SDS-PAGE.

Unit-5: Spectroscopy

Concepts of spectroscopy, Visible and UV spectroscopy, Beer- Lambert's law, Principles and applications of colorimetry.

Electron microscopy-Transmission and scanning, freeze fracture techniques, specific staining of biological materials.

Recommended Books/References:

1. Wilson K. and Walker J., Principles and Techniques ofBiochemistry and Molecular Biology, 7thed., Cambridge University Press, 2010.
2. Boyer, R.F., Biochemistry Laboratory: Modern Theory and Techniques, 6thed., Boston, Mass: Prentice Hall, 2012.
3. Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), 1998.

Course outcomes

- Students will learn about the principle and applications of spectrophotometry, different chromatographic techniques like gel filtration, Ion exchange, thin layer, etc.
- Students will also learn about various electrophoresis techniques such as cellulose acetate, gel, PAGE, etc. and their applications in analyzing proteins and nucleic acids.
- Students will learn the basic principles of centrifugation, various types of centrifuges, rotors and methods for sub cellular fractionation.
- They will also learn the principles of electron microscopy more especially of SEM and TEM and their applications in characterizing biological samples.

Semester - I
Practical
Biochemical Techniques

Course Objective

- The students will obtain hands-on training in basic separation techniques in biochemistry like electrophoresis, chromatography, etc.
- Gain expertise in the isolation of various biomolecules and organelles.

Course content

1. Verification of Beer's Law
2. Determination of absorption maxima (λmax) of proteins and nucleic acids
3. Determination of protein concentration using UV-Vis spectrophotometer
4. Fractionation of sub cellular organelles from leaves using differential centrifugation
5. Separation of amino acid acids/sugars by thin layer/paper chromatography
6. Separation of proteins by gel filtration chromatography
7. Separation of nucleic acids using agarose gel electrophoresis
8. Separation of proteins by PAGE and SDS-PAGE.

Course outcomes

Students will acquire practical training to handle the instruments like colorimeter, spectrophotometer and to use them for biochemical determinations.

Using the techniques of paper/thin layer chromatography, students will be able to separate amino acids, sugars.

They will acquire practical skill to separate proteins by gel filtration and PAGE.

Subject I
Major
Semester - II
Cell Biology
Core

Course Objective

- Students will learn about cell theory and techniques for fractionation of sub-cellular organelles.
- They will be acquainted to various microscopic techniques to visualize subcellular organelles.
- Students will have an understanding of the composition of cytoskeleton and extracellular matrix.
- Students will acquire knowledge of cell cycle, cell division and cell death mechanisms.

Unit-1: Introduction of Cell
Origin of life, Cell theory, Structure of prokaryotic and eukaryotic cell. Differences in Animal and Plant cell. Mycoplasma, viruses, viroids, prions.

Unit-2: Structure and function of subcellular organelles
Composition ofbiological membranes. Nucleus: Structure of nuclear envelope, nuclear pore complex nucleolus and chromatin. Endoplasmic Reticulum: RER - Brief overview of co-translational and post-translational transport of proteins; SER – Lipid synthesis, brief overview of export of proteins from ER; Golgi apparatus: organization, brief overview of glycosylation of proteins within Golgi, lipid and polysaccharide metabolism in Golgi apparatus.

Unit-3: Cell Fractionation techniques
Centrifugation, Sedimentation Coefficient, Differential and Density Gradient (isopycnic and rate zonal) centrifugation. Cell Visualization techniques: Principle of Light microscope, Phase Contrast microscope, Fluorescence microscope, Confocal microscope and Electron microscope; Staining techniques for microscopy studies. Principles of identification of sub cellular organelles.

Unit-4: Lysosomes
Different forms of lysosomes, role in cellular digestion, lysosomal storage diseases.

Peroxisomes: assembly, functions, glyoxysomes.

Mitochondria: structure, endosymbiont theory, genome,

Chloroplast: Structure, function, organization

Cell Wall: Structure of prokaryotic and eukaryotic cell wall; ECM components– proteins, polysaccharides and adhesion proteins; concept of anchoring junctions, tight junctions and communication junctions (gap junctions and plasmodesmata).

Cytoskeleton. Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies). Microfilaments: Actin and Myosin Filaments. Role of cytoskeletal elements in the entry of infectious agents

Unit-5: Cell Cycle and Cell Division
(mitosis and meiosis); Apoptosis and necrosis; Types and potency of Stem Cells, Cancer-types, salient features of a transformed cell, causes of cancer. Apoptotic death in relation to cell cycle.

Recommended Books/References:

1. The Cell: A Molecular Approach (2013) 6th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0- 87893-300- 6.
2. Cell and Molecular Biology: Concepts and Experiments. (2010). Karp, G., 6th ed. John Wiley and Sons. Inc. ISBN: 978-1-118-65322-7
3. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.
4. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company.
5. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, D.L. and Cox, M.M.
6. W.H. Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10- 1464126119.
7. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.

Course Outcomes

- This course will provide an understanding of the structure of cell and function of various sub cellular organelles.
- Students will learn about cell theory, basic cell structure, cell fractionation and cell visualization techniques. Besides, students will have an understanding of the composition of cytoskeleton and extracellular matrix.
- Students will acquire knowledge of cell cycle, cell division and cell death mechanisms.

Semester-II
Practical
Cell Biology

Course objectives

- Students will learn the handling of microscope.
- Obtain hands-on training in basic separation techniques in biochemistry
- Gain expertise in the isolation of various cell organelles and staining of cellular biomolecules.

Course Content:

1. To study different parts of microscope
2. Cytochemical staining of proteins by Methylene blue
3. Cytochemical staining of polysaccharides by PAS
4. Cytochemical staining of RNA by Methyl Green
5. Study of stages of Mitosis
6. Study of stages of Meiosis
7. To study cell organelles
8. To study the effect of isotonic, hypotonic and hypertonic solutions on cells

Course outcomes:

- Students will learn the handling of microscope.
- They will gain knowledge about the structure and function of various cell organelles.
- The students will obtain hands-on training in basic separation techniques in biochemistry and gain expertise in the isolation of various cell organelles and staining of cellular biomolecules.

Subject II
Minor
Semester II
Bioorganic Chemistry

Course objectives

- Understand the significance of organic reactions with reference to biological systems.
- Apply the principles of electrochemistry to conductance, voltaic, and electrolytic systems.
- Understanding chemical bonding, strong and weak interactions, hydrogen bondingand to apply these principles in various biomolecules and biological reactions.
- To develop understanding of aliphatic and aromatic compounds, IUPAC nomenclature, reactivity of functional groups and the importance of stereoisomersin biological systems.
- Understanding the formation of polymers and their importance; difference between biodegradable and non-biodegradable polymers and biohazards of polymers.
- Apply concept of stereochemistry in determining conformations of biomolecules.

UNIT I: Introduction to organic chemistry

Classification of organic compounds, unique characteristics, IUPAC nomenclature of organic compounds (including bi-functional) and
biomolecules.

Reaction mechanisms: Concept of inductive effect, resonance and hyperconjugation. Classification of organic reactions (substitution, addition, elimination and rearrangement), with two examples for each. Concepts of the following-carbanions, carbocations, free radicals, carbenes, nucleophiles and electrophiles (Formation and Stability).

UNIT II: Aliphatic hydrocarbons

Mechanism of Markownikoff and anti-Markownikoff addition. Addition of HBr to propene. Dienes-types with examples, 1,3 butadiene-Preparation, stability and mechanism of addition of HBr. Diels-Alder reaction. Conformational analysis of ethane.

Cycloalkanes: Reactivity and relative stability. Bayer's strain theory. Sachse-Mohr theory. Boat and chair forms of cyclohexanes. Axial and equatorial bonds and their relation with biological activities of carbohydrates.

Arenes: Structure of benzene by resonance and molecular orbital theories. Aromaticity.

Mechanism of Nitration and Friedel craft reaction. Electronic interpretation of the orientating influence of substituents in the electrophilic substitution of toluene, chlorobenzene, nitrobenzene and phenol. Resonance structures of naphthalene and anthracene.

UNIT III: Alkyl halides and organomatellic compounds

SN1 and SN2 reaction, their mechanism with one example for each. Concept of elimination reactions, Applications of organometallic compounds-organo lead, organo lithium, cis-platin.

Alcohols: Definition, classification, monohydric alcohols-distinguishing reactions for primary, secondary and tertiary alcohols. Dihydric alcohols: Glycol, preparation (any 2 methods) and uses. Trihydric alcohols: Glycerol, synthesis from propene, properties, (reaction with conc. H_2SO_4, HNO_3, Oxalic acid and HI). Phenols: Acidity of phenols, effect of substituent on acidity.

Hydroxy acids and dicarboxylic acids: Structure & properties ofhydroxy acids: Lactic acid, citric acid and isocitric acid. Dicarboxylic acid: Maleic and fumaric acid. Ketoacids: Pyruvic, α-ketoglutaric, oxalo acetic acids.

UNIT IV: Amines

Classification, properties, functional amino group-Basicity of amines, acylation. React with HNO_2& Schiff's base formation. Distinguishing reactions of primary, secondary and tertiary amines.

Heterocyclic compounds: Definition, classification with examples, structure and biological importance of furan, pyrrole, thiophene, pyridine, pyran, thiazole, pyrimidine, purine, indole, imidazole, quinoline and isoquinoline. Basicity of pyrrole and pyridine.

Terpenes: Definition, isoprene rule, classification, isolation, structure and biological importance of menthol, camphor, farnesol, phytol, lanosterol, lycopene and dolichols.

Steroids: Basic ring structure in steroids. Structure and biological importance of cholesterol, phytosterols and ergosterol. Bile acids (Mono, Di & Tri cholic acids).

Alkaloids: Definition, classification based on their structure and biological functions, isolation, structure and biological action of morphine, nicotine & atropine. Chemical synthesis of nicotine and atropine.

UNIT V: Stereochemistry

Stereoisomerism, types, Fischer-projection formulae, chiral carbon atom, asymmetry and dissymmetry, chirality, conditions for optical isomerism ex: glyceraldehyde, lactic acid, tartaric acid, Nomenclature of enantiomers, diastereomers. D and L notation, R and S system, racemisation and resolution (Biochemical, chemical and physical methods). Geometrical isomerism.

Recommended Books/References:

1. ArunbBahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand. (2019)
2. L. Finar:*Organic Chemistry* (Vol. I & II), E. L. B. S. (2002)
3. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall. (2011)

Course outcomes

- On completion of this course, students will understand the significance of organic reactions with reference to biological systems, chemical bonding in various biomolecules, strong and weak interactions.
- They will gain a good understanding of aliphatic and aromatic compounds, IUPAC nomenclature, reactivity of functional groups and the importance of stereoisomers in biological systems.
- Students will understand the formation of polymers and their importance; difference between biodegradable and non-biodegradable polymers and biohazards of polymers

Subject II
Minor
Practical
Bioorganic Chemistry

Course objective

- Analyse common organic reagents and compounds based on their properties.
- Analyse organic compounds from unknown mixture/origin.
- Apply the properties of functional groups of organic compounds to carry out selective organic reactions.
- Verify reactivity of organic functional groups.
- Develop skills to prepare useful organic compounds in the laboratory.

Practical content:

Systematic qualitative analysis of the organic compounds:
Urea, benzamide, benzaldehyde, aniline, acetophenone, m-cresol, nitrobenzene, chlorobenzene, naphthalene, *p*-toluidine, benzoic acid, salicylic acid, resorcinol, benzyl alcohol and *p*-dichoro benzene.

Organic preparations: Aspirin from salicylic acid, benzoic acid from benzaldehyde, *p*-bromo acetanilide from acetanilide and meta-dinitrobezene from nitrobenzene.

Course outcomes:

- Students will analyze the properties of common organic reagents and compounds, carry out
- Selective reactions of organic functional groups and verify reactivity of organic functional groups.

Subject III
Generic Elective Course
Semester - II
Biochemical basis of Diseases

Course objectives

- To know the Students will get acquainted with various types of human diseases and their biochemical basis.
- Student knows about disorders due to improper dietary constituents. Therefore students will get curiosity to have balanced diets to prevent many nutritional disorders/diseases.
- They will acquire a good understanding of biochemical basis of diseases related to inherited metabolic disorders, digestive and infectious diseases.
- They will learn microbial diseases and pathogencity along with protection.

Unit-1: Inborn Errors of Metabolism

Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia.

Unit-2: Disorders of Carbohydrate Metabolism

Diabetes mellitus, glycogen storage diseases, pentosuria, galactosemia.

Unit-3: Disorders of Lipids

Hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.

Digestive diseases: Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea.

Unit-4: Disorders of liver and kidney

Jaundice, fatty liver, hepatitis

Haemorrhagic disorders: Haemophilia, Anaemias, thrombotic thrombocytopenic purpura (TTP).

Unit-5: Infectious diseases

Bacterial infections: Tetanus, Diphtheria, Tuberculosis, Typhoid, Cholera. Viral infection: Polio, Measles, Mumps, influenza, HIV. Protozoan: Malaria and Trypanosomiasis. Parasitic infection: Leishmaniasis.

Recommended Books/References:

1. Biochemistry (2013) 4th edn., Voet, D., Voet, J. & Pratt, C. Wiley & Sons, Inc. (New Jersey), ISBN:978-1-11809244-6.
2. Biochemistry (2012) 7th edn., Berg, J.M., Tymoczko, J. L. and Stryer, L., W.H Freeman and Company (New York)
3. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York)
4. Klein's Microbiology, (2008) 7 ed., Prescott, Harley, Wiley, J.M. Sherwood,
5. L.M. Woolverton, C.J. McGraw Hill International Edition (New York) ISBN: 978-007- 126727.

Course outcomes

- Students will get acquainted with various types of human diseases and their biochemical basis.
- They will know about disorders due to improper dietary constituents. Therefore students will get curiosity to have balanced diets to prevent many nutritional disorders/diseases.
- Students will acquire a good understanding of biochemical basis of diseases related to inherited metabolic disorders, digestive and infectious diseases.
- They will learn pathogenicity and prevention measures for microbial diseases.

Generic Elective Course
Practical
Biochemical Basis of Diseases
Semester-II

Course Objectives

- Students will acquire practical training for estimation of clinically important compounds.
- The students to perform diagnostic tests for the various diseases related to varying levels of these compounds/chemicals/ biomolecules
- They will be updated with routine checkup parameters such as blood pressure, BMI, Waist/Hip Ratio, Mid Arm Area (MAA) for a normal or diseased person.

Practical content:

1. Estimation of blood glucose
2. Estimation of serum cholesterol
3. Measurement of blood pressure, BMI, Waist/Hip Ratio, Mid Arm Area (MAA).
4. Estimation of Haemoglobin
5. Estimation of calcium
6. Gram staining of bacteria and identification of bacteria

Course outcomes:

- Students will acquire practical training for estimation of clinically important compounds like blood glucose, serum cholesterol, hemoglobin, calcium, etc.
- This will enable the students to perform diagnostic tests for the diseases related to varying levels of these compounds/chemicals.
- They will also get acquainted with routine checkup parameters such as blood pressure, BMI, Waist/Hip Ratio, Mid Arm Area (MAA) for a normal or diseased person.

Subject I
Semester III
Major
301: Human Physiology

Course objectives :

- To enable students to go through human anatomy and structures of various organs
- To provide them complete functioning of organ systems such as kidney, liver, blood, nervous system and muscles.
- To give knowledge of various hormones and the role of second messengers in signal transduction. The process of gaseousexchange in tissues and lungs, respiratory adaption to high altitude and the difference betweenhemoglobin and myoglobin will be explained.
- Students will gain awareness on musculardystrophies, the role of steroids in muscle building and the use of hormones in cattle and poultryindustry. Role of kidneyin erythropoiesis will be explained.

Unit – I: Blood

Composition and functions of Blood, Types of blood cells and their formation, PlasmaProteins: Properties and functions, Coagulation of Blood, Hemoglobin, Transport of oxygen andcarbon dioxide.

Unit – II: Digestive System

Physiology of Gastrointestinal Tract (GIT), Saliva, Mouth, Oesophagus, Stomach,Pancreas, Liver, Gall Bladder, Intestine, Digestion and absorption of food.

Unit – III: Excretory System

Physiology and Anatomy of Kidney, Structure of Nephron, Types of Nephron,Mechanism of formation of urine, Urea Cycle, Renal regulation of acids & bases, Countercurrenttheory.

Unit – IV: Nervous System

Structure, types and functions of Neurons, properties of Nerve fibers, Saltatoryconduction, Na-K Pump, Synaptic transmission.

Structure, Types and Functions of Muscles, Structure of a Muscle fiber, MuscleContraction Theories, Muscle Proteins, Role of Ca++ in Muscle contraction.

Unit – V: Hormones

Introduction, Mechanism of action of hormones, Pituitary hormones, Thyroid Hormones,Paratharmone, Pancreatic Hormones, Adrenal Hormones, Gonadial Hormones.

Suggested Readings:

- Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.
- Concise Medical Physiology – Choudhury – New Central Book Agency – Calcutta.
- TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.
- Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
- Textbook of Medical Physiology: A. C. Gyton, and J. E HallSaunders Elsevier Publications, A division of Reed Elsevier India Pvt .Ltd.New Delhi ISBN 81-8147-084-2
- Human physiology: Chatterjee, Medical Allied Agency.

Course outcome :

- Students to go through human anatomy and structures of various organs
- To provide them complete functioning of organ systems such as kidney, liver, blood, nervous system and muscles.
- To give knowledge of various hormones and the role of second messengers in signal transduction. The process of gaseousexchange in tissues and lungs, respiratory adaption to high altitude and the difference betweenhemoglobin and myoglobin will be explained.
- Students will gain awareness on musculardystrophies, the role of steroids in muscle building and growth. Role of kidneyin homeostasis will be explained.

Subject I
Semester III
301: Human Physiology
Practical

Course objectives :

- Students willto go through human anatomy and structures of various organs.
- They will understand complete functioning of organ systems such as kidney, liver, blood, nervous system and muscles.
- They gain knowledge of various biochemical parameters and their investigations to observe normal and abnormal changes and to learn how to diagnose diseases on biochemical basis.
- To learn the process of gaseousexchange in tissues and lungs, role of hemoglobin, the difference betweenhemoglobin and myoglobin will be explained.
- Students will gain awareness on various musculardisorders, the role of steroids in muscle building and the use of hormones in various diseases. Role of kidneyin erythropoiesis will be explained.

Practical content :

- Preparation of blood smear and differential leucocyte count.
- RBC and WBC counting, Calculation of blood Indices.
- Estimation of hemoglobin
- Colorimetric estimation of Protein by Lowry's method.
- Estimation of Uric acid.
- Urea by DAMO method.
- Creatinine by Jaffe's method.
- Phosphorous by Fiske and Subbarow's method.
- Iron by Wong's method.
- Qualitative analysis of urine - detection of urea, uric acid and creatinine.

Course outcomes :

- Students will understand human anatomy and structures of various organs.
- They will understand complete functioning of organ systems such as kidney, liver, blood, nervous system and muscles.
- They gain knowledge of various biochemical parameters and their investigations to observe normal and abnormal changes and to learn how to diagnose diseases on biochemical basis.
- To learn the process of gaseousexchange in tissues and lungs, role of hemoglobin, the difference betweenhemoglobin and myoglobin will be explained.
- Students will gain awareness on various musculardisorders, the role of steroids in muscle building and the use of hormones in various diseases. Role of kidneyin erythropoiesis will be explained.

24/11/22

Subject II
Semester III
Minor
302: Applied Zoology & Animal Behaviour

Course objectives :

- Student will know about the Fundamentals concept of Animal behavior
- An introduction to Wildlife Biology and environmental existence.
- Student will know about the animal diversity with different principle
- Student will know about Environmental correlation and animal diversity
- Animal conservation tools and law related to protection.
- Student will know about the vertebrate and non vertebrate
- Student will know about the Fundamentals of Conservation Biology

Unit – I: Invertebrates

General characteristics and outline classification of non-chordates according to Parkerandaswell (revised by Marshall and Williams). Type Studies: Protozoa (Paramaecium),Porifera (Sycon), Coelentrata (Obelia), Helminthes (Liver Fluke), Annelida (Earthworm),Arthropoda (Prawn), Mollusca (Pila) and Echinodermata (Star Fish).

Unit – II: Chordata

General characteristics and outline classification of Chordates according to Parker andHaswell (revised by Marshall and Williams). Type Studies: Hemichordata (Balanglosus),Urochordata (Herdmania), Cephalochordata (Amphioxus), Pisces (Scoliodon), Amphibia (Frog),Reptilia (Uromastix), Aves (Pigeon) and Mammalia (Rabbit).

Unit – III: Developmental biology & Evolution

Gametogenesis: Spermatogenesis and oogenesis, Placentation in mammals, Fertilization,Types of eggs, Patterns of Cleavage, Blastulation and gastrulation in Frog and Chick up toformation of germinal layers., Fate Maps, Organizer concept.

Unit – IV: Origin of life

Theories of Evolution (Lamarckism, Darwin and Neo Darwin). Population concept:Characteristics of population, Population growth and factors affecting population, population
control.

Unit – V: Animal behaviour& Applied zoology

General introduction to Ethology, Innate and Learned behavior (Instinct, Imprinting andmotivation), Social Behaviour (Insect and Primates), Neural and Hormonal control of behaviour.

Biological Clocks (Circadian and Circanual Rhythm), Communication, Perception ofenvironment (Audio and Visual). Aquaculture (Prawn & Fish), Lac culture, Sericulture, Apiculture.

Suggested Readings:

- Life: Origin, Evolution and Adaptation by S. Chattopadhyay (Books & Allied Pub.)
- Animal Ecology and distribution of animals – V. B. Rastogi & M. S. Jayaraj

- An introduction to Wildlife Biology: Indian perspective – G. K. Saha& S. Majumder (PHI)
- An introduction to Behavioural Ecology – J. R. Krebs & N. B. Davies (Blackwell Scientific)
- Zoogeography by P. J. Darlington publication
- Animal Behaviour by D. McFarland publication
- An introduction to Animal Behaviour – A. Manning & M. S. Dawkins (Science)
- Animal Behaviour by L. Drickamar& S. H. Vessey McGraw Hill, publication
- Animal Behaviourby R. Mathur Rastogi publication.
- Fundamentals of Conservation Biology – M. L. Hunter, J. James & P. Gibbs (John Willey & Sons)

Course outcomes :

- The Student gain knowledge about the basic concept of Animal behaviour.
- They will be introduced to Wildlife Biology and environmental existence.
- Student will know about the animal diversity with different principle
- Student will know about Environmental correlation and animal diversity
- Animal conservation tools and law related to protection.
- Student will know about the vertebrates and non vertebrates.
- They will know about the Fundamentals of Conservation ecology.

Subject II
Semester III
302:Applied Zoology & Animal Behaviour
Practical

Course objectives :

- To know about intricate structures and salient features of various organisms.
- The student will learn to prepare stained slides of different organs and parasites.
- Student will observe thedifference between L.S. and T.S. sections by watching various slides.
- They will know about various developmental stages of embryo.
- The students will have thorough knowledge of cell division process since first to last stages.

Practical content :

- Identify and comment upon spots.
- Preparation of blood film (Leishmen's stain) prepared slides showing the parasites.
- Study of T.S. and L.S. of different human organs (Prepared slides).
- Comparative examination of mitosis and meiosis in an animal cell by using prepared slides.
- Study of living animals – Amoeba, Paramecium, Euglena, Hydra, Starfish, Octopus.
- Demonstration of different developmental stages of embryo of frog by prepared slides.

Course outcomes :

- To know about intricate structures and salient features of various organisms.
- The student will learn to prepare stained slides of different organs and parasites.
- Student will observe thedifference between L.S. and T.S. sections by watching various slides.
- They will know about various developmental stages of embryo.
- The students will have thorough knowledge of cell division process since first to last stages.

24/11/22

Subject III
Semester III
Skill Enhancement Elective Course (SEC – I)
303: Biostatistics

Course objectives :

- Detailed understanding of genome projects, related disciplines of Bioinformatics use of Databases and Tools in Biological Discovery, Major Bioinformatics Resources.
- To gain detail on biological databases like primary sequence databases, proteinthree dimensional databases, Protein Structure Mathematical model databases, PCR andquantitative PCR primer databases, Chemical Databases, Drug & DrugTarget/Therapeutic Target Databases, Disease databases, Immunological database.
- In depth study of various types of tools including sequence submission tools,
- Chemical molecule designing software, Protein & Chemical molecule visualization tools, Docking software, Molecular dynamics software; QSAR, ADME Toxicity prediction, Allergen prediction, Venomics&Antivenomics.

Unit I

Data Collection and Presentation: Biological data management using statistical tools. Concepts of population and sample, advantages of sampling, Basic concepts in sampling and designing experiments, Estimation of sample size for biological experiments, sources of errors.

Unit II

Sampling schemes: Simple Random sampling, Systemic sampling, Stratified sampling, Cluster sampling, Non probability sampling; Estimation of mean proportion and standard error in cluster sampling, Multistage and multiphase sampling.

Unit III

Collection of data, Types of numerical data, nominal data, ordinal data, ranked data, discrete data, continuous data; Modes of presenting data: Frequency distributions, Relative frequency.

Measurement of central tendency and Analysis of variance: Mean, median, mode; Co-efficient of variation and standard deviation; Range and interquartile range; Grouped mean and grouped variance; Frequency distributions; One-way ANOVA; Two-way ANOVA; AMOVA; student's test.

Unit IV

Probability: Definition, basic concept, operations on events, Venn diagrams, Conditional Probability; Probability distributions.

Hypothesis testing: General concepts – Null hypothesis, alternative hypothesis, Rejection of hypothesis; Type I and Type II errors; P value and sample size estimation.

Unit V

Regression and Correlation: Chi Square Test- Observed and expected frequencies, Calculating p values, assumptions of a chi square goodness of fit; Correlation –Two-way scatter plot, Pearson's correlation coefficient; regression concepts, simple linear regression; Calculation of R2.

Suggested Readings:

- Principles of Biostatistics, M. Pagano and K. Gauvreau (2000); Duxbury Thomas learnings. publishers.
- Analysis of Biological Data, M. Whitlock and D. Schluter (2009); Roberts and company
- Biostatistics by saras publication
- Basic statistics by B.L Agrawal.

Course outcomes:

- Students will acquire hands-on practical training to plan biological experiments with requisite sample size.
- After completion of experiments based on different sample sizes students will be able to perform proper statistical analysis of the data using mean, median, mode, variance and standard deviations.
- Students will be able to apply the principles of biological data management in real life situations.
- Statistical training will improve computational, mathematical and computer skills of the students by learning the use of ANOVA, AMOVA and student t-test.
- Students will be able to formulate a hypothesis, relevance to type of sample collected and sample size.

Subject III
Semester III
303: Biostatistics
Practical

Course objectives :

- To understandrelated disciplines of Bioinformatics use of Databases and Tools in Biological Discovery, Major Bioinformatics Resources.
- In depth study of various types of tools including sequence submission tools,
- Chemical molecule designing software, Protein & Chemical molecule visualization tools, Docking software, Molecular dynamics software; QSAR, ADME Toxicity prediction, Allergen prediction.

Practical content :

- Estimation of population means and variance in simple random sampling.
- Collection of data by Random sampling method,
- Collection of data by Cluster sampling method, Cluster Sampling- Equal and unequal cluster sizes.
- Data representation - Frequency and relative frequency distribution table,
- Data representation-plotting of biological data in a representative graphical format.
- Data analysis - Calculating Mean, median, mode, variance, standard deviation and standard error for a given data set. Standard t-test for grouped samples. Analysis of 2 way variance.

Course outcomes :

- Students will acquire hands-on practical training to plan biological experiments with requisite sample size.
- After completion of experiments based on different sample sizes students will be able to perform proper statistical analysis of the data using mean, median, mode, variance and standard deviations.
- Students will be able to apply the principles of biological data management in real life situations.
- Statistical training will improve computational, mathematical and computer skills of the students by learning the use of ANOVA, AMOVA and student t-test.
- Students will be able to formulate a hypothesis, relevance to type of sample collected and sample size.

Subject IV
Semester III
Generic Elective Course (GEC – III)
304: Nutrition Biochemistry

Course objectives :

- Students will learn glycemic index, balanced diet, micronutrient deficiencies and the remedies,nutraceuticals and their importance, junk foods and their hazards.
- They will understand the needfor specialized food for people with special needs - diabetes, pregnancy, inherited geneticdisorders.
- The use of alternate crops – cereals and pulses and their importance will be explained.
- The Cattle industry and their contribution to greenhouse gases, merits and demerits of vegetarianand non-vegetarian foods will be studied.

Unit – I

Concept of food and Nutriotion, Balanced Diet, Daily, Recommended Diet for adults,women and children, Nutritional aspects of carbohydrates, fats and proteins, Daily Requirementof Vitamins and Minerals.

Unit – II

Energy Measurement, Calorific Value of Food, Respiratory Quotient, SDA & BMRFactors affecting SDA. Preparation of diet chart, WHO diet recommendation

Unit – III

Diet in Pregnancy & Lactation, Diet in Diabetes Mellitus, Diet in Fevers and Infections,Diet in G.I. Disorders (Diarrhoea, constipation, peptic ulcer)

Unit- IV

Protein Energy Malnutrition, Causes of Malnutrition in India, Community nutrition,Malnutrition and infection, Obesity, Weaning foods, Importance of correct and timely weaning

Unit- V

Planning and preparation of diet in hypertension, in kedney failure, in various diseases.Preparation of low cost recipes, cost concept and cost control, Concept of food supplement,probiotics and organic food.

Suggested Readings:

- Nutritional Biochemistry – MS Swaminathan (2015)
- Nutrition and Dietetics by Davidson S and Pasmor JR (2001)
- Food science by B. Sreelakshmi (2010)
- Food facts and principles –SakunthalaManay, Sadhakshara Swami. (2008)
- Medical Biochemistry by M.N.Chatterji& Rana Shinde.
- Text Book of Biochemistry by Harold Harper.
- Nutruition and Biochemistry by T. Rajeshwari.

Course outcomes:

- Students will learn glycemic index, balanced diet, micronutrient deficiencies and the remedies,nutraceuticals and their importance, junk foods and their hazards.

- They will understand the needfor specialized food for people with special needs - diabetes, pregnancy, inherited geneticdisorders.
- The use of alternate crops – cereals and pulses and their importance will be explained.
- The Cattle industry and their contribution to greenhouse gases, merits and demerits of vegetarianand non-vegetarian foods will be studied.

Subject IV
Semester III
304: Nutrition Biochemistry
Practical

Course objectives:

- The students will acquire expertise in the determination of moisture in food, adulteration in food.
- To determine the minerals, amino acids and sugars in various foods.
- They will acquire trainingto determine saponification value and iodine value of oils and fats.

Practical content:

- Determination of :
  Moisture content of foods
- Adulterants in food
- Calcium in ragi
- Iron in drumsticks.
- Estimation of vitamin-C in lemon and gooseberries.
- Gravimetric estimation of sulphate as barium sulphate.
- Estimation of amino acid by formal titration.
- Estimation of reducing sugars by Hedgedon and Jensen method.
- Determination of saponification value of oil or fat.
- Determination of iodine value of oil or fat.

Course outcomes:

- Students will learn glycemic index, balanced diet, micronutrient deficiencies and the remedies,nutraceuticals and their importance, junk foods and their hazards.
- They will understand the needfor specialized food for people with special needs - diabetes, pregnancy, inherited geneticdisorders.
- The use of alternate crops – cereals and pulses and their importance will be explained.
- The Cattle industry and their contribution to greenhouse gases, merits and demerits of vegetarianand non-vegetarian foods will be studied.

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Subject I
Semester IV
Major
401: Biochemistry of Enzymes

Course Objectives :

- To acquire fundamental knowledge on enzymes and their importance in biological reactions.
- To understand ability to difference between a chemical catalyst and biocatalyst.
- Exposure to the concept of activation energy and its importance in biological reactions.
- Exposure to the nature of non-protein enzymes such as ribozymes.
- Understanding the role of enzymesin clinical diagnosis and industries.

Unit– I

General Properties of Enzymes, Structural properties of enzymes, Nomenclature and classification of Enzymes, Protein nature of Enzymes, Enzyme specificity. Concept of active site, co-factors – coenzymes and metal ions.Concept ofmetalloenzymesand metal activated enzymes.

Unit – II

Models proposed for Enzymatic action : Lock & Key Model, Koshland's Induced Fit Model, Enzyme substrate model, Factors affecting the rate of enzyme catalyzed reaction. Michaelis – Menten equation, Lineweaver – Burk(L-B) plot. Determination of Vmax & Km and their significance

Unit – III

Acid-base catalysis of enzymes, Covalent catalysis, Metal ion catalysis, Serine Protease,Ribonuclease, Chymotrypsin, Lysozyme.

Unit – IV

Enzyme inhibition: Reversible-Irreversible inhibition and their types, Feedback Inhibition, Allosteric Enzymes :Sigmoidal curve, positive and negative modulators, qualitative description of "concerted" & "sequential" models for allosteric enzymes. Positive and negative co-operativity with special reference to aspartate transcarbamoylase and phosphofructokinase.

Unit – V

Enzyme Biotechnology – Immobilization, Uses of enzymes in milk industry, foodindustry, leather industry, enzymes in cellulose & metal degradation, Designer enzymes,Biosensors, Enzymes as reagents, Marker enzymes in diagnostics,

SuggestedReadings:

- Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:019 850229X.
- R.K.Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, HARPER'S BIOCHEMISTRY, 22nd edn. (1990), Prentice-Hall, International, USA.

- P.K. Stumpf, OUTLINES OF BIOCHEMISTRY, 4th edn. (1994), Wiley Eastern, NewDelhi, (Chapters7 & 8).
- Nelson and Cox, LEHNINGER's PRINCIPLES OF BIOCHEMISTRY, (2000), KalyaniPublishers,Ludhiana/Worth Publishers, Inc., New York.
- L. Stryer.BIOCHEMISTRY 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA
- G.L. Zubay BIOCHEMISTRY 4th Ed. (1998) W.C. Brown Publishers, USA.

Course outcomes:

- The learning outcomes include: knowledge on enzymes and their importance inbiological reactions.
- Students will understand the difference between co-enzymes and cofactors, metalloenzymes and metal activated enzymes.
- They will acquire knowledge of inhibition of enzymes, their types and its importance in the biological system.
- They will be exposed to the Industrial and biomedical applications of enzymes.

Subject I
Semester IV
401: Biochemistry of Enzymes
Practical

Course objectives :

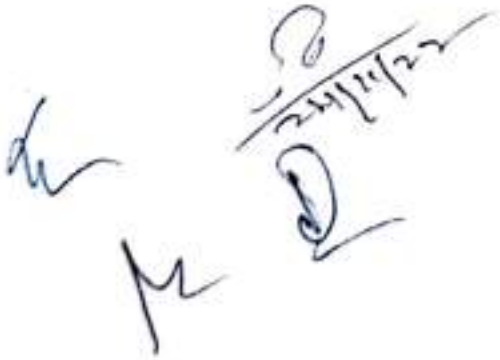
- To study the extraction and purification process of enzymes.
- Estimation of enzyme activity, determination of optimum pH, optimum temperature, Km and Vmax of enzymes .
- To observe the effect of varying substrate concentration, enzyme concentration on the activity of enzymes.

Practical Content:

- Isolation of amylase and demonstration of its activity
- Isolation of acid phosphatase and demonstration of its activity
- Determination of specific activity of salivary amylase by DNS
- Purification of urease
- Time course of urease reaction
- Influence of substrate concentration and pH on the rate of enzymatic reaction
- Determination of Km and Vmax of salivary amylase
- Determination of initial velocity [time kinetics] of salivary amylase
- Determination of optimum temperature of salivary amylase

Course outcomes:

- To gain practical knowledge on enzymes and their importance inbiological reactions.
- Students will perform isolation and purification of enzymes by itself and understand the steps and its modification according to different enzymes.
- They will study the effect of temperature, pH and substrate concentration on the activity of enzymes.
- They will be exposed to the Industrial and biomedical applications of enzymes.



Subject II
Semester IV
Minor
402: Molecular Biology

Course objectives :

- Students will acquire knowledge related to discovery of DNA as genetic material, DNA replication, transcription, DNA repair and translation.
- Coding and non-coding regions of eukaryotic genome and their importance will be analyzed. *E. coli lac* operon, PCR, expression vectors and their importance in Biotechnology will be studied.
- Production of insulin using recombinant DNA technology, transgenic crops-merits and demerits will be studied. Students will acquire basic knowledge related to processes of transcription and translation in prokaryotes and eukaryotes.
- They will develop understanding of the molecular basis of RNA processing and RNA splicing and also the ways in which the biological processes are regulated and the significance of regulation in maintaining different life forms.

Unit – I

Basic concepts of genetic information: Nucleic acids as genetic information carriers, experimental evidences e.g. bacterial genetic transformation, Hershey Chase experiment, Central dogma, Genetic code, various types of genes, Wobble hypothesis.

Structure and organization of DNA

Building blocks of DNA, Watson and Crick model, features of double helix, denaturation and renaturation of DNA, DNA supercoiling, Organization of DNA and RNA in prokaryotes and eukaryotes, Nucleosome structure and DNA packaging, Types of DNA & RNA, organization of genes and genome.

Unit – II

DNA replication: DNA replication in prokaryotes and eukaryotes, conservative, semi conservative and dispersive types of replication, Meselson and Stahl experiment, Enzymology of DNA replication. Errors & regulation DNA replication, DNA and damage repair, Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine.

Transcription: Mechanism of Transcription (Initiation, Elongation, Termination), RNA polymerases, Promotors, Post transcriptional modification, Inhibitors of transcription.

Unit – III

Translation: Mechanism of Translation (Initiation, Elongation & Termination), Ribosomes structure, Activation of amino acids, amino acyl tRNA synthesis, Inhibitors of protein biosynthesis. Release Factors and Nonsense codons, Comparison of protein biosynthesis in prokaryotes with eukaryotes.

Unit – IV

Regulation of Gene Expression:

Concept of Operon, Promoters, Operator, Repressers, Structural genes, Inducers, *lac* operon, *trp*operon, Positive and Negative Regulation, regulation of gene expression in prokaryotes, steps and process involve in gene expression.

Unit – V

Mutations: Concept of mutation and mutagen, types of mutagens, mutagenesis, site directed mutagenesis, site directed mutagenesis Concept of miss-sense, nonsense, point mutation and frameshift mutation, mutations determination, suppressor mutation, mutation rate, mutation by hydrolysis, alkylation, oxidation and radiation.

Course outcomes:

- Students will acquire knowledge related to discovery of DNA as genetic material, DNA replication, transcription, DNA repair and translation.
- Coding and non-coding regions of eukaryotic genome and their importance will be analyzed. *E. coli lac* operon, PCR, expression vectors and their importance in Biotechnology will be studied.
- Production of insulin using recombinant DNA technology, transgenic crops-merits and demerits will be studied. Students will acquire basic knowledge related to processes of transcription and translation in prokaryotes and eukaryotes.
- They will develop understanding of the molecular basis of RNA processing and RNA splicing and also the ways in which the biological processes are regulated and the significance of regulation in maintaining different life forms.

Suggested Readings:

- Nelson and Cox, Lehninger's Principles of Biochemistry (2000), Worth Publish., Inc. NewYork.
- L. Stryer. BIOCHEMISTRY, 4th Edn., (1995), W.H. Freeman Press, San Fransisco, USA.
- E.J. Gardner and D.P. Snustad. Principal of Genetics (1984), John Wiley & Sons, Ney York.
- Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.Molecular Biology – Freifelder

Subject II
Semester IV
402: Molecular Biology
Practical

Course objectives:
Students will learn the to isolate RNA, DNA, total nucleic acids and total RNA from bacteria, yeast and plant tissues.

Practical Content:

- Extraction and estimation of DNA from coconut endosperm.
- Extraction of RNA from spinach leaves and its estimation by Orcinol Method
- Determination of absorption maxima of nucleic acids
- Extraction of total nucleic acids from plant tissues
- Isolation of total RNA from bacteria/yeast

Course outcomes:

- The student will learn to isolate DNA and RNA from various sources.
- They will gain knowledge of purification techniques of DNA.
- Students will be aware about light absorption process and its use in the quantitative determination of nucleic acids.

Subject III
Semester IV
Skill Enhancement Elective Course (SEC – II)
403: Research Methodology

Course objectives:

- Students will understand the objectives of doing scientific research.
- They will learn how to identify the area of research to be conducted, how to proceed for literature survey using a variety of sources and how to write research project proposal with well laid hypothesis and objectives.
- They will learn the skills of research design, nature of sample size as well as collection and analysis of data.
- They will also know the skills of writing research report and making oral presentations.

Unit I

Research Methods: Scientific Research: The scientific method and problem solving. Various phases of research. Major steps in the research process: Abstracting, Literature review, Research proposal and outcome aspects.

Review of literature using appropriate sources: reviews, patents, research papers, books. Theoretical contexts, research problem, research hypothesis.

Unit II:

Tools in Research: Basic tools involve in research scheme, theoretical and data expression, equations, formula and abbreviation representation, data separation and distribution testing of hypothesis and test of significances, highlights of research with outcomes with aims.

Unit III

Research Designs: Types of research designs, exploratory, descriptive, experimental, survey and case study, Sampling techniques and sample size determination, Sample types, criteria, characteristics and steps; Tools and techniques to execute experiments, types of investigation.

Unit IV

Research Reports: Data preparation and preliminary analysis, statistical analysis, model building and decision making. Types of research documents, writing and formatting of report, presentation, interpretation, art of oral presentation, format of publications in research journals; Journal Impact factor, h-index and i-10 index.

Unit V

Bio-Ethics: Introduction of bioethics, importance, health and professional ethics, Bioethical related to research; Plagiarism; Citation and acknowledgement, preparations of standard references, types, and expression of research by oral and display mode.

Suggested Readings:

- Bhattacharya, D. K. (2003): Research Methodology, Excel Books, New Delhi
- Cenise F. Polit, J.B. Bemadette, P. Hungler (1984) Essential of Nursing Research Methods Lippinott Company, U.K.
- Carol T. Bush (1985): Nursing Research, Reston Publishing C. Reston.

Course outcomes:

- The Students will understand the objectives of doing scientific research.
- They will learn how to identify the area of research to be conducted, how to proceed for literature survey using a variety of sources and how to write research project proposal with well laid hypothesis and objectives.
- They will learn the skills of research design, nature of sample size as well as collection and analysis of data. They will also know the skills of writing research report and making oral presentations.

Subject IV
Semester IV
Skill Enhancement Elective Course (SEC – II)
404: Gene and Recombinant DNA technology

Course objectives:

- Students will be exposed to the latest techniques employed in recombinant DNA technology related to DNA manipulation in prokaryotes and eukaryotes.
- Students will getacquainted with the importance of gene cloning, methods for screening cloned genes,DNA sequencing, gene expression, etc.
- They will understand the importance ofrecombinant DNA technology in production of insulin, drugs, diagnostics, vaccines and transgenic plants.

Unit I

Concept of gene: Gene expression in prokaryotes - concept of lac-operon.Functional units in a typical eukaryotic gene-promoter, introns and exons,Allele and multiple allele, Pseudo-alleles.
Pre-mendelian theories: Laws of Mendels-applications and deviations, Law of Dominance, Law of Segregation, Law of Independent, Assortment, Codominance, Monohybrid Cross, Dihybrid Cross, Back Cross and Test Cross.

Unit II

Genetic Linkage and Crossing over: Genetic Linkage factors and patterns of crossing over cytological basis of crossing over, molecular mechanism of crossing over, Two factor and Three factor crosses.

Unit –III

Outline of techniques of genetic engineering Isolation of DNA, cutting ofDNA by restriction endonucleases – staggered cut and blunt end.Cutting genomic DNA, separation of fragments by agarose gel electrophoresis. Vectors, plasmid PBR322, insertion of foreign DNA into vectors. Transfection of vectors into host cells, gene transfer tools, cDNA.

Unit IV

Gene techniques: Molecular markers, PCR, PAGE, RFLP, RAPD, DNA finger printing, DNA foot printing. Molecular hybridization techniques, molecular probe, Blotting techniques, Principle and procedure of Southern, Northern & Western Blotting, Immuno-PCR.

Unit V

Recombinant DNA technology: Recombinant DNA technology, Restriction enzymes-nomenclature, classification and mode of action. Restriction endo and exonuclease, Cloning and DNA Hybridization, Introduction to Cloning Vectors, hybridoma technique.Chromosomal Mapping, Recombination, Types and Mechanism of Recombination.
Applications of genetic engineering: Transgenic plants, transgenic animals and gene therapy. Human genome project.

Suggested Readings:

- Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell Publishing (Oxford, UK).
- Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press(Washington DC)
- Current Protocols in Molecular Biology (2013) Ausubel, F.M. et al., John Wileyand Sons (Somerset, NJ)

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Course outcomes :

- Students will be exposed to the latest techniques employed in recombinant DNA technology related to DNA manipulation in prokaryotes and eukaryotes.
- Students will getacquainted with the importance of gene cloning, methods for screening cloned genes,DNA sequencing, gene expression, etc.
- They will understand the importance ofrecombinant DNA technology in production of insulin, drugs, diagnostics, vaccines and transgenic plants.

Subject I
Semester IV
Major
501: Metabolism

Course objectives :

- Students will acquire the concept of anabolism, catabolism and role of high energycompoundsinthe cell. They will acquire knowledge related to regulation of various pathways.
- The importance oflipids as storage molecules and structural component of biomembranes will be ascertained.
- Theimportance of high energy compounds, electron transport chain, synthesis of ATP under aerobicand anaerobic conditions will be understood. The role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions, redox balance will be explained.
- The fact that perturbations in the carbon metabolism can lead to various disorders such as diabetesand cancer will be explained.
- The student will appreciate the fact that differences in the propertiesof metabolic enzymes of the host and pathogens can be exploited for the development of new drugs.
- Finally, the student will gain insights into metabolic engineering for the production of useful biomolecules.

Unit I
Biological Oxidation: Oxidation, Reduction, Enzymes involved in oxidation-reduction,Electron Transport Chain in detail. Basal Metabolic Rate &its affecting factors.

Unit II
Digestion and absorption of carbohydrates, Concept of Carbohydrate Metabolism,Glycolysis – aerobic & anaerobic Glycolysis, TCA cycle, Glycogen Metabolism.

Unit III
Digestion, absorption and mobilization of Lipids, Transport of Fatty Acids, Role ofHormones in Digestion and mobilization, Elementary idea of metabolism of Triglycerides, β-oxidation of Fatty acids, Cholesterol, Ketone Bodies.

Unit IV
Digestion, absorption and mobilization of Proteins and Amino Acids, Oxidation,Reduction, Decarboxylation, deamination and transamination of amino acids, Concept ofGlucogenic and Ketogenic amino acids, Nitrogen excretion and Urea cycle.

Unit V
Haem Metabolism – Source of Bilirubin,. Transport of Bilirubin, Conjugation ofBilirubin, Secretion and excretion of Bilirubin. Detoxication.

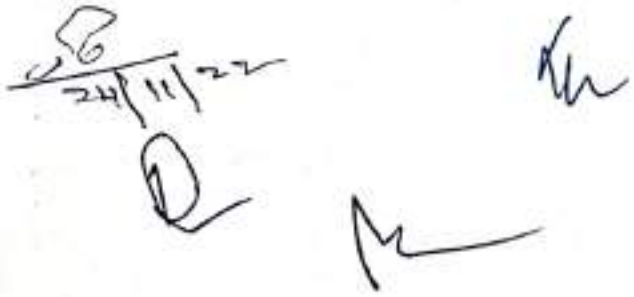
Suggested Readings:

- R.K.Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, HARPER'S BIOCHEMISTRY, 22nd edn. (1990), Prentice-Hall, International, USA.

- P.K. Stumpf, outlines of biochemistry, 4th edn. (1994), Wiley Eastern, NewDelhi, (Chapters7 & 8).
- Nelson and Cox, Lehninger's principles of biochemistry, (2000), KalyaniPublishers,Ludhiana/Worth Publishers, Inc., New York.
- L. Stryer BIOCHEMISTRY 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA
- G.L. Zubaybiochemistry 4th Ed. (1998) W.C. Brown Publishers, USA.
- Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.
- Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.

Course outcomes :

- Theimportance of high energy compounds, electron transport chain, synthesis of ATP under aerobicand anaerobic conditions will be understood. The role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions, redox balance will be explained.
- The fact that perturbations in the carbon metabolism can lead to various disorders such as diabetesand cancer will be explained.
- The student will appreciate the fact that differences in the propertiesof metabolic enzymes of the host and pathogens can be exploited for the development of new drugs.



Subject I
Semester IV
501: Metabolism
Practical

Course objectives:
The learning outcomes include: preparation of buffers, estimation of glucose , proteins in serum samples, isolation of lipids from egg and estimation of serum cholesterol.

Practical Content:

- Preparation of acidic and basic buffers
- Determination of pH using pH meter.
- Determination of pKa value of amino acid using pH meter.
- Estimation of blood glucose by DNS method.
- Protein by Biuret method.
- Assay of salivary amylase.
- Isolation of lipids from egg yolk and separation by TLC.
- Estimation of serum cholesterol

Course outcomes:

- Theimportance of high energy compounds, electron transport chain, synthesis of ATP under aerobicand anaerobic conditions will be understood. The role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions, redox balance will be explained.
- The fact that perturbations in the carbon metabolism can lead to various disorders such as diabetesand cancer will be explained.
- The student will appreciate the fact that differences in the propertiesof metabolicenzymes of the host and pathogens can be exploited for the development of newdrugs.

Subject II
Semester V
Discipline Elective Course (DSE – I)
502: Plant Biochemistry

Course objectives:

- Learning outcomes for this course include detailed understanding of metabolic processes specific for plants such as nitrate assimilation, photosynthesis, respiration, nitrogen fixation.
- To learn about role of different metabolic pathways in plant growth and development.
- Students will also gain insight to various stressful conditions of the environment that affect plant growth and productivity.
- To learn about the defense mechanisms in plants due to which plants survive under stresses.

Unit I

Introduction of Plant kingdom: features of thallophytic, bryophyte, pteridiophytes, gymnosperm and angiosperm, reproductive life cycle. Occurrence, structure, classification, and reproduction in algae and fungi.

Unit II

Electron transport system in plants: Oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, mechanism of ATP synthesis.

Unit III

Photosynthesis: Photosynthetic apparatus, photosynthetic pigments, role of carotenoids, photosystems I and II, Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, C3 and C4 pathway and its regulation, Photorespiration.

Unit IV

Secondary plant metabolites: Terpenes, lignin, tannins, pigments, phytochrome, waxes, alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components.

Plant movements: Photoperiodism and flowering, Vernalisation, Plant hormone, chemical nature and action, Fruit Ripening, Dormancy and seeds germination.

Unit V

Nitrogen metabolism: Nitrate assimilation, features of nitrate and nitrite reductase, ammonia incorporation into organic compounds, Biological nitrogen fixation free living and in symbiotic association; nitrogenase enzyme structure and function.

SuggestedReadings:

- Bhatnagar, S.P. and Moitra, A., 1996, Gymnosperms New Age International Pvt. Ltd., New Delhi.
- Davis, P.H. and Heywood, V.H., 1973, Principles of Angiosperms Taxonomy, Robert E. Krieger Pub. Co., New York.
- Grant V., 1971, Plant Speciation, Columbia Univ. Press, London.
- Harrison, H.J., 1971, New Concepts of Flowering Plant Toxonomy, Hieman Educational Books Ltd., London.
- Nordenstam, B., El Ghazaley, G. and Kassar, M., 2000, Plant Systematics for 21st Century, Portland Press Ltd., London.
- Takhtajan, A.L.,1997, Diversity and Classification of Flowering Plants, Columbia Univ. Press, New York.
- Pandey, Mishra & Trivedi, 2001, A Text Book of Botany, Vol. II & III, Vikas Publishing House Pvt. Ltd., Delhi.
- Vashishta, 1976, Botany for Degree Students (Algae, Fungi, Bryophyto& Gymnosperms) Gymnosperms (Vol. III), S. Chand & Co. Ltd., Delhi.

Course outcomes:

- To Learn detailed understanding of metabolic processes specific for plants such as nitrate assimilation, photosynthesis, respiration, nitrogen fixation.
- To learn about role of different metabolic pathways in plant growth and development.
- Students will also gain insight to various stressful conditions of the environment that affect plant growth and productivity.
- To learn about the defense mechanisms in plants due to which plants survive under stresses.

Subject II
Semester V
Discipline Elective Course (DSE – I)
502: Bioinformatics

Course Objectives

- The objective of this course is to impart basic understanding of bioinformatics and computational biology.
- The course will introduce the broad scope of bioinformatics by discussions on the theory and practices of computational methods in biology.
- This course also aims to provide students with a practical hands-on experience with common bioinformatics tools and databases.
- Students will be trained in the basic theory and application of programs used for database searching, protein and DNA sequence analysis, and prediction of protein structures.

UNIT I: Introduction to Bioinformatics: Introduction to Bioinformatics, Computer fundamentals, Operating Systems, Hardware, Software, Programming languages in bioinformatics - PERL/R programming, role of supercomputers in biology, Historical background. Scope of bioinformatics - Genomics, Proteomics, and Computer aided drug design and Systems Biology.

UNIT II: Biological databases and data retrieval: Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot), small molecule databases (PubChem, Drug Bank). Organism specific databases, Structure viewers.

UNIT III: Sequence alignment & Phylogeny: Similarity, identity and homology. Concept of Alignment – local and global alignment, pairwise and multiple sequence alignments, amino acid substitution matrices, BLAST and CLUSTALW, Definition of phylogeny and its importance, Methods of Phylogenetic tree generation.

UNIT IV: Genomics: Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, Genome annotation, gene prediction approaches and tools.

UNIT V: Protein sequence, structure prediction and analysis: Protein Structure - Primary, Secondary and Tertiary structure, Protein structure prediction methods: Homology modeling.

SuggestedReadings:

- Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India).
- M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, AcademicPress, 2010
- Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press

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- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc.

Subject III
Semester V
Skill Enhancement Elective Course (SEC – III)
503: Genetic Engineering

Course objectives:

- Students will acquire knowledge about gene concept, its fine structure ans various types of genes.
- They will be known with laws of Mendel its applications as well as their deviations.
- They will analyze Coding and non-coding regions ofeukaryotic genome and their importance.
- Students will gain knowledge about Linkage, Crossing over and inheritance types.
- Students will acquire basic knowledge to develop understanding of the genetical tools and techniques.
- Students benefited with processesare regulated and the significance of regulation in maintaining different life forms.

UNIT I:
Principles of heredity
Pre-mendelian theories, Law of Dominance, Law of Segregation, Law of Independent Assortment, Codominance, Monohybrid Cross, Dihybrid Cross, Back Cross and Test Cross, Concept of Gene: Allele and multiple allele, Pseudo-allele

UNIT II:
Genetics of bacteria and viruses
Concept of cistron. Bacterial and viral genomes, Mechanism of genetic exchange - conjugation, transformation and transduction. Human pedigree analysis,sex linked inheritance, Applications of pedigree analysis

UNIT III:
Linkage, crossing over
Linkage and Crossing over, Cytological basis of crossing over, molecular mechanism of crossing over, Two factor and Three factor crosses, Chromosomal Mapping, Recombination, Types and Mechanism of Recombination.

UNIT IV:
Population and Evolutionary Genetics:
Hardy-Weinberg law, predicting allele and genotype frequencies and exceptions to Hardy-Weinberg principle. Molecular evolution, homologous sequences, phenotypic evolution and speciation.Extra nuclear inheritance, tests for organelle heredity and maternal effect, Genetic basis of sex determination in Humans

UNIT V: Chromosomal aberrations: Principle of chromosomal aberrations, causing factors, Variations in chromosome number: aneuploidy and polyploidy. Variations in chromosome structure, inversions, deletions, duplications and translocations, substitution.

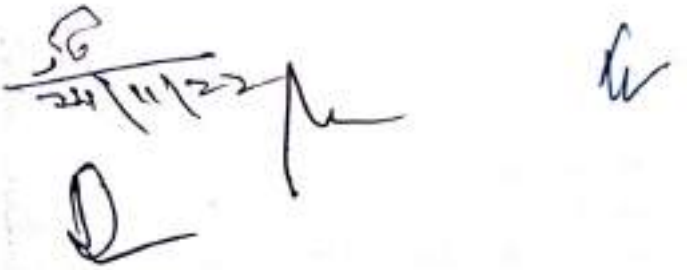
Suggested Readings:

- Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore).
- Genetics - A Conceptual Approach (2012), 6h ed., Pierce, B.A., W.H. Freeman & Co. (New York).

- An Introduction to Genetic Analysis (2017), 11th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York).
- Cytogenetices by P.K. Gupta S. Chand Publication.
- Cell and Molecular Biology by Albert.
- Cell and Molecular Biology by P.K. Gupta S. Chand Publication.

Course outcomes:

- The student will be known with laws of Mendel its applications as well as their deviations.
- They will analyze Coding and non-coding regions ofeukaryotic genome and their imp
- Students will gain knowledge about Linkage, Crossing over and inheritance types.
- Students will acquire basic knowledge to develop understanding of the genetical tools and techniques.



Subject I
Semester –VI
Major
601: Microbial Biochemistry

Course objectives:

- The students will get acquainted with the contributionsof Louis Pasteur, Edward Jenner and Robert Koch in microbiology. To enable the student to learn the regulation of genes in bacteria.
- Discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, hospital acquired infections will be studied.
- The importance of microorganisms as model systems in genetics and biochemistry will be explained. The contribution of gut microbiome to human health will be discussed.
- Students will be exposed to basic concepts of metabolic engineering and synthetic biology. The fight against major killer diseases – tuberculosis, HIV and malaria will be discussed.
- Students will be gain detailed information on antibiotics bioactive productsdevelopments.

Unit I

Introduction to Microorganisms: Classification of Bacteria, Occurrence, Morphology, Locomotion and Structural organization, Gram +ve and –ve bacteria.

Staining of micro-organisms: principle and procedure of gram stain and acid fast stain.

Unit II

Viruses and Bacteriophages: Introduction to viruses, Classification based on genetic material, Occurrence, Morphology, Structural organization, virus reproduction, Reverse Transcription, Transformation, Transduction, plant and animal viruses. Bacteriophages,Morphology, general characteristics, life cycle (lysogeny and lytic cycle).

Unit III

Culture Media/Microbial nutrition:

Nutritive media, growth of micro-organisms, Bacterial growth phases, growth curve, minimal media, pure culture, methods of isolation, maintenance and preservation of Pure culture, factor affecting growth, growth measurement, influencing factors of growth, Batch and continuous culture.

Unit IV

Microorganisms and Industry

Industrial uses of Bacteria and Yeasts, Bioengineering, and Bioprocessing: Food spoilageand preservation, Food born infection and diseases, Disposal of domestic and industrial wastes.

Biochemistry of microbial active compounds, Fermentors – types and components, Production and importance of alcoholic beverages (Beer and wine), fermented products of milk cheese, penicillin antibiotic production, single cell protein-*Spirulina* production. Immobilization of microbes, immobilization types, applications of microbes' immobilization

Unit V

Microbial Pathology: mechanism of microbial pathogenesity, pathology of common microbial disease, Common microbial infection and treatment.

Antibiotics: Definition, mechanism of action of penicillin streptomycin, and chloramphenicol, antibiotic resistance, Bacterial toxins classification, structure and mode of action.

Suggested Readings:

- M. Pelczar, E.C.S. Chan and M.R. Krieg, Microbiology, McGraw Hill Inc.Singapore (1997).
- General Microbiology, Vol. I & II – Powar, Daginawala – Himalaya Publishing House.
- (2015).
- General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press London
- (1987)
- Text book of microbiology, by Dubey and Maheshwari New edition.

Course outcomes :

- To know the discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, hospital acquired infections will be studied.
- The importance of microorganisms as model systems in genetics and biochemistry will be explained. The contribution of gut microbiome to human health will be discussed.
- The Students will be exposed to basic concepts of metabolic engineering and synthetic biology. The fight against major killer diseases – tuberculosis, HIV and malaria will be discussed.

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Subject I
Semester –VI
601: Microbial Biochemistry
Practical

Course objectives:

- Students will acquire knowledge to identify different microbes and to perform bacterialcultures in different media.
- They will get acquainted with routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, staining etc.
- They will acquire expertise to culture and screen microbes for antibiotic resistance.

Practical content:

- Preparation and sterilization of culture media
- To perform culture transfer techniques: Solid to solid (streaking), liquid to solid (spreading), liquid to liquid, solid to liquid and determine CFU/ml
- To stain bacteria using methylene blue and other dyes
- To perform gram staining for identification of bacteria
- Isolation of microbes from soil and sewage water.
- To prepare temporary mount of algae (Spirogyra)
- To prepare temporary mount of fungi (Penicillium)
- Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides
- To prepare growth curve of bacteria.

Course outcomes :

- Students will acquire knowledge to identify different microbes
- Students get acquainted with routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, staining etc.
- They will acquire expertise to culture and screen microbes for antibiotic resistance.

Subject II
Semester VI
Discipline Specific Elective Course (DSE – II)
602: Advance Techniques in Biochemistry

Course objectives:

- Students will acquire a sound background of latest methods used in biochemistry for purification of enzymes, isolation and characterization of proteins, nucleic acids, etc.
- Students will also develop practical skills related to applications of microscopy, labeling DNA, proteins and whole cells and their applications inbiochemistry research.
- The students will get equipped with the latest techniques used in analysis of biomolecules and this will help them in undertaking further research in the area of biochemistry in any research/industrial institution.

Unit I

Enzyme and pigments purification methods:
Salt precipitation, salting in and salting out, ultra-filtration, organic solvent precipitation, principle, equipment, working, application of gel filtration, ion exchange chromatography, affinity chromatography.

Unit II

Methods for protein analysis: Protein-Protein interaction, Immuno-precipitation, Protein fragment complementation assay, Western blotting, Protein microarrays, ELISA. Proteomics: Isoelectric focusing, protein gel electrophoresis, Structural analysis: MALDI-TOF, MS/MS,LC/MS. quantification of protein.

Unit III

Methods for nucleic acid analysis: Comet assay, Hybridization methods: Southern blotting, Northern blotting, in situhybridization, Colony hybridization. DNA pull down assays, lectrophoretic Mobility Shift Assay (EMSA), DNA foot-printing, Chromatin immune-precipitation, Gene expression analysis: Reporter, DNA Microarrays, RNA seq.

Unit IV

Cytological techniques: Cell culture and transfection, cell fixation, Immuno histochemistry, Immunofluorescence, Flow cytometry, FACS, TUNEL assay, Non-invasive scanning of soft tissue, Cell imaging and tissues alterations.

Unit IV

Labeling methods: Radioactive and Non-radioactive labeling: DNA, Proteins, Whole cells. Fluorescent labeling: DNA, Proteins, bacteria, living cells; Metabolic labeling, Pulse chase analysis.Radio Imaging, Principle of Radio Imaging, CT scan, MRI, ultra sound etc.

Suggested Readings:

- The Ultimate Guide to Your Microscope (2008) Levine, S. and Johnstone, L., Sterling.

- Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex).
- Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th ed., Wilson, K., and Walker, J. (eds), Cambridge University Press (New Delhi).
- Introduction to Instrumentation in Life Sciences (2012) Bisen, P.S. and Sharma, A., CRC Press/Taylor and Francis Group (California).
- Molecular Cloning: A Laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York).
- Current Protocols in Molecular Biology (2013) Ausubel, F.M. et al., John Wiley and Sons.
- Current Protocols in Immunology (2013) Coligan, J.E. et al., John Wiley and Sons.

Course outcomes:

- Students will develop laboratory/practical skills to perform various experiments related to purification of enzymes, analysis of proteins, nucleic acids, etc.
- They will acquire hands-on-training with the latest techniques in Biochemistry such as 2D protein gel electrophoresis, WesternBlotting, Southern hybridization, DNA Labeling.
- This will lead to development of practical skills to undertake future analytical/research activities in Biochemistry.

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Subject II
Semester VI
Discipline Specific Elective Course (DSE – II)
602: Microbial Techniques

Course Objectives :

- To impart basic understanding of microbial techniques by hands on experience on working with microorganisms.
- Students aware about the characteristic features of different microbes
- They culture microorganisms in aseptic conditions
- Students prepare and sterilize different types of media
- Students know to maintain different types of cultures
- Students carry out research using microorganisms.
- Student learn the principles behind and importance of sterilization while working in varied areas of biology in various laboratories.

Course Contents

UNIT I: Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming. Development of various microbiological techniques and golden era of microbiology.

UNIT II: Microbial Nutrition and Growth: The common nutrient requirements. Nutritional types of microorganisms. Culture media and its components, Synthetic or defined media, Complex media, Enriched media, Selective media, Differential media. Isolation of Pure culture: Streaking, Serial dilution and Plating methods, cultivation, maintenance of pure cultures. Microbial Growth: phases of growth, measurement of microbial growth

UNIT III: Control of microorganisms by physical and chemical methods: Mechanism of Dry Heat, Moist Heat, Hot air oven, Filtration and Radiations, Use of Phenolics, alcoholics, halogens, heavy metals, aldehydes and gases for sterilization.

UNIT IV: Bacterial, Fungal and Algal cell organization and staining: Overview of characteristic features of bacterial, fungal and algal cell. Composition and detailed structure of gram- positive and gram- negative cell wall. Simple staining and negative staining of bacteria. Mechanism of gram staining.

UNIT V: Introduction to Viruses: General characteristic features of viruses. Nacked and envelop viruses. Examples of RNA and DNA viruses. Subviral particles: viroids, prions, virusoids and their importance. Isolation and cultivation of viruses. Virus purification and assays

Suggested Readings

- Willey JM, Sherwood LM, and Woolverton CJ. (2017). Prescott's Microbiology. 10th edition. McGraw Hill Higher Education.

- M.T. Madigan, J.M. Martinko& D.A. Stahl, Brock Biology of Microorganisms, 13th Ed., Pearson Education International. (2010).
- J.G. Cappuccino, and N. Sherman, Microbiology: A Laboratory manual, 10th Ed. Benajamin/ Cummings (2013).
- Microbiology by Pelzar. Isolation and enumeration of bacteriophages (PFU) from water sample. PelczarJr MJ, Chan ECS, and Krieg NR.(2004). Microbiology.5th edition Tata McGraw Hill.
- Cappucino J and Sherman N. (2013). Microbiology: A Laboratory Manual. 10th edition. Pearson Education Limited.
- Madigan MT, Martinko JM, Dunlap PV and Clark DP (2010).Brock Biology of Micro-organisms.13thedition. Pearson Education, Inc.
- Dubey R.C and Maheshwari D.K. (2010). Practical Microbiology. First Edition. S. Chand. ISBN: 81-219-2153-8

Course Outcome :

- Students prepare and sterilize different types of media
- Students know to maintain different types of cultures
- Students carry out research using microorganisms.
- Student learn the principles behind and importance of sterilization while working in varied areas of biology in various laboratories.

Subject II
Semester VI
602: Microbial Techniques
Practical

Course Objectives :

- To impart basic understanding of microbial techniques by hands on experience on working with microorganisms.
- Students aware about the characteristic features of different microbes
- They culture microorganisms in aseptic conditions
- Students prepare and sterilize different types of media

Practical content:

- Demonstration of presence of microflora in the environment by exposing nutrient agar plates to air.
- Study of different shapes of bacteria, fungi and algae using permanent slides/pictographs
- To stain bacteria using crystal violet/methylene blue.
- To perform Gram's staining.
- To prepare temporary mount of algae.
- To prepare temporary mount of fungi.
- Isolation of pure cultures of bacteria by streaking method.
- Enumeration of colony forming units (CFU) count by spread plate method/pour plate
- Study the morphological structures of viruses (DNA and RNA) and their important characters using electron micrographs.

Course Outcome :

- Students prepare and sterilize different types of media
- Students know to maintain different types of cultures
- Students carry out research using microorganisms.
- Student learn the principles behind and importance of sterilization while working in varied areas of biology in various laboratories.

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Subject III
Semester VI
Discipline Specific Elective Course (DSE – III)
603: Biology of Infectious Diseases

Course objectives:

- Students will get acquainted with various classes of microbial infectious agents, their mode of action, biology of the diseases, transmission of diseases, the concepts of treatment, and drug resistance for various antimicrobial agents.
- Students will learnmolecular basis of diagnosis and treatment of diseases as well as strategies fordevelopment of vaccines against these diseases.
- Students will be exposed to the details ofimportant infectious diseases such as tuberculosis, AIDS, malaria, filariasis, etc. whichare highly prevalent in tropical countries.
- Students will also understand the significanceof hygiene, sanitation, vaccination in prevention of infectious diseases.

Unit I

Infectious diseases: Classification, Nosocomial infections; Past and present emergingand re-emerging infectious diseases and pathogens. Source, reservoir and transmissionof pathogens. Safety measures when working with pathogens, biosafety levels,infection and evasion.

Unit II

Bacterial diseases: Classification of bacterial pathogens, virulence factors and hostpathogen interaction. Bacterial toxins, enterotoxins and their mode of action, diarrhea,cholera; Tuberculosis, infection and pathogenicity, diagnostics, therapeutics andvaccines, drug resistance. Other bacterial diseases such as - Typhoid, Diphtheria,Pertussis, Tetanus, Botulism Anthrax and Pneumonia; their virulence factors andhost pathogen interactions.

Unit III

Viral diseases: Structure and classification of viruses, viral virulence factors, hostpathogen interactions; AIDS: history, causative agent, pathogenesis, diagnostics,drugs; Other viral diseases such as Hepatitis, Influenza, Rabies, Dengue and Polio;Chicken Pox, Herpes Virus.

Unit IV

Parasitic diseases: Classes of parasites and diseases caused by them, Malaria:causative agents, vectors, etiology, diagnostics, drugs, vaccine development.
Leishmaniasis and Amoebiasis, Giardiasis and Trypanosomainfections.

Unit V

Fungal diseases: Etiology, characteristics and diagnosis of Candidiasis, Sporotrichosis,Aspergillosis and Ring worm.
Role of drugs, vaccines and sanitation in prevention and treatment of infectiousdiseases.

Suggested Readings:

1. Jawetz, Melnick and Adelbergs Medical Microbiology 27th ed., McGraw HillEducation
2. Klien's Microbiology (2008) 7th ed., Prescott, Harley, Wiley, J.M., Sherwood,L.M., Woolverton, C.J. McGraw Hill International Edition (New York)
3. Sherris Medical Microbiology: An introduction to infectious diseases (2010)Kenneth J. Ryan, C.,George Ray, Publisher: McGraw-Hill.

CousreOutcomes :

- Students will get acquainted with various classes of microbial infectious agents, their mode of action, biology of the diseases, transmission of diseases, the concepts of treatment, and drug resistance for various antimicrobial agents.
- Students will learnmolecular basis of diagnosis and treatment of diseases as well as strategies fordevelopment of vaccines against these diseases.
- Students will be exposed to the details ofimportant infectious diseases such as tuberculosis, AIDS, malaria, filariasis, etc. whichare highly prevalent in tropical countries.

Subject III
Semester VI
Discipline Specific Elective Course (DSE – III)
603: Industrial Biochemistry

Course Objectives:

- To learn about various industrial productions of important biological compounds.
- To know the process of manufacture and quality control systems in industries
- The student will learn manufacture process and their modofications in cement, soap and fertilizers.

Unit I: Paint & Pigment

Classification of paints, constitution of paints. Setting of paints. Qualities of a good paint,paint failure, Methods of applies paints, baking, paint removers.

Pigment: Definition study of following pigments lithopone, titamiumdioxide ultramarine blue, zincoxide, white lead. Varnishes: - raw material manufacture of varnishes japaines.

Unit II: Pulp & Paper

Manufacture of pulp, sulfate pulp, rag pulp, benting, refining, filling, sizing &colouringmanufacture of paper, calendaring ecological problems of Indian pulp & paper industry.

Unit III: Cement Industries

Types of cements cementing materials, raw materials manufacture setting of cements,properties of cement, testing of cement, mortars & concrete, curing of concrete, decay of concrete.Limemanufacture of lime, properties of lime, setting & hardening of lime, gypsum, plaster of Paris.

Unit IV: Fertilizers

Definition & classification of fertilizer manufacture of phosphate fertilizer (superphaspatetriple superphaspate of calcium) manufacture of nitrogen fertilizers (urea & ammonium phosphatepollution caused by fertilizers, effects of fertilizers.

Unit V: Soap and Detergents, Fats, Oil & Wax Soap and Detergents

Soap- manufacture, toilet and transparent soap, metal soap, cleaning action of soap. Principalgroup of synthetic detergent, classification of surface active agents, cationic detergents, non ionic

detergents, amphoteric detergents, containing enzymes, eco friendly detergent. Manufacture ofshampoos. Fat, Oil & Wax properties, Classification, Analysis, Manufacture and Refining ofvegetable oils, animal and mineral oil, hydrocarbon oil, essential oil, oils as emollients, some commonwax, solubility of wax, synthetic fat, oil and wax, manufacture of candel hydrogenation of oil

CourseOutcomes :

- To learn about various industrial productions of important biological compounds.
- To know the process of manufacture and quality control systems in industries.
- The student will learn manufacture process and their modofications in cement, soap and fertilizers.

Subject I
Semester VII
Major
701: Immunology

Course objectives:

- Students will gain an overview of the immune system including cells, organs and receptors.
- They will understand structure and functions of different classes of immunoglobulin.
- To understand the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.
- They will be acquainted with the importance of antigen-antibody interaction in disease diagnosis.
- Students will be in a position to explain the principles of tolerance, autoimmunity and the role of immunity in protection against pathogens.

Unit I

Immunity: Immunity types, Innate, Acquired Immunity, Passive and active Immunity, Cellular and Humoral Immunity. Cells and organs involved in immune response (Bone marrow, thymus, spleen and lymphocytes). Formation and functions of T and B Lymphocytes, Helper T-cells and killer T-cells. Macrophages. Complement activation by classical, alternate pathway, complement activation, regulation and complement deficiencies.

Unit II

Antigens: Definition, nature of antigen, essential factor for antigenicity, antigenic substances, types of antigen, epitopes, haptens, carriers, adjuvants, antigen types.

Antibodies: Definition, types, properties, structure of different immunoglobulins, B-cell Receptors, Epitopes, Antigenic determinants on immunoglobulins, functions of antibody, immunoglobulin super family, monoclonal antibodies production and applications.

Unit III:

Specificity & activation of immune system: Major histocompatibility complex I and II. Polymorphism of MHC genes, role of MHC antigens in immune responses, MHC antigens in transplantation. Humoral immune response and its regulation. Cell mediated immunity-cytolytic and natural killer T lymphocytes. Activation of B lymphocytes.

Antigen-antibody reaction: Formation of antigen-antibody complex. Application of immunodiffusion, RIA, ELISA.Precipitation, Agglutination, Cross reactivity, Concept of Radioimmunoassay, Enzyme-linked immunosorbent assay, Western Blotting, Immunoflorescence, harmful effect of antigen-antibody reactions.

Unit IV

Autoimmunity and hypersensitivity: Self-tolerance and possible mechanisms of induction of

autoimmunity, autoimmune and isoimmune reaction, Autoimmune disease, Organ specific and systemic autoimmune diseases, hypersensitivity.

Immunization: Vaccination, vaccines types, vaccines developments,active and passive immunization by vaccines, importance of vaccine.

Unit - V

Immunological disorders: Allergy and allergens, autoimmune disorders, Immunodeficiency diseases, reorganization of immune deficiency, Immune response in various infectious diseases, Immunity in AIDS and Cancer, introduction of immune haematology, introduction of transplantation immunology.

Suggested Readings:

- I.M. Riott, J. Brostoff, D. Male "Immunology" 3rd edn. W.H. Freeman and Pub. Company,
- J. Kuby "Immunology" 3rd edn., Mosby Year Book Co., England
- Introduction to Immunology, NandiniShetty (2003)
- Immunology, Janis Kuby, W. H. Freeman and Co. 7th edition (2019)
- Janeway'sImmunobiology 2012 8th ed., Murphy, K., Mowat, A., and Weaver, C.T.,Garland Science (London & New York),

Course outcomes:

- They will understand structure and functions of different classes of immunoglobulin.
- To understand the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.
- They will be acquainted with the importance of antigen-antibody interaction in disease diagnosis.

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Subject I
Semester VII
701: Immunology
Practical

Course objectives :

- Students will develop skills to isolate lymphocytes from blood/spleen and to perform
- Various immunoassays such as Ouchterlony double immunodiffusion, Western
- Blotting, ELSA, for diagnosis of various diseases. Students will also
- Learn techniques to purify immunoglobulins and the principles of blood typing.

Practical content:

1. Isolation of lymphocytes from blood/spleen.
3. Purification of antibodies of immunoglobulins
4. Demonstration of Antigen antibody interaction or binding reaction.
5. Assays based on agglutination reactions - Blood typing (active) and passive agglutination.
6. Enzyme linked immunosorbent assay (ELISA).

Course outcomes:

- The Students will develop skills to isolate lymphocytes from blood/spleen and to perform
- The various immunoassays such as Ouchterlony double immunodiffusion, Western Blotting, ELSA, for diagnosis of various diseases.
- To learn techniques to purify immunoglobulins and the principles of blood typing.
- To learn about salient features of structure of various immune cells and organs.

Subject II
Semester VII
Discipline Specific Elective Course (DSE – IV)
702: Biochemistry of Hormones

Course objectives:

- The students will understand the different modes of communication between cells including signal reception, transduction, amplification and response.
- Theywill understand the role of endocrine system in maintaining ionic and glucose homeostasis and the communications that regulate growth appetite, metabolism and reproduction in humans.
- The students will be able to decipher molecular and biochemical mechanisms of all hormones and will be in a position to interpret hormonal levels in individuals with health and disease conditions.
- Besides,students will also understand the role of various plant hormones in growth and development of plants.

Unit I

Chemical classification of hormones, Functions of hormones andtheir regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrineand neuroendocrine mechanisms. General introduction to Endocrinology.Hormone receptors - extracellular and intracellular. Receptor - hormone binding,G protein coupled receptors, second messengers, Effector systems – adenylate cyclase, guanyl cyclase, PDE, PLC. Protein Kinase. Steroid hormone Receptor. Receptor regulation.

UnitII

Pituitary: anatomy, histology and secretions. Physiological and biochemical actions of pothalamic hormones and anterior pituitary hormones; Posterior pituitary hormones –structure, physiology and biochemical actions of AVP and Oxytocin.

UnitIII

Thyroid gland - Histology; Biosynthesis of thyroid hormone and its regulation:Role of TRH and TSH in T4 synthesis and response. Physiological andbiochemical action of Thyroxine. Pathophysiology of thyroxine secretion: Hyperand hypothyroidism, 'Goiter, Graves' disease, Cretinism, Myxoedema.

Regulation of calcium homeostasis: PTH, Vitamin D and calcitonin. Regulation of Growth: growth hormone and somatostatin, Endocrine disorders - gigantism, acromegaly, dwarfism, pygmies.Physiology and biochemical actions of Growth factors- EGF, PDGF
And Erythropoietin.

UnitIV

Hormones of adrenal gland: Physiology and action of Aldosterone; the ReninAngiotensin System. Physiology and Biochemical actions of Cortisol. Adrenalmedullary Hormones: Epinephrine and Norepinephrine. General adaptationsyndrome: acute and chronic stress response. Pathophysiology – Addison'sdisease, Conn's syndrome.

UnitV

Hormones in digestion :The gastrin familyof hormones and CCK: the secretin family of hormones,Summary of hormone metabolite control of GI function. Hormones of thePancreas:

Structure, synthesis, physiology and biochemical actions of insulin andglucagon. Adipocyte hormones: Adiponectin and leptin; Appetite and satietycontrol.
Male and female sex hormones. Hormones during ovarian and uterine phasesof menstrual cycle; Placental hormones; role of hormones during parturition andlactation.

Suggested Readings :

1. Lehninger:PrinciplesofBiochemistry(2017)7thed.,Nelson,D.L.andCox,M.M. W.H. Freeman & Company (New York
2. Vander'sHumanPhysiology(2019)15thed.,Widmaier,E.P.,Raff,H.andStrang, K.T. McGraw Hill International Publications (USA)
3. Endocrinology (2007) 6thed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc.
4. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA).

Course outcomes:

- Theywill understand the role of endocrine system in maintaining ionic and glucose homeostasis and the communications that regulate growth appetite, metabolism and reproduction in humans.
- The students will be able to decipher molecular andbiochemical mechanisms of all hormones and will be in a position to interpret

hormonal levels in individuals with health and disease conditions.

Subject II
Semester VII
Discipline Specific Elective Course (DSE – IV)
702: Environmental Biochemistry

Course objective:

- Develop a qualitative and quantitative understanding of the major chemical processes involved in Earth systems
- Use standard chemistry measurement and conversion methods
- Describe matter in terms of chemical composition, on elemental and molecular levels
- Understand basic chemical models that define chemical processes and describe characteristics, and their effects on environmental systems
- Develop an understanding of chemicals, chemical processes, their effects on the environment, and their use in human activities such as water and wastewater treatment
- Obtain a basic understanding of how natural chemical systems are altered by anthropogenic influences

Unit I:

Enviornment Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biochemical cycles of C, N, P, S, & O, Biodistribution of elements.

Unit II

Hydrosphere Chemical composition of water bodies- lakes, streams, rivers & wet lands etc. Hydrological cycle. Aquatic pollution & water quality: Inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters- dissolved oxygen, biochemical oxygen demand, solids, metals, and contents of chloride soleplate, phosphate, nitrate and microorganisms. Water quality standards. Analytical methods for measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc), residual chloride and chloride demand.

Unit III:

Purification & treatment of water Introduction, potability of water, sterilisarion and disinication of water by ozonization and silver ion method, removal of gas from water determination softening of water by lime soda process, determination of hardness of water by soap and titration method

Unit IV:

Soils Composition, micro and macro nutrients, pollution, fertilizers, pesticides, plastic and metals, Waste treatment system

Unit V:

Atmosphere Chemical composition of atmosphere- particles, ions, radicals and their formation. Chemical & photochemical reactions in atmosphere, smog formation. Oxides of N,C, S, O and their effects. Air pollution: Pollution by chemicals, petroleum, minerals, chlorofluorocarbons.

Green house effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants, Continuous monitoring instruments.

Suggested Readings:

- H.W. Willard, LL. Merritt and J.A. Dean: Instrumental Methods of Analysis
- Vogel's Text book of Quantitative Inorganic Analysis.
- Analytical Chemistry Instrumental Methods of Analysis H. Kaur
- Green Chemistry: Environment Friendly Alternatives by Rashmi Sanghi, M M Srivastava
- H.W. Willard, LL. Merrit and J.A.Dean: Instrumental Methods of Analysis. Affiliated East-West).
- D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson). 4. J.G. Dick : Analytical Chemistry (McGraw Hill).
- Analytical method manual of APHA, 2005.

Course outcomes:

- Use standard chemistry measurement and conversion methods
- Describe matter in terms of chemical composition, on elemental and molecular levels
- Understand basic chemical models that define chemical processes and describe characteristics, and their effects on environmental systems
- Develop an understanding of chemicals, chemical processes, their effects on the environment, and their use in human activities such as water and wastewater treatment
- Obtain a basic understanding of how natural chemical systems are altered by anthropogenic influences

Subject II
Semester VII
Minor
703: Biochemistry of Drugs

Course objectives:

- To give knowledge of nature and sources of drugs, Routes of drug administration and dosage forms.
- The students will know the application of Pharmacokinetics in new drugdevelopment and designing, drug delivery systems.
- Antipyretic and analgesic drugs, NSAIDS, Pharmacology of cough etc.
- The students will know the mechanism of action of a drug, Drug Receptors etc.
- The students will know the General principles of chemotherapy of infections.

Unitl
General Pharmacology
Nature and sources of drugs, Routes of drug administration and Dosage forms,Absorption and Bioavailability of drugs, Factors affecting drug absorption, Distribution of drugs,Fate of drugs. Pharmacokinetic models, Application of Pharmacokinetics in new drugdevelopment and designing, drug delivery systems

Unit II
Dosage form consideration in preformulation, solid dosage form, solution formulations,emulsion, suspension, freeze dried products and its regulatory considerations, drug design phase,
solubility analysis, dissolution and permeation, characterization scheme, stability tastings, order of reaction, antioxidants, chelating agents, impurity, GMP related to bulk drugs and APIs,
Quality control of drug.

Unit III
Mechanism of action of a drug, Drug Receptors, Dose response relationship, Adversedrug reactions (ADR), Manifestations of ADR, Factors affecting the drug effect.

Unit IV
Drugs in GIT: Digestants, Antiflatulants, Appetite suppressants, Hypolipidaemic agents.Emetics, drug therapy of vomiting, Vertigo and Diarrhea, Pharmacotherapy of constipation.Sedatives, Hypnotics, Antipyretic and analgesic drugs, NSAIDS, Pharmacology of cough,Hypertension and Heart failure.

Unit V: Chemotherapy
General principles of chemotherapy of infections, Chemotherapy of UTI, Chemotherapyof Malaria, Chemotherapy of Tuberculosis, Chemotherapy of viral infections, Antiseptics,disinfectants and insecticides.

Suggested Readings :

- Textbook of pharmacology by P. Satoshkar
- Medicinal Chemistry by Varley
- Medical Biochemistry by M.N. Chatterji and Rana Shinde
- Pharmaceutical Chemistry by Himalaya Publications.

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Course outcomes:

- The students will know the application of Pharmacokinetics in new drugdevelopment and designing, drug delivery systems.
- Antipyretic and analgesic drugs, NSAIDS, Pharmacology of cough etc.
- The students will know the mechanism of action of a drug, Drug Receptors etc.

Subject I
Semester VIII
Major
801: Clinical Biochemistry

Course objectives:

- Students will learn about the normal constituents of urine, blood and their significance in
- maintaining good health.
- The mechanisms of causation of diseases of liver, kidney and of Cancerwill be explained.
- Students will become aware with the variations in the levels of trigyceridesandlipoproteins and their relationship with various diseases.
- Students will get acquainted with the role of enzymes in diagnosis of various diseases.

Unit I

Water and Electrolyte Balance and Imbalance, Dehydration, Water Intoxication, Acid-Base Balance and Imbalance, Regulation of acid-base by respiration, Regulation of acid-base by renal.

Unit II

Functions of Liver, Liver Function Tests, Renal Function Tests: Glomerular FiltrationTests, Tests for Renal Blood Flow, Tests of Tubular functions, Gastric Function Tests, Thyroid Function Tests.

Unit III

Clinical Significance of Enzyme Assay, Serum Enzymes in Heart Diseases, SerumEnzymes in Liver Diseases, Serum Enzymes in GI Tract Diseases, Serum Enzymes in Muscle Diseases, Serum Enzymes in bone Diseases.

Unit IV

Blood Sugar, Hypoglycemia & Hyperglycemia, Measurement of Blood sugar,Maintenance of Normal Blood Glucose, Introduction to Diabetes Mellitus, Ketone Bodies, FattyLiver & Obesity, Jaundice, faileria, stone diseases.

Unit V

Biochemistry of Cancer cells, Carcinogenesis, Properties of cancer of cells, Biochemistry of Metastasis, Oncogenic Markers &Tumour Markers, Etiology of Cancer.

Course outcomes:

- The learning outcomes include: Qualitative and quantitative analysis of constituents of Biologicalfluids such as urine, blood and their estimation using standard methods.
- To learn estimations of various important biochemical parameters.
- To know how to diagnose different diseases based on normal or abnormal serum values

Subject I
Semester VIII
801: Clinical Biochemistry
Practical

Course objectives:

- Students will learn about the normal constituents of urine, blood and their significance in
- maintaining good health.
- The mechanisms of causation of diseases of liver, kidney and of Cancerwill be explained.
- Students will become aware with the variations in the levels of trigyceridesandlipoproteins and their relationship with various diseases.
- Students will get acquainted with the role of enzymes in diagnosis of various diseases.

Practical content :

- Qualitative and quantitative analysis of urine : proteins, Bence-Jones proteins, Cl-, Ca+2
- Qualitative analysis of abnormal constituents in urine - glucose, albumin, bile
- pigments,bile salts and ketone bodies.
- Experiments on blood
    - Estimation of haemoglobin by cyanmethemoglobin method
    - Determination of A/G ratio in serum
- Isolation and estimation of serum cholesterol
- Serum enzyme assays: alkaline phosphatase, SGOT, SGPT
- Gel Electrophoresis of serum proteins

Course outcomes:

- The learning outcomes include: Qualitative and quantitative analysis of constituents of Biological fluids such as urine, blood and their estimation using standard methods.
- To learn estimations of various important biochemical parameters.
- To know how to diagnose different diseases based on normal or abnormal serum values

Subject II
Discipline Specific Elective Course (DSE – V)
802: Biotechnology

Course level learning outcomes:

- The students will acquire basic knowledge of recombinant DNA technology.
- DNA manipulation in prokaryotes and eukaryotes, engineering of DNA molecules using restriction and modification enzymes.
- They will get acquainted with the use of cloning and expression vectors, creation of genomic and cDNA libraries and their applications.
- Students will also understand the methods for production of proteins using recombinant DNA technology and their application in industrial systems.

UNIT I

Principles of gene cloning: Restriction and modification systems, restrictionendonucleases and other enzymes used in manipulating DNA molecules. Ligation of DNA, DNA, sticky ends, blunt ends, linkers and adapters,homopolymer tailing, Synthetic oligonucleotides.
Cloning vectors-plasmids, pBR322, pUC8. Viruses as vectors, cloning vectors basedon M13 and λ bacteriophage.

Uptake of DNA by cells: Selection and identification for transformed cells,Transfection. Chemical and physical methods of DNA introduction into cells. Directselection, marker rescue. cDNAandGenomiclibraries, Southern and Northernhybridization.

UNIT II

Plant genetic engineering: gene isolation, gene transfer systems, Ti plasmid, plantvirus vectors, electroporation, microinjection, microprojectile technology, geneexpression, regeneration. Application in relation to protein quality, photosyntheticefficacy, nitrogen fixation efficiency and resistance to environmental stresses.

UNIT III

Protein engineering: Sitedirected mutagenesis, yeast two hybridsystems, Production of recombinant pharmaceuticals such as insulin, human growth hormone, Recombinant vaccines.

Plant Tissue culture: Plant tissue culture, anther and pollen culture, protoplast culture,protoplast fusion, embryo rescue, animal cell lines and organ culture.

UNIT IV

Transgenic plants and animals
Production of recombinant proteinsby eukaryotic cells. Fusion tags such as, polyhistidine, glutathione, maltose binding proteins and their role in purification ofrecombinant proteins.Techniques involve in transgenesis, gene transformation technique

UNIT V

Fermentation technology: Fermentors, general design of fermentor, principle, fermentation

processes, production of alcohols, antibiotics, vaccine and enzymes.

Enzyme Technology: Large scale production of enzymes, enzyme bioreactors. Enzyme electrodes, biosensors.

Suggested Readings:

1. Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK)
2. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, UK)
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC)
4. Molecular Cloning: A laboratory manual (2014), 4th ed., Michael R Green and J. Sambrook Cold spring Harbor laboratory press (3vol.)

Course outcomes:

- The students will acquire basic knowledge of recombinant DNA technology,
- DNA manipulation in prokaryotes and eukaryotes, engineering of DNA molecules using restriction and modification enzymes.
- They will get acquainted with the use of cloning and expression vectors, creation of genomic and cDNA libraries and their applications.Students will also understand the methods for production of proteins using recombinantDNA technology and their application in industrial systems.

Subject II
Semester VIII
Discipline Specific Elective Course (DSE – V)
802: Nursing and Hygeine

Course objectives :

- To enable the students to know about human body its functioning and regulation of various mechanisms.
- The student will be aware of cleanliness, daily hygiene and safety precautions .
- Students be acquinted with blood, lymph , CSF and other body fuids.
- They get knowledge of primary medicines and first aid to avoid any emergency.

Unit I

Scope and Concept of nursing :Characteristics,natureand scope of nursing practice, Functions of nurse, Qualities of a nurse, Categories of nursing personnel, Nursing as a profession, History of nursing in India. Values in professional nursing.

Unit II

Documentation and reporting : Documentation – Purpose of reording and reporting, Communication within the health care team, Types of records, ward records medical nursing records, common records – keeping fors, computerized documentation.

Unit III

TemperaturePhysiology, regulation, factors affecting body temperature, Assessment of body temperature – sites, equipments and technique, special considerations.

Pulse : Physiology and regulation, characteristics of pulse, Factors affecting pulse, Alteration in pulse.

Unit IV

Needs of Patient: Providing safe and clean environment, Physical environment, temperature, Humidity, Noise, Ventilation, Light, Odour, Pests control. Reduction of physical hazards : fire , accidents, safety devices.

Unit V

Nutrition :Importance of patients nutrition and food habits, factors affecting nutrition needs, Assessment of nutritional needs, Oral, Eternal, Naso/ Orogastric supplements.Maintenance of the normal diet and nutrition according to the patient's requirements.

Course outcomes :

- To enable the students to know about human body its functioning and regulation of various mechanisms.
- The student will be aware of cleanliness, daily hygiene and safety precautions .
- Students be acquinted with blood, lymph , CSF and other body fuids.
- They get knowledge of primary medicines and first aid to avoid any emergency.