

**DWARAKA DOSS GOVERDHAN DOSS
VAISHNAV COLLEGE**



Department of Biochemistry
Choice Based credit system
ACADEMIC YEAR 2018- 2019

Programme & Programme Code:
B.SC Biochemistry (11)

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SEMESTER I

CORE PAPER –I

NUTRITIONAL BIOCHEMISTRY

TOTAL NO OF HRS : 75

Objective: To understand the different nutritional aspects of food and dietary management

Unit I

15 HRS

Definition of Nutrition.

Basic food groups - Energy yielding, Body building and protective foods. Basic concepts of energy expenditure, Unit of energy, BMR-Factors affecting BMR, **Measurements of energy food Stuffs by bomb calorimeter.**

Calorific value of proteins, carbohydrates and fats, RQ of foods. SDA.

Unit II

15 HRS

Nutritional aspects of carbohydrates. Significance of fibre in the diet; Nutritional Aspects of proteins - Dietary sources, RDA, Physiological role; significance of essential aminoacids, Protein energy malnutrition in children; Nutritional Aspects of lipids - Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs.

Unit III

15 HRS

Vitamins- Classification. function, RDA dietary source & deficiency diseases of water soluble vitamins Vit B1, B2, B5,B6, B9 and B12 and Fat soluble vitamins – A, D, E& K

Unit IV

15 HRS

Minerals- Dietary source, RDA, function & deficiency symptoms of Calcium, Phosphorus, Iron, Iodine, Sodium, Chlorine and Potassium- Supplementation of calcium, Iron rich foods

Unit V

15 HRS

Diabetes mellitus-Definition. Symptoms and types. **Dietary management for Diabetes Mellitus.**

Renal failure- Definition, Causes and types (**acute & chronic**). Dietary management for renal failure patients

Recommended Books

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
2. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
3. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
4. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
5. Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd..

Course Outcome

At the end of the course

The student will be able to

Acquire knowledge about food groups and measure the calorific value of food

Understand the nutritive importance of macronutrients in the body

Comprehend the importance of major and minor trace elements (Minerals),vitamins in the food

ALLIED CHEMISTRY – I

TOTAL NO OF HRS : 75

Objective: To induct rational thinking on fundamental particle of matter, its existence in different forms, their energy and matter exchanges with precise quantification forms scope this paper.

UNIT 1: ATOMIC STRUCTURE

15 HRS

Atom-fundamental particles present in atom – electron, proton and neutron - Arrangement of electrons in an atom-Bohr-Bury rule. Atomic models - Dalton Model, Thomson model, Rutherford and Bohr Model. Planck's quantum theory- postulates and limitations only. atomic number, mass number. Quantum numbers - orbitals types and shapes.

UNIT 2 STATES OF MATTER AND ITS INTER-MOLECULAR FORCES

15 HRS

Matter characteristics-Mass, volume (Definitions only). States of matter-solid, liquid and gases only. Liquid-Density, evaporation, surface tension and Viscosity. **Gas-Pressure**, diffusion and compressibility and gas laws. Charles law, avogadro's law – Intermolecular forces- definition of Vander waal's force, dispersion forces, Hydrogen bonding, dipole-dipole, dipole-induced dipole forces – ideal and real gases definition and equation for combined gas law – ideal gas equation..

UNIT 3 REACTION AT AN sp^3 HYBRIDIZED CARBON

15 HRS

Electronic displacement effects: a) Inductive, resonance and steric effects. Nucleophiles, Electrophiles. Homolytic and Heterolytic bond dissociations(definitions only). Nucleophilic substitution Reactions-Leaving group, Nucleophile, Kinetics and Mechanism of SN_2 , SN_1 stereochemistry of SN_2 and SN_1 reactions of alkyl halides. Competition between SN_1 and SN_2 . Role of Solvent. E_2 reaction-Zaitsev's and Hoffman rule E_1 reaction stereochemistry of E_2 and E_1 reactions.

UNIT 4:

15 HRS

Introduction-System and its types, surrounding, Basic concepts - Work, energy, heat, Intensive and extensive properties. State and path functions. reversible and irreversible process. Exothermic and endothermic process. **First law of Thermodynamics** (definitions only) - internal energy, Enthalpy, heat capacity and specific heat. Limitations of I law of thermodynamics. Need for II Law – Different Statements of II Law –Third law of thermodynamics (only definition). Gibbs Free energy, conditions of spontaneity.

UNIT 5: ERRORS HANDLING IN TITRIMETRIC ANALYSIS

15 HRS

Standard solutions – Normality, molarity, molality – pH, pOH – Henderson hasselbach equation – definition, derivation and significance – **Buffers** – definition and examples (phosphate buffer and chloride buffer)

Recommended Books

- 1) Puri, Sharma and Kalia(2012).Principles of Inorganic Chemistry.33rd Edition.Milestone publishers and distributor, Delhi. India
- 2) B.R. Puri , L.R. Sharma and K.C. Kalia(2014). Principles of Physical Chemistry. 47th edition, Vishal Publishing Co. India
- 3) Robert Thornton Morrison and Robert Neilson Boyd, Organic Chemistry, 6th edition,Pearson Education,India

Course Outcome

At the end of the course

The student will be able to

Firm foundation in the fundamentals/concepts/theories and its applications in solution chemistry.

Learn about various dimensions and units used for basic chemical calculations.

Understand the concept related to material balance for systems with and without chemical reactions.

SEMESTER I

NME-I BASICS OF MEDICAL TERMINOLOGIES

TOTAL NO OF HRS : 35

Objectives: To give the students an insight to the students for better understanding of medical terminologies

UNIT -1

7 HRS

Parts of the Human body - Head, neck, thorax, abdomen, pelvis, upper limbs and lower limbs. Important Internal organs, glands, bones, nerves and muscles present in each part .Head - eyes, ears, nose, mouth, sinuses, brain, cranial bones.

UNIT –II

7 HRS

Human diseases - Definition of terms, signs, symptoms, autopsy, biopsy - artery, vein, nerve, muscle -Medial, lateral, superior, inferior, dorsal ventral, anterior , posterior - tissue, organ, ulcer, cirrhosis, necrosis, cancer, ischemia, angina pectoris, coma, anemia, edema, pus, lymph-lymphoma, acidity, pyrexia, myopia, hypermetropia, hypoxia, cyanosis.

UNIT –III

7 HRS

Medical Terms- (Definitions only) Metabolic diseases - diabetes mellitus, Dabetes insipidus, Kernicterus, Hypertension. Endocrine disorders - hyper and hypo secretions of thyroid, pituitary, reproductive hormones. Neurological disorders - alzheimers disease, schizophrenia, parkinsons, paralysis, migraine, Respiratory disorders - asthma, wheezing, tuberculosis - problems due to smoking, pneumonia. Skin - leucoderma, psoriasis, spontaneous burning syndrome, Complications in pregnancy, abortion, miscarriage.

UNIT -IV

7 HRS

Medical reports - definitions of normality, molarity, molality, osmoles, equivalents, milliequivalents, concept of positive and negative tests, examples for g/mol, mEq/mol, mg/dL, mg/mol -normal range for selected blood parameters- glucose, bilirubin, creatinine, cholesterol, triglycerides, hemoglobin, CRP, urea. Types of samples - whole blood, plasma, serum, urine, CSF, lymph, sweat, gastric juice, sputum, stools (faeces). Route of administration of drugs - oral, Intravenous, subcutaneous, intraperitoneal, nasal , intramuscular.

UNIT -V

7 HRS

Areas of application of medical terminologies - basic knowledge of medical coding, medical transcription, medical billing, insurance sectors, lab technicians, diagnostic labs

Recommended Books

1. Concise Medical dictionary 8th edition (2010). Oxford University Press
2. Human anatomy - CC.Chaterjee
3. Practical Biochemistry – Varley
4. Practical Biochemistry - David Plummer.
5. Medical physiology - Wolf Ganong Lange Publishers.

Course Outcome

At the end of the course

The student will be able to

- Apply Medical Terms in Health Sectors or Medical Reports preparation
- Analyze The Functions of Different Parts of Human body
- Interpret Normal Values Of Metabolic Parameters in laboratory diagnosis.

SEMESTER- II

CORE PAPER – III CELL BIOLOGY

TOTAL NO OF HRS : 75

Objectives: To study and understand the architecture of cells and organelles along with the functions.

UNIT I

15 HRS

Architecture of cells- Structural organization of prokaryotic and eukaryotic cells – microbial, plant and animal cells. The ultra structure of nucleus, mitochondria, RER, SER, golgi apparatus, lysosome, peroxisome and their functions.

UNIT II

15 HRS

Cytoskeleton- microfilament, microtubules and intermediary filament- structure, composition and functions.

UNIT III

15 HRS

Biomembranes- Structural organization of bilipid layer model and basic functions- transport across cell membranes- uniport, symport and antiport. Passive and active transport.

UNIT IV

15 HRS

Cell cycle- Cell division- mitosis and its significance, meiosis (definitions and overview) ,basic characteristics of cancer cells.

UNIT V

15 HRS

Extra cellular matrix – Collagen, laminin, fibronectin and proteoglycans- structure and biological role. Structure and role of cadherin, selectins, integrins, gap junction and tight junction.

Recommended Books

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Sheeler, P and Bianchi, D.E. (2006) Cell and Molecular Biology, 3rd edition, John Wiley & sons NY
4. Cell and molecular Biology(1986) DE Roberties EDP, EMF Roberties, 7th Edition, saunders company.
5. Geoffrey M. Cooper, Robert E. The Cell: A Molecular Approach Hausman Edition: 4th, 2007: Sinauer associates.

Course Outcome

At the end of the course

The student will be able to

- Comprehend the structure of prokaryotic and eukaryotic cells and function of their cell organelles.
- Understand the structure, composition and function of cytoskeleton and extracellular matrix
- Explain the ultrastructure of biomembrane and the transport mechanism displayed by it.

SEMESTER - II

ALLIED CHEMISTRY – II

TOTAL NO OF HRS : 75

Objective: To understand the basics of kinetic of chemical reaction, nuclear and co-ordination chemistry

UNIT 1 FUNDAMENTALS IN NUCLEAR CHEMISTRY 15 HRS

Fundamental particles of nucleus, isobars, isotopes, isotones, isomers, Mass defect . Nuclear fission- fission chain reaction and critical mass. Differences between chemical and nuclear reactions (definitions only). Application of radio isotopes – carbon dating and medical applications

UNIT 2 BASICS IN CHEMICAL KINETICS 15 HRS

Rate of chemical reaction – average and instantaneous rate (definitions only), factors affecting rate **of reactions** - order and molecularity (definitions only) – integrated rate expression for first, second and zero order reactions (no derivation) . **Half life period – Activation energy.** Arrhenius equation. Arrhenius theory – Homogeneous and heterogeneous catalysis (Definition and Examples only)

UNIT 3 CO-ORDINATION CHEMISTRY AND THEIR CHEMICAL BONDING 15 HRS

Differences between Double salts, co-ordination compounds. Werner Theory of co-ordination compounds terminologies-, Complex, Ligand and its types, coordinations sphere, charge of the complex, chelation, Nomenclature, Homoleptic and heteroleptic complex. Isomerism-structural and stereo isomerism (definitions and examples only) - Bonding in Co-ordination compounds-VBT and CFT(only). Colour, paramagnetism and diamagnetism of Co-ordination complexes - Applications of co-ordination of compounds.

UNIT 4 AN BRIEF INTRODUCTION TO ELECTROCHEMISTRY 15 HRS

Conductor of **electricity**-Electrolytic, metallic and mixed conductors. Kohlrausch's law and its applications. Electrochemical cells-Electrolytic (definitions only) - Galvanic cells – emf – standard electrode potential, half cell reactions (definitions and examples only) electrochemical series and its applications. Nernst equation, equilibrium constant and Gibbs energy of reaction - reference electrodes.

UNIT 5.VOLUMETRIC TITRIMETRY-AN OVERVIEW 15 HRS

Solution, suspension, **colloids** – definitions only.

Colloids – types with examples – dispersed phase, dispersion medium – properties – Tyndall effect, Brownian movement, electroosmosis – Donnan Membrane equilibrium.

RECOMMENDED BOOKS

1. Puri, Sharma and Kalia(2012).Principles of Inorganic Chemistry.33rd Edition.Milestone publishers and distributor, Delhi. India
2. B.R. Puri , L.R. Sharma and K.C. Kalia(2014). Principles of Physical Chemistry. 47th edition, Vishal Publishing Co. India
3. Robert Thornton Morrison and Robert Neilson Boyd, Organic Chemistry, 6th edition,Pearson Education,India

Course Outcome

At the end of the course

The student will be able to

- Realize the concepts of chemistry of coordination compound and Bio inorganic chemistry .
- Apply the knowledge gained in Industry related Jobs.
- understand and apply concept of ionic equilibria, salt hydrolysis and buffer solution.

SEMESTER II

NME – II EVOLUTIONARY BIOLOGY

TOTAL NO OF HRS : 35

Objectives: To expose the student the basics of evolution

Unit I **7 HRS**

Emergence of evolutionary thoughts: Lamarck; Darwin—concepts of variation, fitness and natural selection.

Unit II **7 HRS**

Environment – Biotic and Abiotic environmental factors.

Unit III **7 HRS**

Origin of cells and unicellular evolution: Evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes.

Unit IV **7 HRS**

Evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale.

Unit V **7 HRS**

Adaptation – aquatic, Volant, desert adaptations

Recommended Books

1. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
2. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
3. Smith, T.M. and Smith, R.C. (2006) Elements of Ecology 1st edition Pearson Publications
4. Miller, G.T (2006) Environmental Science 11th edition Brooks/Cole
5. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

Course Outcome

At the end of the course

The student will be able to

Understand and explain the terms of evolution

Develop and explain the importance of evolutionary studies as a foundation of comparative biology

NME - PLANT BIOACTIVE COMPOUNDS IN TRADITIONAL MEDICINE.

Objective: To understand that plant bioactive compounds are secondary plant metabolites eliciting pharmacological or toxicological effects in human and animals.

TOTAL NO OF HRS : 35

UNIT-I

7 HRS

Definition of bio active compounds, types, glycosides, saponins, flavonoids, proanthocyanidins, tannins, terpenoids ,resins, lignans, alkaloids, coumarins and other healing compounds their composition with examples.

UNIT-II

7 HRS

Ethnopharmacology and Types of **traditional medicine in India and other countries**, ayurveda, siddha, unani, Chinese, greek, roman, Arabic, monastery and scientific medicine. Traditional and modern medicine (Difference)

UNIT-III

7 HRS

Plants and bioactive compounds used in traditional medicine Ayurveda , Siddha and Unani - tulsi, turmeric, neem, ashwagandha, brahmi, amla, liquorice, coriander, ginger, Aloe barbadensis Nila vembu kashayam preparation.

UNIT-IV

7 HRS

Plants proved to be effective in the treatment of Diabetes, respiratory disorders, nervous disorders, heart functioning, digestive system, excretory system, arthritis and immune modulation. Plants compounds in combating oxidative stress – Vitamin-A, C, D, E, K, selenium, carotenoids and polyphenols.

UNIT-V

7 HRS

Biochemical techniques in isolation purification and analysis of plant bioactive compounds (Definition and abbreviations only.) PC, TLC, GLC, HPLC, UV, IR, NMR, MS

Recommended Bookss

- 1) Phytochemical methods – A guide to modern technique of plant analysis.Third edition by J B Harbone.
- 2) Bioactive compounds in plants – benefits and risks for man and animals Proceedings from a symposium held at The Norwegian Academy of Science and Letters, Oslo, 13 – 14 November 2008 Edited by: Aksel Bernhoft.
- 3) Plants-herbal wealth as a potential source of ayurvedic drugs. Ajay Kumar Meena, Parveen Bansal, Sanjiv Kumar National Institute of Ayurvedic Pharmaceutical Research, Patiala, India. Asian Journal of Traditional Medicines, 2009, 4 (4)
- 4) Studies on Medicinal Plants used in Ayurveda, Unani and Siddha Systems of Medicine by Neelam Kumar, Centre of Excellence in Dravyaguna and Medicinal Plants Research Institute in Indian System of Medicine, Joginder Nagar, District Mandi (H.P)

Course Outcome

At the end of the course

The student will be able to

- Discuss the plants used in traditional medicine of Ayurveda, siddha, Unani and Greek medicine
- Identify the plants used in the treatment of diabetes, arthritis and immune modulation
- Analyse the plants with different biochemical techniques

SEMESTER III

CORE PAPER – II CHEMISTRY OF BIOMOLECULES

TOTAL NO OF HRS : 75

Objectives : To understand the structure-function relationship of Biomolecules

UNIT I

15 HRS

Carbohydrates: Classification of carbohydrates, stereoisomerism and optical isomerism of sugars, anomeric forms and mutarotation. Occurrence, structure and biological importance of mono, di (Lactose, maltose, sucrose) and polysaccharides (starch, cellulose, glycogen, dextrin, inulin). Physical and chemical properties of carbohydrates reactions (oxidation, reduction, reaction with phenylhydrazine, esterification, etherification). Heteropolysaccharides (Structure not needed).

UNIT II

15 HRS

Classification and structure of amino acids. Physical and chemical properties of amino acids. **Protein- classification** based on solubility and composition, shape, and function. Properties of proteins. Denaturation and renaturation of proteins..

UNIT III

15 HRS

Determination of amino acid sequence of a polypeptide chain. Protein structure- primary, secondary, (α -helix and β -pleated sheet), tertiary and quaternary structures of proteins (basic concepts). Structure of peptide bonds. **Forces stabilizing the secondary, tertiary and quaternary structure of proteins.**

UNIT IV

15 HRS

Structure of purine and pyrimidines, nucleosides and nucleotides. Differences between DNA and RNA, double helical structure of DNA, **Types of RNA –m-RNA, t-RNA, r-RNA** and their biological functions.

UNIT V

15 HRS

Definition and classification of lipids- **chemical properties of fats- iodine value, saponification value, acid number, rancidity, RM value.** Structure and biological functions of Lecithin, Cephalins, phosphatidyl inositol, Plasmalogen, sphingomyelin, cerebrosides, gangliosides.. Sterols (Cholesterol only), bile acids and bile salts.\

Recommended Books

1. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H Freeman and Co.
2. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill.
3. Biochemistry – Zubay G.L, 4th edition, 1998, Mc Graw-Hill.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
5. J.L JAIN fundamentals of Biochemistry S. Chand publications(2004),reprint edition

Course Outcome

At the end of the course

The student will be able to

Comprehend the structure of prokaryotic and eukaryotic cells and function of their cell organelles.

Understand the structure, composition and function of cytoskeleton and extracellular matrix

Explain the ultrastructure of biomembrane and the transport mechanism displayed by it.

SEMESTER III

ALLIED –II MICROBIOLOGY – I

TOTAL NO OF HRS :75

Objective: To expose the students to the structural and growth characteristics of microorganisms

UNIT 1

15 HRS

Evolution of Microbiology. Classification of micro-organisms (Bergey's system of Classification). Structural characteristics of Bacteria. Actinomycetes.

UNIT II

15 HRS

Basic microbiological techniques - Cleaning of glassware. Sterilization of glassware and media. Streak plate, spread plate, pour plate, enrichment culture, single spore isolation, serial dilution, standard plate count. Lyophilization. Types of culture media. Staining techniques-simple and differential.

UNIT III

15 HRS

Structural characteristics of fungi (molds and yeasts) and Protozoa - Entamoeba, Plasmodium, Mycoplasma and viruses (general structure), HIV Structure.

UNIT IV

15 HRS

Cultivation of bacteria-nutritional requirements and nutritional types of bacteria, physical conditions for growth, bacterial growth curve. Measurement of microbial growth (turbidity, biomass, cell count)

UNIT V

15 HRS

Microbiology of Soil. Microbes in soil, rhizospheres and rhizoplane. Nitrogen fixation –symbiotic and asymbiotic. Rhizobial Biofertilizers.

Recommended Books

1. Microbiology - Michael J.Pelczar I.R., Chan E.C.S and Noel R.Kreieg, 2004, 5th Edition, 27th reprint Tata McGRAW-Hill, New Delhi.
2. Principles of microbiology-Atlas RM,1997, WCB publishers.
3. Microbiology –Prescott,2003, 3rd edition, Mc Graw hill, Boston.
4. Microbiology – Panicker, 2006,6th edition, Sarup & Sons ,New Delhi
5. Microbial methods – J.Collins.

Course Outcome

At the end of the course

The student will be able to

Understand about the microorganisms and its nature.

Demonstrate staining procedures.

Measure the growth of microorganisms and apply the knowledge in food , Water industry.

SEMESTER IV

CORE PAPER IV BIOCHEMICAL TECHNIQUES

TOTAL NO OF HRS : 75

Objectives: To understand the principles and procedure of techniques employed in Biochemistry

UNIT I

15 HRS

CENTRIFUGATION Basic principles of centrifugation, RCF, Types of Rotors, Principle, procedure and applications of differential and density gradient centrifugation, Preparative and analytical ultracentrifugation Determination of Molecular weight (Derivation excluded).

UNIT II

15 HRS

CHROMATOGRAPHY: Principles of chromatography, Paper chromatography, Thin layer chromatography, Ion exchange, Affinity chromatography, Gel permeation chromatography, HPLC and GLC

UNIT III

15 HRS

PRINCIPLES OF SPECTROSCOPY: Basic principles of electromagnetic radiation, energy, wavelength, wavenumber and frequency – absorption and emission spectra, Beer- Lambert law, light absorption and transmittance. UV and Visible spectrophotometry – Principle, instrumentation and applications on enzyme assays and kinetic assays, protein structural studies. Applications of MALDI and NMR

UNIT IV

15 HRS

ELECTROPHORETIC TECHNIQUES: Definition, Factors affecting electrophoresis – Principle, procedure and applications of Paper, Cellulose acetate/Nitrate, Agarose gel electrophoresis, SDS PAGE and Its applications.

UNIT V

15 HRS

RADIOACTIVITY

Atomic structure, radiation, types of radioactive decay, half life, units of radio activity. Detection and measurement of radioactivity - methods based upon ionization (GM counter), methods based upon excitation (Scintillation counter). Autoradiography and isotope dilution techniques. Applications of radioisotopes in the elucidation of metabolic pathways, clinical scanning and radio dating. Biological hazards of radiation and safety measures in handling radio isotopes.

Recommended Books

1. A biochemical Guide to principles and techniques of practical biochemistry - Keith Wilson and Kenneth H. Goulding
2. Principles and techniques of practical biochemistry - Bryan L. Williams and Keith Wilson
3. Instrumental methods of Analysis - Chatwal – Anand
4. Hage D S and Carr J D, (2010) Analytical Chemistry & Quantitative Analysis, Prentice Hall
5. Analytical Biochemistry - R.B Turner, Elsevier, N.Y.

Course Outcome

At the end of the course

The student will be able to

separate biological sample by centrifugation and separate sub cellular organelles by differential centrifugation acquiring analytical skills to separate amino acids and sugar using paper and thin layer chromatography. assay biochemical parameters using UV spectroscopy and spectrofluorimetry, electrophoresis.

SEMESTER – IV**ALLIED PAPER- MICROBIOLOGY – II****TOTAL NO OF HRS : 75**

Objective: To study the applications of microbes in various fields and to know the pathogenicity of certain microbes.

UNIT I**15 HRS**

Microbiology of water. Municipal water purification. Sewage water treatment –Primary, Secondary and tertiary

Microbiology of air. Microbes in air. Methods of purification of air, Air sampling devices

UNIT II**15 HRS**

Food microbiology. Types of food, Factors affecting number and kind of microbes in food, Microbial spoilage of meat and fish. Food preservation techniques-Asepsis, Canning, Bottling, Smoking, Pasteurization and Bottling, Salting, dehydration (hot and cold).

UNIT III**15 HRS**

Microbiology of milk. Microbes in milk and their sources. Pasteurization. Phosphatase and reductase tests. **Dairy products- cheese and yoghurt.**

UNIT IV**15 HRS**

Industrial microbiology. Microbes in the production of organic acids (Citric acid, Vinegar), antibiotics (Penicillin & Streptomycin) and alcoholic beverages(Beer, Wine).

UNIT V**15 HRS**

Microbes and diseases- microbial flora of healthy human host, infection and its types.

Immunity (native, acquired) Vaccines (live, attenuated & recombinant).

Pathogenesis-bacterial pathogens (Salmonella, Mycobacterium tuberculosis, E.coli, HIV-Life cycle and AIDS,

Recommended Books

1. Pelzar, Chan and Reid, 1986.Microbiology.Tata Mcgraw Hill.
2. Purohit S.S.1991.Microbiology.Agro Botanical Publishers.
3. Microbiology –Prescott,2003, 3rd edition, Mc Graw hill, Boston.
4. Ananthanarayanan R. and Panicker J. 1986. Textbook of Microbiology.Orient Longmans
5. Frazier W.C. 1978.Food Microbiology. Mcgraw Hill

Course Outcome**At the end of the course**

The student will be able to

Understand about the microorganisms and its nature.

Demonstrate staining procedures.

Measure the growth of microorganisms and apply the knowledge in food , Water industry.

SEMESTER V

CORE PAPER -V ENZYMES

TOTAL NO OF HRS : 75

Objective: To educate the students about enzymes, the kinetics of reactions catalyzed by them and industrial applications of enzymes

UNIT I

15 HRS

Introduction : Nomenclature, IUB system of enzyme classification, specificity, turn over number enzyme units (IU and Katal), active site, allosteric site.

UNIT II

15 HRS

Enzyme Kinetics: Rate and order of reactions, factors affecting the enzyme activity, derivation of Michaelis - Menton Equation, Significance of K_m , Line - Weaver and Burk plot. Enzyme inhibition –Competitive, non-competitive and uncompetitive inhibitors (kinetic derivations excluded) with suitable examples.

UNIT III

15 HRS

Mechanism of enzyme action Fischer's Lock and Koshland's Induced fit hypothesis and induced fit hypothesis – Activation energy. acid base catalysis, metal ion and covalent catalysis

UNIT IV

15 HRS

Cofactors & coenzymes Prosthetic group : Structure and functions of NAD, FAD, CoA, biotin, cobamide, TPP, PLP, THF with one example.

UNIT V

15 HRS

Enzyme application: Industrial uses of enzymes - Amylase, Protease and Lipase- Immobilized enzymes production and applications. Abzymes and ribozymes.

Recommended Books

1. Understanding enzymes – palmer(2007), second edition,elseiver publishers
2. Biochemistry - Geoffrey L, Zubay, 1998, 4th edition.
3. Fundamentals of Biochemistry - Donald Voet, Judith Voet and Pratt, 1995, 2nd edition.
4. Harper's Biochemistry - Murray et al, 2000, 40th edition, Appleton and Lange Publishers.
5. Principles of Biochemistry - Lehninger, Nelson and Cox, 2005, 4th edition, WH Freeman and Company, New York, USA

Course Outcome

At the end of the course

The student will be able to

Gain fundamental knowledge about the nature, properties, nomenclature and classification of enzymes and coenzymes

Analyze factors affecting enzyme activity, deduce Michaleis Menten equation and apply the understanding on enzyme inhibition in medicine and industry

Relate the use of enzymes and immobilized enzymes in industry.

SEMESTER V

COREPAPER- VI INTERMEDIARY METABOLISM

TOTAL NO OF HRS : 75

Objective: To Introduce the metabolic pathway with reference to carbohydrates and to interrelate it with other metabolic pathways

UNIT I

15 HRS

Introduction to Intermediary metabolism. Metabolism-Catabolism and Anabolism

Carbohydrates metabolism: The glycolytic pathway – aerobic and anaerobic glycolysis, energetics, Pyruvate to acetyl CoA and its energetics, citric acid cycle and its energetics. Glycogenesis and glycogenolysis –Reactions and its regulation, Pentose phosphate pathway Reactions and its significance.

UNIT II

15 HRS

Electron transport chain - components and reactions of ETC. Oxidative phosphorylation –Chemiosmotic hypothesis, Uncouplers of Oxidative phosphorylation. Energetics. High energy compounds-Definition and examples ATP, SAM

UNIT III

15 HRS

Protein metabolism – Introduction- catabolism of amino acids- Phenyl alanine, Leucine Transamination, Oxidative and Non-oxidative Deamination, Decarboxylation – Urea cycle and its regulation. Biosynthesis of creatinine.

UNIT IV

15 HRS

Lipid metabolism –Biosynthesis of saturated fatty acids. Oxidation of fatty acids – Beta oxidation- Role of carnitine, Energetics of Palmitic acid Oxidation, alpha oxidation and omega oxidation. Biosynthesis of cholesterol. Ketogenesis.

UNIT IV

15 HRS

Nucleic acid metabolism- Biosynthesis of purine nucleotides – Denovo synthesis and salvage pathways, regulation of purine biosynthesis. biosynthesis of pyrimidine nucleotides - Denovo synthesis and salvage pathways, regulation of pyrimidine synthesis. Catabolism of purine nucleotides and pyrimidine nucleotides - regulation.

Recommended Books

1. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox (Hardcover - Feb 1, 2008)
2. Fundamentals of Biochemistry: Life at the Molecular Level by Donald J. Voet, Judith G. Voet, and Charlotte W. Pratt (Hardcover - Jan 14, 2008)
3. Harper's Illustrated Biochemistry (Harper's Biochemistry) by Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (Paperback - Jun 13, 2006)
4. Biochemistry - Geoffrey L. Zubay, 1998, 4th edition.
5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
6. D. Anandhi- Introduction to Meatbolism-Pearson Pulications-2014

Course Outcome

At the end of the course

The student will be able to

Explain how carbohydrates get metabolized in the body via glycolysis, TCA cycle and how we derive energy from it.

Understand how ATP is formed through Electron transport chain and oxidative phosphorylation.

Describe the metabolism of lipids and nucleic acids.

SEMESTER V

CORE Paper –VII HUMAN PHYSIOLOGY

TOTAL NO OF HRS : 75

Objective: To study the anatomy and physiology of human system

UNIT I

15 HRS

Blood composition and function, types of blood cells, morphology and function. **Blood groups- ABO and Rhesus system**. Composition and function of lymph and lymphatic System. Respiratory system- structure & function of different components of respiratory units. mechanism of respiration. Gaseous Exchange, Bohr's effect.

UNIT II

15 HRS

Circulatory System- Heart- structure, properties of cardiac muscle. overview of systemic and pulmonary circulation, conducting system of the heart, **heart rate, cardiac cycle, cardiac output**, Systolic and Diastolic pressure.

UNIT III

Digestive systems: Structure of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salt in digestion of lipids, Mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive process.

UNIT IV

15 HRS

Excretory system-Structural components of urinary system: Kidney structure and its organization. **Mechanism of urine formation- Glomerular filtration rate (GFR)**, Tubular Secretion and reabsorption.

UNIT V

15 HRS

Brief outline of **nervous system**-brain (parts and ventricles), spinal cord, nerve fibres, synapses, chemical and electrical synapses, Transmission of **nerve impulses**, action potential and neurotransmitters-Cholinergic and Adrenergic Neurotransmitters.

Muscles-Types of muscles and their functions: myofilamentation and **contraction and relaxation of skeletal muscles.**

Recommended Books

1. Chatterjee, C.C - Human Physiology – Volume I & II, 11th edition, 1992.
2. Human physiology, 2nd edition- BJ Mejer, HS Meij, AC Meyer, AITBs publishers and distributors.
3. Cell physiology by Giese, 5th edition, W.B saunders company, Tokyo, Japan.
4. A text book of animal physiology, KA Goel, KV Sastri, Rastogi publications Meerut.
5. A Hand Book of Basic Human physiology- K. Saradha subramanyam, S. Chand & Co., Ltd..
6. Principles of Anatomy and physiology (Gerard of Tortora/Bryan Derrickson, Wiley

Course Outcome

At the end of the course

The student will be able to

Understand the functions of blood and circulatory system

Learn the process of digestion and absorption and it can be applied in the field of medicine

Learn the process of gaseous exchange in tissues and lungs and the mechanism of muscle contraction

SEMESTER V

CORE PAPER -VIII MOLECULAR BIOLOGY

TOTAL NO OF HRS : 75

Objective: To acquire knowledge about the central dogma of cell

UNIT I

15 HRS

Central Dogma of Molecular Biology. DNA as the vehicle of inheritance – experimental evidence – Griffith, McLeod, McCarty and Avery, Hershey – Chase experiments.

UNIT II

15 HRS

DNA replication -semi conservative mode of replication, replication fork, semi discontinuous replication-Okazaki fragments. Enzymes of replication – DNA polymerases I, II, III, topoisomerases, helicases, binding proteins and ligases.

Replication in E.coli – replisomes, events at OriC (initiation), events on the replication fork (elongation) and termination. Fidelity of replication, Inhibitors of replication.

UNIT III

15 HRS

Transcription – Structure and functions of prokaryotic RNA polymerases. Initiation, elongation and termination –Rho dependant and Rho independent termination-Hair Pin loop Formation. Inhibitors of Prokaryotic transcription.

UNIT IV

15 HRS

Genetic code –Codons and anticodons. Basic features of genetic code. Deciphering of genetic code. Wobble hypothesis.

Protein biosynthesis-Prokaryotic ribosomes-Shine dalgarno sequence, Aminoacyl tRNA synthetases. Stages involved in protein biosynthesis-Initiation, Elongation and termination. Inhibitors of translation.

UNIT V

15 HRS

Regulation of **gene expression** in prokaryotes. Operon concept – Inducible operon, Positive and negative regulation of lac operon and trp operon

Recommended Books

1. Biochemistry (Biochemistry (Berg)) by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer (Hardcover - May 19, 2006)
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox (Hardcover - Feb 1, 2008)
3. The Biochemistry of the Nucleic Acids by R.L. Adams, J.T. Knowler, and D.P. Leader (Paperback - May 31, 1992)
4. Molecular Biology of the Gene (6th Edition) by James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann (Hardcover - Dec 15, 2007)
5. David Freifelder (1983) Jones & Bartlett publishers. 2ed Molecular biology. Reprint (1993) Narosa Publishing House.

Course Outcome

At the end of the course

The student will be able to

Carry out experiments related to gene expression studies.

Develop Media kits to identify the microorganisms using molecular biology techniques

Understand the concepts of genetic code and relate it to translation process and explain protein biosynthesis

SEMESTER V

ELECTIVE PAPER I - PRINCIPLES OF BIOTECHNOLOGY

TOTAL NO OF HRS : 75

Objective: To introduce the basics concepts in the field of applied biotechnology

UNIT I

15 HRS

Biotechnology – Introduction, Scope, definition, History and Application - Brief history of recombinant technology- Restriction endonuclease- DNA cutting enzymes, DNA ligase-DNA joining enzymes, alkaline phosphatase, DNA modifying enzymes

UNIT II

15 HRS

Vectors- the cloning vehicles- plasmids, bacteriophages, cosmids, artificial chromosome vectors, shuttle vectors, preparation of rDNA, insertion of r DNA into vector, methods of transfer, selection of recombinants and screening – genetic methods, immuno chemical methods, South-Western screening, Nucleic acid hybridization methods, radio-active and non-radioactive labelling of probes.

UNIT III

15 HRS

Animal Biotechnology- animal cell culture, tissue culture- gene transfer methods in animals- transfection- microinjection, electroporation, cell viability, cell transformation- transgenic animals- applications.

UNIT IV

15 HRS

Plant Biotechnology: Agro bacterium – mediated gene transfer to plant cells, microprojectiles, transgenic plant technology – for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins.

UNIT V

15 HRS

PCR-types and applications. gene therapy, antisense therapy, production of insulin in *E. coli*.

RECOMMENDED BOOKS

1. Brown TA Gene Cloning and DNA Analysis ; Blackwell Publishing; (2006)
2. Twyman RM, Primrose SB Principles of Gene Manipulation and Genomics ; Blackwell Publishing; (2006)
3. Old RW, Primrose SB An Introduction to Genetic Engineering S.B; Blackwell Science (2003)
4. U.Satyanarayana, Biotechnology,Uppala Author –Publisher interlinks (2005).
5. R.C.Dubey,A Textbook of Biotechnology- S.Chand and Company Ltd (2005)
6. Freidfelder 1990. Molecular Biology.
7. Rastogi 1997. Concept in Molecular Biology.
8. Brown. T.A. 1999. Genomes John & Sons (Asin). Singapore.
9. Howkins J.D. 1996. Gene structure and expression. Cambridge.
10. Twyman. R.M. 1998. Advanced Molecular Biology. ViVa book, Chennai.
11. Benjamin Lewin, 2000. Gene VII.
Watson, 1996 4th Ed. Molecular biology of the gene. Benjamin and cumming publication.
Datnel, Lodish and Baltimore 1968. Molecular cell biology. Scientific American publication

Course Outcome

At the end of the course

The student will be able to

Familiarise with the basic knowledge of Tissue culture, Molecular biology, rDNA technology, plant transformation.

Opportunity to contribute to cutting edge research.

Have access to training and support to develop a broad range of professional skills.

SEMESTER VI

CORE PAPER –IX BIOINFORMATICS

TOTAL NO OF HRS : 75

Objective: To expose the students the computational methods applied in the field of Biochemistry

UNIT-I

15 HRS

Introduction to Bioinformatics – Bioinformatics and its applications. – Genome, Metablome-Definition, and its applications. Metabolome-Metabolome database-E.Coli metabolome database, Human Metabolome database. Transcriptome-Definition and any three applications.

UNIT II

15 HRS

Biological Databases - definition, types and examples –, Nucleotide sequence database (NCBI, EMBL, Genbank, DDB) Protein sequence database- Swiss Prot, TrEMBL, Structural Database- PDB, Metabolic database-KEGG

UNIT III

15 HRS

Sequence Alignment-Local and Global alignment-Dot matrix analysis, Pam, BLOSUM. Dynamic Programming, Needleman-Wunch algorithm, Smith waterman algorithm

UNIT IV

15 HRS

Heuristic methods of sequence alignment-BLAST-features, types (BLASTP, BLASTN, BLASTX), PSI BLAST, result format-DNA Microarray-Procedure and applications.

UNIT V

15hrs

Genomics and Proteomics. Structural genomics-Whole genome sequencing (Shotgun approach), Comparative genomics-tools for genome comparison, VISTA servers and precomputed tools. Molecular visualization tools. RASmol, Swiss PDB viewer. Nutrigenomics- Definition.

Recommended Books:

1. T.K. Attwood and D.J. Parry – Smith, Introduction to bioinformatics, Pearson Education Ltd., New Delhi (2004).
2. Arthur M. Lesk, Introduction to bioinformatics, Oxford University Press, New Delhi (2003).
3. S. Sundara Rajan and R. Balaji, introduction to Bioinformatics, Himalaya Publishing House, New Delhi (2002).
4. Bioinformatics- Lohar .MJP publishers,First edition
5. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
6. Nutrigenomic and nutrigenetics in functional foods and Personalized nutrition-Lynnete R Ferguson, CRC Press.

Course Outcome

At the end of the course

The student will be able to

Gain Knowledge as professionals are working in pharmaceutical and Biotech companies.
Perform and infer bioinformatics and statistical analyses with real molecular biology data.
Develop pipelines of analysis tools to analyse real-world biological data sets

SEMESTER VI

CORE PAPER –X IMMUNOLOGY

TOTAL NO OF HRS : 75

Objective: To understand the concepts related to immune system of human body

UNIT II

15 HRS

Structure and function of primary lymphoid organs (thymus ,bone marrow), secondary lymphoid organs (spleen, lymph node), reticuloendothelial cells, phagocytosis.

UNIT II

15 HRS

Antigens – Nature, immunogens, haptens. Immunoglobulin types - structure and function. Cells involved in antibody formation, differentiation of T and B lymphocyte, Clonal selection theory, co-operation of T-cell with B-cell. Monoclonal antibody – production and application in biology.

UNIT III

15 HRS

Immunity and its types-Innate, Acquired, active and passive. Commonly used toxoid **vaccines**, killed vaccines, live attenuated vaccines, rDNA vaccines. Humoral and cell mediated immunity. Complement proteins-Definition, Classical pathway

UNIT IV

15 HRS

Antigen-antibody reactions, General features of Antigen Antibody reactions. Precipitation, Immunodiffusion, Oudin Procedure, Oakley Fulthrope Procedure, Radio immunodiffusion, Ourlony double diffusion, CIE, Rocket electrophoresis, Agglutination-Coomb's test Complement Fixation test-Wasserman's reaction, RIA, ELISA.

UNIT V

15 HRS

Hypersensitivity – Immediate (Type 1) and Delayed (Type IV), Auto-immune diseases with examples. Organ specific and systemic autoimmunity. SLE, RA. Transplantation – Types of Grafts, structure & functions of MHC, graft Vs host reaction, immunosuppressive Agents.

Recommended Books

1. Immunology – Janis Kuby, 2000, 4th edition, WH Freeman Company, USA.
2. Essential Immunology – Ivan Roitt, 1997, Blackwell Science Publishers, UK.
3. A Hand Book of Practical Immunology – Talwar G.P, 1983, Vikas Publishing House.
4. An introduction to Immunology – Rao C.V, 2002, 1st edition, Narosa Publishers, India.
5. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

Course Outcome

At the end of the course

The student will be able to

Carry out experiments related to gene expression studies.

Ability to Develop testing kits to identify the microorganisms using molecular biology techniques

Understand the concepts of genetic code and relate it to translation process and explain protein biosynthesis

SEMESTER VI

CORE PAPER –XI PHARMACEUTICAL BIOCHEMISTRY

TOTAL NO OF HRS : 75

Objective: To understand the basic concepts related to drug and drug metabolism in the body.

UNIT-I

15 HRS

Drug - Structural feature and pharmacology activity, prodrug concept. Absorption - first –pass effect. Distribution, metabolism- Phase I, II reactions, action of cytochrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug – receptor interaction, agonist & antagonist.

UNIT-II

15 HRS

Adverse response to drugs, IC 50,LD50, of a drug - Drug tolerance, Drug intolerance, Idio synergy (pharmacogenesis), drug allergy- allergic responses to sulphadugs. Drug abuse.

UNIT-III

15 HRS

Novel drug delivery systems– role of liposomes and nanoparticles in drug delivery – non conventional routes of administration. Anti-AIDS drug development.

UNIT-IV

15 HRS

Mechanism of action of drugs used in therapy of GI tract disorder – Digestants, appetizers vomiting, constipation suppressants . Hypolipidemic agents, and peptic ulcer. Antibiotics – sulfonamides, trimethoprim, cotrimoxazole and penicillin. Insulin and Oral antidiabetic drugs - sulphonyl ureas, biguanides.

UNIT-V

15 HRS

Bioactive components of plant origin: flavonoids, alkaloids, terpenoids, glycosides, saponins, Home remedies- traditional medicine -Diabetes mellitus and Cancer. Chemotherapy – Cytotoxic drug. Biological analysis of active compounds using HPLC, GC-MS (Basic principles only).

Recommended Books:

1. The pharmacology Vol I and II- Goodman And Gillman, Mc Graw Hill
2. Basic pharmacology- Foxtercox Bulter Worth's, 1980.
3. Pharmacology and pharmacotherapeutics- R.S.Satoskar. S.D.Bhandhakar & S.S.Anilapure Popular Prakashar Bombay.
4. Principles of medicinal chemistry- William O. Foge.B.I. Waverks Pvt Ltd, New Delhi.
5. Oxford textbook of clinical pharmacology and drug therapy. D.G. Burger's medicinal Chemistry & Drug Discovery.
6. Principles and practice- Manfred.E. Wolf John Wiley and sons

Course Outcome

At the end of the course

The student will be able to

Demonstrate an understanding of concepts such as drug metabolism, bioavailability and pharmacokinetics

Understand the adverse effects of drugs

Gain knowledge about the bioactive compounds in nature that can be used as drugs

know about home remedies for common and grave conditions like Diabetes and Cancer

SEMESTER VI

ELECTIVE PAPER II CLINICAL BIOCHEMISTRY

TOTAL NO OF HRS : 75

Objective: To understand the clinical significance and disorders of Biomolecules

UNIT I 15 HRS

Blood glucose relation, hypo and hyperglycemia. **Diabetes mellitus** – types, clinical features and metabolic changes. **Glucosuria, galactosemia and fructosuria**. Glycogen storage diseases

UNIT II 15HRS

Etiology and clinical manifestation of Phenyl Ketonuria, Cystinuria, Albinism, Hypo and hyperuricemia, Gout. Clinical features of atherosclerosis.

UNIT III 15 HRS

Liver Function Tests –Jaundice – types- hemolytic , hepatic and obstructive, Differential diagnosis of jaundice. Test based on excretory function(BSP),Test Based on bile pigment metabolism.

UNIT IV 15 HRS

Renal Function Tests – Clearance tests – Urea, Creatinine, Inulin, PAH test, concentration and dilution test.

Gastric Function Tests – Collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis.

UNIT V 15HRS

Clinical Enzymology – Definition of functional and non-functional plasma enzymes. Isozymes and diagnostic tests, enzyme patterns in liver damage, bone disorders, myocardial infarction.

Recommended Books

2. Varley's Practical Clinical Biochemistry - Alan H Gowenlock, published by CBS Publishers and distributors, 1988, 6th edition, India.
3. Textbook of Biochemistry with clinical correlations-T.M.Devlin, 2002, 5th edition.
4. Biochemistry: A case oriented approach- Montgomery, Comway, Spector, Chappell,1996, 6th edition, Mosby Publishers, USAChawla. R. 1995. Practical Clinical Biochemistry. Methods and Interpretations. New Delhi,Jaypee Brothers. Medical Publishers (P) Ltd.

Course Outcome

At the end of the course

The student will be able to

Understand the pathophysiological processes responsible for common biochemical disorders of carbohydrate, lipid, protein and nucleic acid metabolism

Apply the knowledge in lab report analysis during various organ function tests.

Clinically assess the role of serum enzyme and isozyme indicators in pathological condition and diseases of heart, bone and liver.

SEMESTER VI

ELECTIVE PAPER III GENETICS

Objectives: To understand the basic principles of inheritance

Total no of hrs : 75

UNIT I	15 HRS
History: Mendelian and classical genetics - Mendel's material and crossing over technique, phenomenon of dominance, incomplete dominance, codominance, law of segregation, law of independent assortment, Mendel's monohybrid and dihybrid cross, test cross with examples.	
UNIT II	15 HRS
Features of inheritance - Discrete inheritance, cytoplasmic inheritance, and sex linked inheritance and its significance. - Notation and diagrams Interactions of multiple genes	
UNIT III	15HRS
Linkage – Bateson and Punnet's coupling and repulsion hypothesis , Morgan's view on linkage , types of linkage – complete linkage , incomplete linkage , linkage groups , significance of linkage.	
UNIT IV	15 HRS
Crossing over - Types of crossing over – somatic or mitotic crossing over, germinal or meiotic crossing over, mechanism, duplication, breakage and union, terminalization, significance of crossing over.	
UNIT V	15 HRS
DNA and chromosomes mutations – types – point, multiple, spontaneous, induced , sex linked mutations with example significance of mutation.	

Recommended books

1. Cell biology, genetics, molecular biology, evolution and ecology by P. S. Verma and K. Agarwal. S.Chand & sons Ltd
2. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Raven, P.H et al (2006) Biology 7th edition Tata McGraw Hill Publications, New Delhi
4. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Course Outcome

At the end of the course

The student will be able to

Comprehend the chemical basis of heredity.

Gain knowledge required to design, execute, and analyze the results of genetic experimentation in biological model systems.

Understand the role of genetic technologies in industries related to biotechnology, pharmaceuticals