**ANNAMALAI UNIVERSITY**

**210. B. Sc. Biochemistry**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted in Affiliated Colleges
in the academic year 2022 -2023 ONLY)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Part** | **Study Components & Course Title** | **Hours/Week** | **Credit** | **Maximum Marks** |
| **CIA** | **ESE** | **Total** |
|  |  | **SEMESTER – I** |  |  |  |  |  |
| **22UTAML11** | I | **Language Course - I : Tamil-I** | 5 | 3 | 25 | 75 | 100 |
| **22UENGL12** | II | **English Course - I : Communicative English I** | 5 | 3 | 25 | 75 | 100 |
| 22UBIOC13 | III | Core Course –I : Biomolecules | 4 | 4 | 25 | 75 | 100 |
| 22UBIOC14 | Core Course –II: Cell Biology | 4 | 4 | 25 | 75 | 100 |
|  | Core Practical – I  | 3 | - | - | - | - |
| 22UCHEA01 | Allied - I : Chemistry– 1  | 4 | 4 | 25 | 75 | 100 |
|  | Allied Chemistry Practical – I  | 3 | - | - | - | - |
| **22UENVS18** | IV | **Environmental Studies** | 2 | 2 | 25 | 75 | 100 |
|  | **Total** | **30** | **20** |  |  | **600** |
|  |  | **SEMESTER – II** |  |  |  |  |  |
| **22UTAML21** | I | **Language Course - II : Tamil-II** | 5 | 3 | 25 | 75 | 100 |
| **22UENGL22** | II | **English Course - II : Communicative English II** | 5 | 3 | 25 | 75 | 100 |
| 22UBIOC23 | III | Core Course –III: Human Physiology | 4 | 4 | 25 | 75 | 100 |
| 22UBIOP24 | Core Practical – I  | 3 | 3 | 40 | 60 | 100 |
| 22UCHEA02 | Allied – I: Chemistry -II | 4 | 4 | 25 | 75 | 100 |
| 22UCHEP01 | Allied Chemistry Practical – I  | 3 | 3 | 40 | 60 | 100 |
| 22UBIOE26 |  | Internal Elective - I  | 2 | 3 | 25 | 75 | 100 |
| **22UVALE27** | IV | **Value Education** | 2 | 1 | 25 | 75 | 100 |
| **22USOFS28** | **Soft Skill** | 2 | 1 | 25 | 75 | 100 |
| 22UNMSD01 |  | **Effective English**  |  | 2 |  |  |  |
|  | **Total** | **30** |  **27** |  |  | **900** |
|  |  | **SEMESTER – III** |  |  |  |  |  |
| **22UTAML31** | I | **Language Course – III : Tamil-III** | 5 | 3 | 25 | 75 | 100 |
| 22UENGL32 | I | English Course – III: English Through Literature-I | 5 | 3 | 25 | 75 | 100 |
| 22UBIOC33 | III | Core Course –IV: Biochemical Techniques -I | 4 | 4 | 25 | 75 | 100 |
|  | Core Practical – II  | 3 | - | - | - | - |
| 22UMICA01 | Allied - II : Allied Microbiology I | 4 | 4 | 25 | 75 | 100 |
|  | Allied Practical – II - Microbiology | 2 | - | - | - | - |
| 22UBIOE36 | Internal Elective - II  | 3 | 3 | 25 | 75 | 100 |
| 22UBION37 | IV | Non-Major Elective – I  | 2 | 2 | 25 | 75 | 100 |
| 22UBIOS38 | Skill Based Subject – I: Biostatistics  | 2 | 2 | 25 | 75 | 100 |
|  |  | **Total** | **30** | **21** |  |  | **700** |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **SEMESTER – IV** |  |  |  |  |  |
| **22UTAML41** | I | **Language Course - IV: Tamil-IV** | 5 | 3 | 25 | 75 | 100 |
| 22UENGL42 | I | English Course – IV: English Through Literature-II | 5 | 3 | 25 | 75 | 100 |
| 22UBIOC43 | III | Core Course –V: Biochemical Techniques -II | 5 | 4 | 25 | 75 | 100 |
| 22UBIOP44 | Core Practical – II  | 4 | 3 | 40 | 60 | 100 |
| 22UMICA02 | Allied – II: Microbiology – II | 4 | 3 | 25 | 75 | 100 |
| 22UMICP01 | Allied Microbiology Practical – II  | 3 | 2 | 40 | 60 | 100 |
| 22UBION47 | IV | Non-Major Elective – II  | 2 | 2 | 25 | 75 | 100 |
| 22UBIOS48 | Skill Based Subject-II: Toxicology and Herbal medicine | 2 | 2 | 25 | 75 | 100 |
| 22UNMSD02 |  | **MS-Office Essentials** |  | 2 |  |  |  |
|  |  |  | **30** | **24** |  |  | **800** |
|  |  | **SEMESTER – V** |  |  |  |  |  |
| 22UBIOC51 | IIIIII | Core Course –VI: Intermediary metabolism | 4 | 4 | 25 | 75 | 100 |
| 22UBIOC52 | Core Course –VII: Enzymes  | 4 | 4 | 25 | 75 | 100 |
| 22UBIOC53 | Core Course –VIII: Molecular Biology  | 4 | 4 | 25 | 75 | 100 |
| 22UBIOC54 | Core Course –IX: Clinical Biochemistry  | 4 | 4 | 25 | 75 | 100 |
| 22UBIOP55 | Core Practical – III :  | 3 | - | - | - | - |
| 22UBIOP56 | Practical (Elective)– IV:  | 3 | - | - | - | - |
| 22UBIOE58 | Internal Elective - III | 4 | 3 | 25 | 75 | 100 |
| 22UBIOS59 | IV | Skill Based Subject-III: Bioinformatics | 2 | 2 | 25 | 75 | 100 |
| **22UGENS57** | **Gender Studies** | 2 | 1 | 25 | 75 | 100 |
|  |  | **Total** | **30** | **22** |  |  | **700** |
|  |  | **SEMESTER – VI** |  |  |  |  |  |
| 22UBIOC61 | III | Core Course –X: Endocrinology  | 5 | 4 | 25 | 75 | 100 |
| 22UBIOC62 | Core Course –XI: Biotechnology  | 5 | 4 | 25 | 75 | 100 |
| 22UBIOC63 | Core Course –XII: Immunology  | 5 | 4 | 25 | 75 | 100 |
| 22UBIOP64 | Core Practical – III  | 4 | 4 | 40 | 60 | 100 |
| 22UBIOP65 | Practical (Elective ) – IV  | 4 | 4 | 40 | 60 | 100 |
| 22UBIOE66 | Internal Elective - IV | 4 | 3 | 25 | 75 | 100 |
| 22UBIOS68 | IV | Skill Based Subject-IV: Pharmaceutical Biochemistry | 3 | 2 | 25 | 75 | 100 |
| **22UEXTA67** | V | **Extension Activities** | - | 1 | 100 | - | 100 |
|  |  | **Total** | **30** | **26** |  |  | **800** |
|  |  | **Grand Total** | **180** | **140** |  |  | **4500** |

**INTERNAL ELECTIVE COURSES**

|  |  |  |
| --- | --- | --- |
| 22UBIOE26-1 | Internal Elective – I | Nutritional Biochemistry |
| 22UBIOE26-2 | Food Technology |
| 22UBIOE26-3 | Health and Diseases |
| 22UBIOE36-1 | Internal Elective – II | Industrial Biochemistry  |
| 22UBIOE36-2 | Histopathological techniques |
| 22UBIOE36-3 | Nanomaterials and Nanomedicine |
| 22UBIOE58-1 | Internal Elective – III | Medical Lab technology |
| 22UBIOE58-2 | Hospital Management |
| 22UBIOE58-3 | Microbiology |
| 22UBIOE66-1 | Internal Elective – IV | Plant Biochemistry |
| 22UBIOE66-2 | Stem cell Biology |
| 22UBIOE66-3 | Life style &diseases |

**ALLIED COURSES**

|  |  |  |
| --- | --- | --- |
| 22UCHEA01 | Theory | Allied -I Chemistry-I |
| 22UCHEA02 | Theory | Allied - I Chemistry-II |
| 22UCHEP01 | Practical | Allied Chemistry Practical – I  |
| 22UMICA01 | Theory | Allied - II : Microbiology -1 |
| 22UMICA02 | Theory | Allied - II : Microbiology -1I |
| 22UMICP01 | Practical | Allied Microbiology Practical – II  |

**Non-Major Elective Courses (NME)**

(Department of Biochemistry offers the following NME to other Departments)

|  |  |
| --- | --- |
| 22UBION37 | Food and Nutrition |
| 22UBION47 | Lifestyle Diseases & Prevention |

 **Credit Distribution**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Part | Study Components | Papers | Credits | Total Credits | Marks | Total Marks |
| Part I | Languages | 4 | 3 | 12 | 100 | 400 |
| Part II | Communicative English & English | 4 | 3 | 12 | 100 | 400 |
| Part III | Core Courses | 12 | 4 | 48 | 100 | 1200 |
|  | Core Practical | 4 | 4 | 16 | 100 | 400 |
|  | Allied Courses | 4 | 4 | 16 | 100 | 400 |
|  | Allied Practical | 2 | 3 | 6 | 100 | 200 |
|  | Internal Electives | 4 | 3 | 12 | 100 | 400 |
| Part IV | Environmental Studies | 1 | 2 | 2 | 100 | 100 |
|  | Value Education | 1 | 1 | 1 | 100 | 100 |
|  | Soft Skill | 1 | 1 | 1 | 100 | 100 |
|  | Gender Studies | 1 | 1 | 1 | 100 | 100 |
|  | Non Major Electives | 2 | 2 | 4 | 100 | 200 |
|  | Skill Based Courses | 4 | 2 | 8 | 100 | 400 |
| Part V | Extension Activities | 1 | 1 | 1 | 100 | 100 |
|  |  | 45 |  | 140 |  | 4500 |

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| **SEMESTER-I****CORE – I** | **22UBIOC13: BIOMOLECULES****( 60 hrs )** | **HRS/WK-4**CREDIT-4 |

COURSE OBJECTIVES

1. To study the structure, classification, types and functions of carbohydrate.
2. To acquire knowledge about the structure and function of amino acids and proteins.
3. To learn the structure, classification and importance of lipids.
4. To study the structure and function of nucleic acid.
5. To learn the structure and functions of lipids and heterocyclic compounds.

Unit: 1 CARBOHYDRATES Hours: 12

Classification, General properties with reference to glucose, isomers, anomers, epimers, enantiomers and mutarotation. Fischer projections, Haworth projection, pyranose and furanosestructure chair and boat conformations. Source, structure and biological functions – monosaccharides (glucose and fructose), disaccharides (sucrose, lactose, maltose), polysaccharides (starch, glycogen, inulin, cellulose, chitin). Heteropolysaccharides (hyaluronic acid, heparin).

Unit :2 AMINO ACIDS AND PROTEINS Hours: 12

Classification, stereoisomerism, and general properties, 3-letter and 1-letter abbreviation. Essential, non essential amino acids and non protein amino acids. General properties of amino acids and zwitter ion. Classification of proteins based on size and shape, solubility and functions. Peptide bond. Structure of proteins - Primary, secondary, tertiary & quaternary. Bonds stabilizing the structure of proteins, Biologically important peptides - Glutathione, vasopressin, and oxytocin.

Unit :3 LIPIDS Hours: 12

Classification of lipids and fatty acids, Properties of fatty acids (Iodine number, Acid number, RM number, Saponification number and Rancidity). Structure and functions of phospholipids - Lecithin, cephalin, phosphatidyl inositol and phosphotidylserine, sphingomyelin, plasmalogen. Sterols-cholesterol. Glycolipids - cerebrosides and gangliosides.

Unit: 4 NUCLEIC ACIDS Hours: 12

 Nitrogen bases, nucleosides and nucleotides. Phosphodiester linkage. Watson – Crick double helical structure of DNA. A, B and Z forms of DNA. Properties of DNA- Denaturation, renaturation, Tm and hyperchromicity. Major classes of RNA- structure and biological functions. Differences between DNA and RNA.

Unit: 5 VITAMINS AND HETEROCYCLIC COMPOUNDS Hours: 12

Definition and classification of vitamins - Fat-soluble vitamins - sources, requirements, biological actions of vitamins A, D, E, and K. Water-soluble vitamins - sources, requirements, biological actions of thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, biotin, folic acid and vitamin B12. Structure and biological importance of heterocyclic compounds-Pyridine, pyrole, furan, and thiophene.

COURSE OUTCOMES

On the successful completion of the course, student will be able to:

1. Understand the nature, types, structure and function of carbohydrates.
2. Comprehend the classification of proteins and their properties.
3. Gain knowledge about the classification and properties of complex lipids.
4. Acquire knowledge about the structure, properties and types of DNA and RNA.
5. Understand about the structure and functions of heterocyclic compounds.

Text Books

1. RenukaHarikrishnan ,1995, *“ Biomolecules and Enzymes*” (2nd edition), Madurai, IndrajaPathipagam.
2. Lehninger, Nelson and Cox, (1982), *Principles of Biochemistry*, (4th ed) UK, Macmillan Worth Publishers.
3. Jain J.L., Sanjay Jain and Nitin Jain, (1997), “*Fundamentals of Biochemistry*”(6thEdition), New Delhi, S. Chand & Company Ltd.
4. Power &Chatwal*Biochemistry* (4thed) Himalaya Publishing House.

Supplementary Readings

1. Cambell& Farrell (2007), *Biochemistry* (5thed), Delhi, Baba Borkhanath printers.
2. Pattabiraman T. N. (1993) *Principles of Biochemistry* (5thed), Bangalore, Gajanana Book Publishers and Distributors
3. Dr. Deb A C., (1983), *Fundamentals of Biochemistry* (8thed), Kolkata, New Central Book Agency.
4. Voet and Voet. Fundamentals of Biochemistry. Wiley. 5th ed. 2018.
5. Jyothi Roshan Kumar Chemistry of chemical bonding. 2008.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | **3** | **3** | **3** | **2** | **1** |
| CO2 | **3** | **3** | **3** | **2** | **1** |
| CO3 | **3** | **3** | **3** | **2** | **1** |
| CO4 | **3** | **3** | **3** | **2** | **1** |
| CO5 | **3** | **3** | **3** | **2** | **1** |

3- Strong;2- Medium;1-Low;

|  |  |  |
| --- | --- | --- |
| SEMESTER-ICORE – II | 22UBIOC14: **CELL BIOLOGY**(60 hrs) | HRS/WK-4CREDIT-4 |

COURSE OBJECTIVES

1. To know the classification and composition of cells.
2. To gain knowledge on structure and composition of membrane.
3. To acquire information on cell organelles.
4. To study about the cytoskeleton of the cell.
5. To know the stages of mitosis and meiosis cell division.

Unit :1 **INTRODUCTION TO CELL** [12 hrs]

An overall view of cells – origin and evolution of cells, cell theory. Classification of cell – prokaryotic and eukaryotic cells. Difference between prokaryotic and eukaryotic cells. Molecular composition of cells- Water, carbohydrate, Lipids, Nucleic acids and proteins.

Unit: 2 CELL MEMBRANE [12 hrs]

Cell membrane structure - Fluid mosaic model of membrane structure. Membrane protein and their properties. Membrane carbohydrate and their role. Endocytosis and exocytosis. Transport across membranes: diffusion, active and passive transport.

Unit: 3 **CELL ORGANELES** [12 hrs]

Endoplasmic reticulum –types, structure and function. Golgi apparatus – structure and function. Lysosomes structure and functions. Ribosomes – Types structure and functions.

Unit: 4 CELL CYTOSKELETON [12 hrs]

Mitochondria structure and functions. Cytoskeleton - Types of filaments and their functions. Microtubules - Chemistry and function (Cilia and flagella).

Unit: 5 CELL DIVISION [12 hrs]

Chromosome- chromatin structure. Cell cycle – phases of cell cycle. Meiotic and mitotic divisions, cell-cell communications. Cell recognition, cell adhesion and cell functions.

COURSE OUTCOMES

Upon successful completion of the course, student will be able to:

1. Understand the origin, classification and types of cell.
2. Apprehend membrane composition and transport mechanisms.
3. Understand the structure and function of the cell organelles.
4. Comprehend the cytoskeleton of the cell.
5. Understand cell steps involved in cell cycle and division.

Text Books

1. Rastogi SC. *Cell Biology*. New Age International Publishers.
2. Lodish et al., (2016) *Molecular Cell Biology*. (8thed) Freeman.

Supplementary Readings

1. Martin BM. (2013) *Tissue Culture Techniques-An Introduction*. Springer Science and Business Media.
2. Karp. (2016) *Cell & Molecular Biology* (8thed) Wiley.
3. Alberts et al. *Molecular Biology of the Cell*. Garland Sci. 6th ed. 2014

OUTCOMES MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **2** | **2** | **3** | **2** |
| **CO2** | **3** | **2** | **2** | **3** | **2** |
| **CO3** | **3** | **2** | **2** | **3** | **2** |
| **CO4** | **3** | **2** | **2** | **3** | **2** |
| **CO5** | **3** | **2** | **2** | **3** | **2** |

3- Strong;2- Medium;1-Low;

|  |  |  |
| --- | --- | --- |
| SEMESTER: IPART: III | 22UCHEA01: CHEMISTRY-I | CREDIT: 4HOURS: 4 |

COURSE OBJECTIVES

1. To impart wide knowledge about Metallurgy.
2. To invoke the knowledge in basic concepts of chemistry.
3. To provide a knowledge on chemical kinetics.
4. To Familiarize the students about Industrial Chemistry.
5. To inculcate interest in Nuclear chemistry.

Unit – I: METALURGY HOURS: 9

Metallurgy – Introduction – Metals – Occurrence of Metals – Minerals and Ores – Difference between Minerals and Ores – Minerals of Iron, Aluminium and Copper – Concentration of Ores – Froth Floatation process, Magnetic separation, Calcination, Roasting, Smelting, Flux.

Reduction of Mineral to Metal – Aluminothermic process – Refining of Metals – Electrolysis, Van Arkel and Zone refining.

UNIT – II: FUNDAMENTAL CONCEPTS HOURS: 9

Fundamental concepts – Bonding – Nature of bounds – Ionic, Covalent, Coordinate and Hydrogen bonds – Cleavage bonds - Homolytic and Heterolytic Fission – Electrophiles, Nucleophiles and Free Radicals. Types of Organic Reactions – Substitution, Addition Elimination, Rearrangement - Definition & Examples.

Isomerism – Optical Isomerism – Lactic and Tartaric acid – Geometrical Isomerism – Maleic and Fumaric Acid.

UNIT – III: CHEMICAL KINETICS AND PHOTOCHEMISTRY HOURS: 9

Chemical Kinetics – Rate of a reaction – Order and Molecularity – Definition & Differences – First Order rate equation – Derivation – Half life period – Catalysis – Catalyst – Autocatalyst – Enzyme Catalyst – Promoters – Catalytic poisons – Homogeneous and Heterogenous Catalysis – Differences – Industrial application of Catalysis.

Photochemistry – Grotthus – Draper law – Stark Einstein’s law – Quantum yield – Photosynthesis.

UNIT-IV: FUELS HOURS:9

Fuels – Classification of Fuels – Calorific Value of Fuels - Water gas, Semi water gas, Carburetted Water gas and Producer gas – Composition and Uses

Non-Conventional Fuels-Need Of Solar Energy-Bio Fuels-Oil gas,Natural gas and LPG-Uses

UNIT – V: NUCLEAR CHEMISTRY HOURS: 9

Nuclear Chemistry-Introduction-Fundamental Particle of Nucleus-Isotopes, Isobars, Isotones and Isomers-Definition and Examples-Nuclear Binding Energy, Mass Defect and N/P ratio-Nuclear Fission and Nuclear Fusion(Elementary Idea)-Applications of Radioisotopes in Medicine, Agriculture and Industries-Carbon dating.

Metallic bond-Band theory-Conductors, Insulators and Semiconductors - types.

COURSE OUTCOMES

1. Acquire thorough Knowledge about Metallurgy and Fundamental concepts in Organic chemistry.
2. Acquire an idea about Chemical Kinetics.
3. Identify the Importance of Nuclear chemistry and Metallic Bond.
4. Acquire Knowledge on Photochemistry
5. Extensive Knowledge about Fuels.

Text Books

1. P.L. Soni, 2014, Text Book of Inorganic Chemistry, Sultan Chand & Sons, 29th edition, New Delhi.
2. P.L.Soni, H.M.Chawla, 2014, Text book Of Organic Chemistry,Sultan Chand & Sons, New Delhi.
3. Arun Bahl, B.S.Bahl, 2019, A Text Book Of Organic chemistry, Sultan &Sons, 22nd Edition, New Delhi.
4. M.K. Jain, S.C.Sharma, 2012, Modern Organic Chemistry, Vishal Publishing Company, 4th Edition, New Delhi.

Supplementary Readings

1. B.R. Puri, L.R.Sharma, K.C.Kailia, 2016, Principles of Inorganic Chemistry, Vishal Publishing Company, 33rd Edition, New Delhi.
2. Samuel Glasstone, David Lewis, 1963, Elements Of Physical chemistry, Palgrave Macmillan, New Delhi.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 2 | 3 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 |

(1-Low, 2-Moderate, 3-High)

|  |  |  |
| --- | --- | --- |
| SEMESTER: IPART: IV | 22UENVS18: ENVIRONMENTAL STUDIES | CREDIT: 2HOURS: 2 |

COURSE OBJECTIVES

1. To gain knowledge about the importance of environmental sciences and natural resources.
2. To learn the concept, structure and function of ecosystem and the importance of biodiversity.
3. To understand and gain knowledge about environmental pollution and management.
4. To impart knowledge about social issues and human population.
5. To acquire the skills for identifying and solving pollution problem.

UNIT - I: INTRODUCTION TO ENVIRONMENTAL SCIENCES: NATURAL RESOURCES:

Environmental Sciences – Relevance – Significance – Public awareness – Forest resources – Water resources – Mineral resources – Food resources – conflicts over resource sharing - Exploitation - Land use pattern - Environmental impact - fertilizer -PesticideProblems-casestudies.

UNIT - II:ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION:

Ecosystem – concept – structure and function producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquaticeco system.

Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses ofbiodiversity - biodiversity at global, national (India) and local levels - Hotspots, threatstobiodiversity-conservationofbiodiversity-Insitu &Exsitu.

UNIT - III:ENVIRONMENTALPOLLUTIONANDMANAGEMENT

Environmental Pollution – Causes – Effects and control measures of Air, Water, Marine, soil, solidwaste, Thermal, Nuclear pollution and Disaster Management - Floods, Earth quake, Cyclone and Land slides.Role of individuals in prevention ofpollution-pollutioncasestudies.

UNIT - IV:SOCIALISSUES-HUMANPOPULATION

Urban issues - Energy - water conservation - Environmental Ethics - Global warming -Resettlement and Rehabilitation issues - Environmental legislations - Environmentalproduction Act. 1986 - Air, Water, Wildlife and forest conservation Act – Population growth and Explosion – Human rights and Value Education – Environmental Health- HIV/AIDS – Role of IT in Environment and Human Health – Women and child welfare – Public awareness – Case studies.

UNIT-V:FIELDWORK

Visittoalocalarea/localpollutedsite/localsimpleecosystem-Reportsubmission

COURSE OUTCOMES

After completion of this course, students will be able to gain knowledge in

1. The scope and importance of environmental science and natural resources.
2. The structure and functions of Ecosystem and biodiversity and its conservation.
3. The problem of environmental pollution and its management.
4. The social issues and human population.
5. They will identify and solve the pollution problem.

Text Books

1. Agarwal,K.C. (2008). *EnvironmentalBiology*, NidiPubl.Ltd.Bikaner.
2. Bharucha Erach, (2004). *Textbook for Environmental Studies,* UGC.
3. Odum, E.P., Odum, H.T. & Andrews, J. (1971). *Fundamentals of Ecology*. Philadelphia: Saunders.
4. Brusseau, M.L., Pepper, I.L., and Gerba, C. (2019). *Environmental and Pollution Science*. Academic Press, USA.
5. Primack R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA.
6. Raven, P.H, Hassenzahl, D.M., Hager M.C, Gift N.Y, and Berg L.R. (2015). *Environment*, (9th Ed.), Wiley Publishing, USA.
7. Rosencranz, A., Divan, S., and Noble M.L. 2002. Environmental Law and Policy in India: Cases, Material & Statutes. Oxford University Press.
8. Schmidtz, D., Shahar, D.C. 2018. Environmental Ethics: What Really Matters, What Really Works 3rd Edition, Oxford University Press, USA.
9. Sengupta,R.(Ed.) 2013. Ecological Limits and Economic Development. Oxford University Press, New Delhi, India.
10. Singh, J.S., Singh, S.P. and Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
11. Stuetz R.M., and Stephenson T. (Eds.) (2009). *Principles of Water and Wastewater Treatment Processes (Water and Wastewater Process Technologies).* IWA Publishing, London, UK.
12. Sodhi, N.S., Gibson, L. and Raven, P.H. (Eds). (2013). *Conservation Biology: Voices from the Tropic*s. John Wiley & Sons.
13. Thapar, V. (1998). *Land of the Tiger: A Natural History of the Indian Subcontinent*. University of California Press, USA.
14. Warren, C.E. (1971). *Biology and Water Pollution Control*. WB Saunders.
15. Wilson, E.O. (2006). *The Creation: An Appeal to Save Life on Earth*. W.W. Norton & Company, NewYork, USA.
16. World Commission on Environment and Development. (1987). *Our Common Future*. Oxford University Press, USA.

Supplementary Readings

1. Kumarasamy,K.,A. Alagappa Moses and M.Vasanthy, (2004). *Environmental Studies*, Bharathidsan University Pub,1, Trichy.
2. Rajamannar, (2004). *Environemntal Studies*, EVR College Pub, Trichy.
3. Kalavathy,S. (ED.) (2004). *Environmental Studies*, Bishop Heber College Pub., Trichy.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 3 |

|  |  |  |
| --- | --- | --- |
| SEMESTER-IICORE – III | 22UBIOC23: HUMAN PHYSIOLOGY(60 hrs) | HRS/WK-4CREDIT-4 |

COURSE OBJECTIVES

1. To learn about the blood composition and circulatory system.
2. To gain knowledge about the respiratory process.
3. To know the digestive and excretory process.
4. To study the role of proteins in muscle contraction.
5. To learn about the brain structure and transmission of impulse.

Unit :1 BLOOD AND CIRCULATORY SYSTEM [12 hrs]

Composition of blood, types and functions of blood cells. Blood groups - ABO group and Rh type. Composition of lymph. Blood coagulation mechanism. Anticoagulants (Heparin and EDTA).

Heart - basic anatomy, cardiac cycle, cardiac output and pace maker.

Unit :2 RESPIRATORY SYSTEM [12hrs]

Structure of lungs - Mechanism of gaseous exchange. Role of Hemoglobin in transport of O2 and CO2. Oxygen dissociation curve, Bohr Effect, Chloride shift.

Unit: 3 DIGESTIVE AND EXCRETORY SYSTEM [12 hrs]

Salivary digestion, gastric digestion - Mechanism of hydrochloric acid secretion, pancreatic digestion, intestinal digestion, Role of bile salt in digestion. Digestion and absorption of carbohydrates, proteins, and lipids. Structure of nephron, Mechanism of urine formation – Glomerular filtration, tubular reabsorption of glucose, water and electrolytes.

Unit: 4 MUSCULAR SYSTEM [12 hrs]

Types of muscle, Ultra structure of skeletal muscle - light band, dark band, Sarcomere, thick filament-myosin, thin filament - actin, myosin, tropomyosin and troponin. Molecular basis of skeletal muscle contraction. Bone structure and formation. Ligaments and tendons.

Unit: 5 NERVOUS SYSTEM [12 hrs]

Structure of neuron. Transmission of nerve impulse. Synapse - types of synapse, synaptic transmission, Neurotransmitters, Neuromuscular junction.

Anatomy of brain - meninges, cerebrum, brain stem, cerebellum and functions. Spinal cord and its function. CSF and Limbic system (brief description only).

COURSE OUTCOMES

Upon successful completion of the course, student will be able to:

1. Understand the blood composition and its circulation.
2. Apprehend the importance of respiratory system.
3. Understand the component of digestion and mechanism of urine formation.
4. Analyze the muscle contraction.
5. Understand the transmission of nerve impulse.

Text Books

1. Sembulingam, Premasembulingam, (2012). *Essentials of medical Physiology*- (6thed), Jaypee Brothers Medical Publishers (P) Ltd.
2. Goel K A, Sastri K V., *AText book of Animal Physiology*, Rastogi publications, Meerut.
3. Jain A.K., (2016). *Textbook of Physiology - Vol - I & II*, (6th Ed) Avichal Publishing Company.
4. Arthur C. Guyton and John E. Hall, (2016). *Textbook of Medical Physiology*, (10thed) Harcourt Asia Pvt. Ltd.

Supplementary Readings

1. Ganong W. E. (2003*). Review of Medical Physiology*, (21sted). McGraw HillMeyer BJ, HsMeij, Meyer AC, *Human Physiology*, (2nded) – AITBS Publishers and distributon.
2. Giese, *Cell Physiology*, (5th ed), W. B Saunders company, Tokyo, Japan.
3. Agarval, RA Anil. K. Srivastav, Kaushal Kumar *Animal Physiology and Biochemistry* – S. Chand & CO.,
4. Zubay (1998), *Biochemistry* (4th edition, WMC Brown Publishers, USA.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 |

3- Strong;2- Medium;1-Low;

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| SEMESTER- I &IICORE PRACTICAL - I | 22UBIOP24: CORE PRACTICAL-I(45 hrs) | HRS/WK-3CREDIT-3 |

COURSE OBJECTIVES

On the successful completion of the course, student will be able to

1. Understand the principles, procedure and results of qualitative and quantitative analysis.
2. Gain practice in reagent preparation and standardization of reagents.
3. Recognize the presence of sugar in the sample by qualitative analysis.
4. Grasp the presence of amino acid in the sample by qualitative analysis.
5. Comprehend the separation techniques of biomolecules.

REGENTS **[3 hours]**

* Preparations of per cent (W/V and V/V %), normal and molar solutions.
* Preparations of isotonic, hypertonic and hypotonic solution.

II VOLUMETRIC ANALYSIS [15 hours]

* Estimation of amino acid by Formal titration method.
* Estimation of ascorbic acid using Dichlorophenol indophenol dye.
* Estimation of reducing sugar by Benedict’s method.
* Estimation of calcium using EDTA by titration method.
* Determination of saponification value of oils.
* Determination of acid number of edible oils.

III CARBOHYDRATES ANALYSIS [9 hours]

Qualitative analysis of carbohydrates.

IV AMINO ACIDS ANALYSIS [9 hours]

Qualitative analysis of amino acids.

V PREPARATION [9 hours]

Isolation of starch from potato.

Isolation of casein from milk.

Isolation of lecithin from egg yolk.

Isolation of cholesterol from egg yolk.

Text Books

1. Dr. Jayaraman J., Manuals in Biochemistry (2011) New Age International pub, Bangalore.
2. David T., Plummer (2000). Introduction to practical Biochemistry New Delhi: Tata McGraw Hill Publishing Company,
3. Pattabiraman, Laboratory manual in biochemistry.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **2** | **2** |
| **CO2** | **3** | **3** | **3** | **2** | **2** |
| **CO3** | **3** | **3** | **3** | **2** | **2** |
| **CO4** | **3** | **3** | **3** | **2** | **2** |
| **CO5** | **3** | **3** | **3** | **2** | **2** |

3- Strong;2- Medium;1-Low;

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| SEMESTER: IIPART - III | 22UCHEA02: CHEMISTRY – II | CREDIT: 4HOURS: 4 |

COURSE OBJECTIVES

1. Make the students familiar with Coordination Chemistry.
2. To acquire thorough knowledge about Carbohydrates and proteins.
3. Enable the students to acquire knowledge in Electrochemistry.
4. To have an idea about paint and varnishes.
5. To create about knowledge in medicinal chemistry.

UNIT – I: COORDINATION CHEMISTRY HOURS: 12

Coordination Chemistry-Introduction-Nomenclature of Coordination Compounds-Ligands, Central Metal Ion, Complex Ion, Coordination Number-Definition and Examples-Werner theory of Coordination Compounds-Biological role of Haemoglobin and Chlorophyll.

Industrial Chemistry- Fertilizers and Manures-Bio fertilizers-Organic Manures and their importance-Role of NPK in Plants-Urea, Potassium Nitrate and Superphosphate of Lime-Preparation and uses.

UNIT – II: CARBOHYDRATES AND AMINOACIDS HOURS: 12

Carbohydrates-Classification—Glucose-Preparation and Properties of Glucose-Structure of Glucose (Elucidation Not Necessary)-Starch and Cellulose-Occurrence, Properties and uses.

Amino Acids and Proteins-Classification of Amino Acids-Essential and Non Essential Amino Acids-Preparation of Amino Acid-Gabriel Phthalimide Synthesis – Iso electric Point of Amino Acid-Proteins-Classification of Proteins based on Physical Properties and Biological Functions-Primary and Secondary Structure of Proteins (Elementary treatment only).

UNIT – III: ELECTROCHEMISTRY HOURS: 12

Electrochemistry-Specific and Equivalent Conductance-their determination-Variation of Specific and Equivalent Conductance on Dilution-Ostwald’s dilution law-Kohlrausch law-Conductivity Measurement-Conductometric Titrations.

pH and Buffer,Importance of pH and Buffers in living systems-Buffer solution and Buffer action-Buffer-Definition-pH determination by Indicator Method.

UNIT – IV: PAINTS AND GLASS HOURS: 12

Paint-Component of paint- Requisites of a Good Paint-Varnishes-Definition-Types and Composition-Safety Matches-Introduction-Contents in Match sticks and Match Box-Industrial making of Safety Matches.

Glass-Composition, Manufacture, types and uses.

UNIT- V: DRUG CHEMISTRY HOURS: 12

Drugs-Sulpha Drugs-Preparation and Uses of Sulpha pyridine and Sulpha diazine-Mode of action of sulpha Drugs-Antibiotics-Uses of Penicillin, Chloramphenicol and Streptomycin-Drug abuse and their Implication.

Chemotherapy-Definition-Analgesics, Antipyretics, Antiseptics, Tranquilizers and Sedatives-Explanation with two Examples-Anaesthetics-Local and General Anaesthetics.

COURSE OUTCOMES

1. Wide Knowledge about Coordination Chemistry.
2. Identify the importance of Carbohydrates, Amino acids and Proteins.
3. Acquire Knowledge about the action of drugs.
4. Able to understand about Paint and Varnishes.
5. Able to understand the concepts of pH and Buffers in living systems.

Text Books

1. R.Gopalan, 2012, Text book Of Inorganic Chemistry, Universities Press, 1st Edition, Hyderabad.
2. P.L.Soni, H.M.Chawla, 2014, Text Book Of Organic Chemistry, Sultan Chand and Sons, 29th Edition, New Delhi.
3. Arun Bahl, BS.Bahl, 2019, A Text Book Of organic Chemistry, Sultan Chand and Sons, 22nd Edition, New Delhi.
4. P.C.Jain, M.Jain, 2019, Engineering Chemistry, Dhanpat Rai& sons, 17th Edition, New Delhi.
5. Jayashree Ghosh, 2015, A Text Book Of Pharmacuetical Chemistry, Sultan Chand and Sons, New Delhi.

Supplementary Readings

1. R.Gopalan, P.S.Subramanian, K.Rengarajan, 1991, Elements of Analytical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
2. B.R.Puri, L.R.Sharma, K.C.Kailia, 2016, Principles Of Inorganic Chemistry, Vishal Publications, 33rd Edition, New Delhi.

OUTCOME MAPPING

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| --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 2 | 3 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 |

(1-Low, 2-Moderate, 3-High)

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| SEMESTER: IIPART: IIIPRACTICAL – I | 22UCHEP01: CHEMISTRY PRACTICAL – I | CREDIT:3HOURS: 3 |

COURSE OBJECTIVES

1. To help the students to develop the skills in Titrimetric Analysis.
2. To learn the basic analytical method.
3. To know about various indicators and their significance.
4. To impart knowledge about primary standard solution.
5. To enhance knowledge about stoichiometric relationship for standardization.

VOLUMETRIC ANALYSIS

 A. Acidimetry and alkalimetry

1. Strong Acid Vs Strong Base.
2. Weak Acid Vs Strong Base.
3. Strong Acid Vs Weak base.
4. Determination of hardness of Water.

B. Permanganometry

1. Estimation of Oxalic acid.
2. Estimation of Ferrous Sulphate. C. Iodometry
3. Estimation of Potassium dichromate.
4. Estimation of Potassium Permanganate.

COURSE OUTCOMES

1. Able to understand the techniques of Titrimetric Analysis.
2. Acquire knowledge in Analytical skills.
3. Analyse the given unknown solution and assess its normality.
4. Evaluate the amount of substance from the normality.
5. Predict the hardness of water samples using EDTA.

Text Books

1. V.Venkateswaran, R.Veeraswamy, A.R.Kulandaivelu, 1997, Basic principles of Practical Chemistry, Sultan Chand and Sons, 2nd edition, New Delhi.
2. Anbusrinivasan.P, 2021 Allied Chemistry Practicals – Volumetry and Organic Analysis, Shri Publications, 1st Edition, Chidambaram, Tamil Nadu, India.
3. A.O.Thomas, 1999, Practical Chemistry, Scientific book Centre,7th Edition, Cannanore, Kerala

Supplementary Readings

1. Sundaram, Krishnan, Raghavan, 1999, Practical Chemistry (Part III), S.Viswanathan Co. Pvt Ltd, 2nd Edition, Kannur.
2. B.S.Furniss, A.J.Hannaford, P.W.G.Smith, A.R.Tatchell, 2005, Vogel's Text Book of Practical Chemistry, 5th Edition, Pearson Education, New Delhi.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 2 | 3 | 2 | 3 | 3 |
| CO2 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 2 |

(1-Low, 2-Moderate, 3-High)

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| SEMESTER-IIINTERNAL ELECTIVE -I | 22UBIOE26-1: NUTRITIONAL BIOCHEMISTRY(30 hours ) | HRS/WK-2CREDIT-3 |

COURSE OBJECTIVES

1. To study the nutritional aspects of various foodstuffs and its measurement.
2. To study the functional aspects of carbohydrate, protein and lipid.
3. To acquire knowledge about the balanced diet and dietary fiber.
4. To study the functional aspects of vitamins and minerals.
5. To learn the importance of nutrient requirements in different age groups

Unit: 1 ENERGY METABOLISM [6hrs]

Basic concepts of energy expenditure. Unit of energy.Basal metabolic rate (BMR), its measurements by bomb calorimeter and factors influencing measurement of BMR. Respiratory Quotient(RQ), factors affecting RQ. Specific dynamic action of foods (SDA).

Unit: 2 PROTEINS IN NUTRITION [6hrs]

Quality of protein - Biological value (BV), Net protein utilization (NPU). Amino acid composition of dietary protein. Protein-energy malnutrition (PGM) – Kwashiorkor and Maramus.

Unit :3 CARBOHYDRATES AND LIPIDS IN NUTRITION [6hrs]

Role of carbohydrates and lipids in diet. Balanced diet. Role of dietary fiber. Nutritional composition – Milk, egg, meat and fish, cereals and pulses, roots and tubers.

Unit : 4 VITAMINS AND MINERALS [6hrs]

Vitamins – Sources, RDA, deficiency diseases of fat soluble vitamins - A,D,E,K and water soluble vitamins - B- complex – B1, B2, B5, B6, B9, B12 and vitamin-C.

Minerals – physiological role, nutritional significance and deficiency of essential trace elements - Sodium, potassium, calcium. magnesium, phosphorous, copper, zinc, iron, iodine, fluorine.

Unit : 5 NUTRITIONAL REQUIREMENTS [6hrs]

Nutritional requirements for infants, children, adolescent, adult (male and female), pregnant and lactating women and geriatrics. Nutritional requirements in diseased condition – hypertension, diabetes and ulcer.

COURSE OUTCOMES

On the successful completion of the course, student will be able to

1. Understand and demonstrate the nutritional measurement of different food stuffs.
2. Gain knowledge about the biological value of proteins by different methods.
3. Gain insights depth about the deficiency and functional aspects of different types of vitamins.
4. Acquire knowledge about the physiological functions and deficiency of minerals.
5. Prepare different dietary plan for different age groups.

Text Books

1. Swaminathan M (1987), Food and Nutrition Vol. I&II, Second edition, Bangalore, Bappco Publishers.
2. Chatterjea M.N. and RanaShinde. Text book of Medical Biochemistry, (4th edition)Jaypee Publishers, New Delhi

Supplementary Readings

1. Patricia Trueman, (2007), Nutritional Biochemistry (Isted), Chennai, MJ publishers.
2. Darnell J, Lodish H, Baltimore D, (1986), Molecular Cell Biology, England, WH Freeman publishers.
3. William’s Basic Nutrition and Diet Therapy Williams (14thed), Staci Nix.
4. SathyanarayanaandU.Chakrapani U., Biochemistry, Books and Allied Publishers.
5. Deb A C., (1983), Fundamentals of Biochemistry (8thed), Kolkata,New Central Book Agency

OUTCOME MAPPING

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| --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 3 | 3 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 1 |

3- Strong;2- Medium;1-Low;

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| SEMESTER –IIINTERNAL ELECTIVE – I  | 22UBIOE26-2 : FOOD TECHNOLOGY(30 hours ) | HRS/WK-2CREDIT-3 |

COURSE OBJECTIVES

1. To learn the constituents of food.
2. To study about the nature of food spoilage.
3. To know about the preservation methods.
4. To impart about the basic knowledge about food regulations and quality control.
5. To gain idea about food products.

Unit:1 COMPOSITION OF FOOD (6 Hrs)

Composition offood- Carbohydrate, lipid, proteins, fiber, water, vitamins and minerals. Pulses, grains, vegetables and fruits. Milk-whole milk, low fat and skimmed milk. Nutritive value and pasteurization. Food adulteration, impact of adulteration in humans.

Unit: 2 FOOD SPOILAGE (6 Hrs)

Food spoilage: Characteristics features, dynamics and significance of spoilage in vegetables, fruits, meat, sea foods, milk and milk products, canned and packed foods.Factors affecting growth and survival of microbes in food.

Unit: 3 FOOD PRESERVATION (6 Hrs)

Food preservation: Principles and methods of food preservation-freezing, high pressure, heating, dehydration, canning and packaging. Application of enzymes in food processing and preservation. Food additives.

Unit: 4 INDUSTRIAL FOODPRODUCTS (6 Hrs)

Industrial food products: ice cream, bread, cakes, mashed potatoes, chips, jams and jellies. Cheese making, fermented vegetables, vinegar, beer and wine.

Unit: 5 FOOD REGULATIONS (6 Hrs)

Food regulations and quality control: History of Indian food regulation - BIS, ISI,FPO, PFA and FDA. HACCP, MFPO, AGMARK and FSSAI. Legal aspects related to storage and disposal.

COURSE OUTCOMES

On the successful completion of the course, student will be able to

1. Understand the food types, constituents, nutritive value and adulteration.
2. Recognize food spoilage and its control.
3. Perceive the methods of preservation.
4. Grasp the industrial food products.
5. Apprehend food regulations and quality control.

Text Books

1. John, L., Ingraham and Catherine A.., Ingraham Microbiology introduction (2nded) Cengage learning, New Delhi.
2. Gabriel Virella (1997), Microbiology and infectious disease(3rd ed.) Ingraham international, New Delhi.
3. Rao,E.S. (2013). Food quality Evaluation.

Supplementary Readings

1. Sivasankar, B. (2005) Food processing and preservation (3rded), Prentice Hall India (P) Ltd.
2. Vijayakhader (2009) Text book of food science and technology(5thed) Indian Council of Agricultural research.
3. Avantina Sharma, Text book of science and technology, (3rded) CBS Publishers.

OUTCOME MAPPING

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| COS | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 2 | 3 | 1 | 2 | 1 |
| CO2 | 2 | 3 | 1 | 2 | 1 |
| CO3 | 2 | 3 | 1 | 2 | 1 |
| CO4 | 2 | 3 | 1 | 2 | 1 |
| CO5 | 2 | 3 | 1 | 2 | 1 |

3- Strong;2- Medium;1-Low;

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| SEMESTER –IIINTERNAL ELECTIVE -I | 22UBIOE26-3 : HEALTH AND DISEASES(30 hours ) | HRS/WK-2CREDIT-3 |

COURSE OBJECTIVES

1. To learn the biochemistry and disorders of various diseases affecting human beings.
2. To know the genetically inherited disorders.
3. To gain information about the prevention of certain diseases by life style modification.
4. To acquire knowledge about the root causes of communicable diseases and its prevention.
5. To know the occurrence and severity of disease by analyzing enzymes activity.

Unit: 1 NUTRITIONAL DEFICIENCY DISORDERS (6 Hrs)

Balanced diet. Importance of macronutrients and micronutrients. Protein and Energy malnutrition. Iron deficiency anaemia, Vitamin A deficiency, Vitamin-B12 deficiency, Iodine deficiency disorders - hyper and hypothyroidism. Nutritional supplements.

Unit: 2 INHERITED DISORDERS (6 Hrs)

Chromosomal disorders - Down syndrome, Klinefelter syndrome, Turner syndrome. Monogenic disorders – cystic fibrosis, sickle cell anemia and phenylketonuria. Multifactorial inherited disorders – Alzheimer’s disease and congenital heart defects. Prenatal screening. Karyotyping.

Unit: 3 LIFE STYLE DISEASES (6 Hrs)

Diabetes mellitus- sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level. Acute and chronic complications. Cardiovascular diseases – atherosclerosis - risk factor and management. Fatty liver – alcoholic and non-alcoholic. Obesity. Cancer – Carcinogens and chemoprevention.

Unit: 4 COMMUNICABLE DISEASES (6 Hrs)

Communicable diseases: Epidemic, endemic and pandemic. Common cold, COVID-19. Chickenpox, Malaria. Sexually transmitted diseases – HPV infection, HIV/AIDS. Prevention- Vaccination schedule. Antiviral antibiotics – types and mechanism of action.

Unit: 5 DIAGNOSTIC ENZYMES AND TESTS (6 Hrs)

Diagnostic enzymes – enzymes in health and diseases. Cardiac, hepatic, bone functional marker enzymes. Hepatotoxicity and nephrotoxicity. Liver and kidney function tests. Renal calculi. Complete blood count. Diagnostic imaging tests – ECG, ultrasound and MRI.

COURSE OUTCOMES

On the successful completion of the course, student will be able to

1. Understand about balanced diet, nutrients, nutritional disorders and dietary supplements.
2. Apprehend the inherited disorders, monogenic and multifactorial disorders and diagnostic tests for inherited disorders.
3. Acquire knowledge on lifestyle disorders like diabetes, cancer and cardiovascular diseases preventive measures and treatment.
4. Understand the communicable disease, prevention methods, and treatment.
5. Students understand the diagnostic markers enzymes, organs functional tests, and diagnostic imaging technologies.

Text Books:

1. Chatterjea, MN., and RanaShinde (2007) Textbook of Medical Biochemistry, (7th edition) Jaypee Brothers, New Delhi.
2. Zilva J.F.,and Pannallthed P.R., (1984) Clinical Chemistry in Diagnosis and treatment, G Publishing pvt limited.

Supplementary Readings

1. William S. Hoffman (1964) The Biochemistry of Clinical Medicine, Year Book Medical Publishers.
2. Krishna Das K V (2013), Clinical Medicine (A Textbook of Clinical Methods and Laboratory Investigations). Jaypee Brothers Medical Publishers, New Delhi
3. 3. Kaplan A., Jack R., Opheim K.E., Toivola B., Lyon A.W., Williams and Wilkins, USA (1995) Clinical Chemistry Interpretation and techniques, (4th ed).
4. 4. DevlinT.M. (2010). Biochemistry with clinical Correlation, (7th ed), Wiley Publications.

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| COS | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | 3 | 2 | 2 | 2 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 2 | 2 | 2 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 1 |
| CO5 | 3 | 2 | 2 | 2 | 1 |

OUTCOME MAPPING

3- Strong;2- Medium;1-Low;

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| **SEMESTER: III****CORE: IV** | **22UBIOC33: BIOCHEMICAL TECHNIQUES -I****( 60 hrs )** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES*** To study the units of measurement.
* To acquire knowledge and skill about the electrochemical techniques.
* To learn about the principle and application of electrophoretic technique.
* To gain knowledge on the application of different electrophoresis in protein separation.
* To acquire knowledge on molecular weight determination by centrifugation technique.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Prepare the solution accurately. |
| **CO2** | Comprehend the uses of electrochemical techniques. |
| **CO3** | Understand the role of electrophoretic separation of charged molecules. |
| **CO4** | Acquire knowledge about advanced technique for the separation of proteins. |
| **CO5** | Understand the principle and applications of centrifugation. |
|  |
| **UNIT - I** | **UNITS OF MEASUREMENTS** | **[12hrs]** |
| Units of measurements of solutes in solution: normality, molality, molarity, ionic strength, millimoles, osmosis, osmotic pressure, osmolarity and its application. Concept of isotonic, hyper and hypotonic solution and its importance in biology. |
| **UNIT - II**  | **ELECTROCHEMICAL TECHNIQUES** | **[12 hrs]** |
| Electrochemical Techniques: Principle, instrumentation and applications – hydrogen and glass electrodes. Principle and applications of oxygen electrode. Oxidation-Reduction (redox) potentials - Principles, potentiometric titration, Redox dyes and their uses. |
| **UNIT- III** | **ELECTROPHORETIC TECHNIQUES - I** | **[12 hrs]** |
| Principles of electrophoresis, factors affecting electrophoretic mobility - sample, electric field, supporting medium, composition of buffer, temperature.Principle and procedure of Paper electrophoresis of amino acids, Cellulose acetate electrophoresis of serum protein and Starch gel electrophoresis of enzymes. |
| **UNIT - IV** | **ELECTROPHORETIC TECHNIQUES - II** | **[12 hrs]** |
| Principle and procedure of Agarose gel electrophoresis of nucleic acids, Native gel and Sodium dodecyl sulphate polyacrylamide gel electrophoresis of proteins. Principle and techniques -Isoelectric focusing and Two-dimensional gel electrophoresis. |
| **UNIT- V** | **CENTRIFUGATION TECHNIQUES** | **[12 hrs]** |
| Principle of centrifugation techniques, Svedberg unit, sedimentation coefficient, revolution per minute. Types of rotors. Preparative ultracentrifugation-Differential centrifugation, density gradient centrifugation- rate zonal and isopycnic centrifugation. Analytical ultracentrifugation - determination of molecular weight. |

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| **TEXTBOOKS** |
| 1 | Wilson and Walker (2018). Principles and techniques of Biochemistry and Molecular Biology. (8th ed) Cambridge University Press.  |
| 2 | Upadhyay, Upadhyay and Nath. (2010). Biophysical Chemistry principles and Techniques. Himalaya Publ.  |
| REFERENCE BOOKS |
| 3 | Friefelder and Friefelder (1983). Physical Biochemistry - Applications to Biochemistry and Molecular Biology. WH Freeman. (2nd ed) |
| 4 | Pavia, Lampman, Kriz, Vyvyan. (2015). Introduction to Spectroscopy. Cengage Learning.(5th ed).  |
| 5 | Rodney. Boyer F. Modern Experimental Biochemistry. Pearson Education. Inc. (3rd ed).  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **2** | **3** |
| **CO2** | **3** | **3** | **2** | **2** | **3** |
| **CO3** | **3** | **3** | **2** | **2** | **3** |
| **CO4** | **3** | **3** | **2** | **2** | **3** |
| **CO5** | **3** | **3** | **2** | **2** | **3** |

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3- Strong;2- Medium;1-Low;

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| **SEMESTER-III****ALLIED** | **22UMICA01: MICROBIOLOGY I** | **HRS/WK-4****CREDIT-4** |

**Course outcomes**

1. To gain knowledge on history of microbiology and various types of microscopes

2. To learn about cell structure and staining methods

3. To understand Microbial Classification and genome organization

4. To gain knowledge on culturing microorganisms and microbial growth

5. To learn about antimicrobials and various groups of microorganisms

**UNIT - I**

Definition and scope of Microbiology, History and Recent Developments, Spontaneous generation, Biogenesis, Contribution of Louis Pasteur, Anton van Leeuwenhoek, Lazzaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch; Microscopy - Simple, Compound, Light Microscopy, Dark ground, Phase contrast, Fluorescence and Electron Microscopy.

**UNIT - II**

Anatomy of Prokaryotic and Eukaryotic cells - ultra structure and function of cell wall and cell organelles. Microbial morphology - wet mount, Hanging drop technique; staining methods - Dyes, Simple, Differential and Special staining techniques - Acid fast staining, spore stain, Capsule stain, staining for metachraomatic granules.

**UNIT - III**

Microbial Classification, Five Kingdom concept, Binomial Nomenclature of microbes, species concept, classical approach with examples; Classical techniques of Microbial identification - Morphological, Physiological and Biochemical properties; Bacterial genome and its organization, Plasmids and their significance.

**UNIT - IV**

Media preparation, Aerobic and Anaerobic culture techniques, pure culture techniques, Preservation of cultures; Measurement of microbial growth, Batch and continuous culture, Growth Determination - Growth curve; Sterilization – physical and chemical methods.

**UNIT - V**

Antimicrobial chemotheraphy - Antibiotics - source, classification, mode of action - Antimicrobial resistance - Tests for Sensitivity to Antimicrobial agents and its Quality control; General characteristics and classification of Algae - *Chlorella*, Fungi – *Mucor*, Protozoa – *Entamoeba*, Viruses – Rabies virus and Bacteriophages – T4.

**Text Book:**

Prescott’s Microbiology. 10th Edition, 2016. Willey J., Sherwood L., Woolverton C.J. McGraw Hill Education, New York.

**Reference Books:**

* Principles of Microbiology. 2nd Edition, 1997. Atlas R.M. William C Brown Publishers, New York.
* Microbiology. 5th Edition, 2006. Pelczar T.R., Chan E.C.S. and Krieg N.R. Tata McGraw-Hill, New Delhi.
* Foundations in Microbiology. 8th Edition, 2001. Talaro K.P. and Chess B. McGraw Hill Companies, New York.
* Microbiology: Principles and Explorations. 8th Edition, 2012. Black J.G. 2012. John Wiley & Sons, Inc., Hoboken, New Jersey.
* Microbiology: An Introduction. 10th Edition, 2010. Tortora G.J., Funk B.R. and Case C.L. Benjamin Cummings, San Francisco.

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| **SEMESTER-III****INTERNAL ELECTIVE -II** | **22UBIOE36-1: INDUSTRIAL BIOCHEMISTRY****(45 HOURS)** | **HRS/WK-3****CREDIT-3** |
| **COURSE OBJECTIVES*** To learn the significance and uses of fermentation technology.
* To update the latest scientific developments on microorganism and its industrial application.
* To gain adequate knowledge about microorganism in the environment
* To study about the role of microorganisms in environmental protection.
* To learn about the commercial applications of microorganisms.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Understand the procedure of isolation and screening of industrially important microbes. |
| **CO2** | Comprehend the principle and types of fermentation. |
| **CO3** | Grasp the basics design of fermentor. |
| **CO4** | Understand the process of bioactive molecule production. |
| **CO5** | Apprehend the role of microbes in environmental protection.. |
|  |
| **UNIT -I** | **ISOLATION OF INDUSTRIAL MICROORGANISMS** | **[10Hrs]** |
|  Isolation and screening of industrially important microbes: Inoculum preparation, strain improvement, primary and secondary screening, detection of microorganisms. Bioassay of fermentation products – Diffusion assay, turbidometric assay, metabolic response assay and enzymatic assay. |
| **UNIT- II** | FERMENTATION | **[10Hrs]** |
| Principles of fermentation. Submerged and solid state fermentation Design and operation of fermentor agitation and aeration. Types of Fermentor - Air lift fermentor, Fluidized bed bioreactor, Packed bed bioreactor. Continuous culture fed batch culture,fixed volume bed fed batch |
| **UNIT-III** | UP AND DOWN STREAM PROCESSING | **[10Hrs]** |
| Upstream processing: Selection of microbes, media formulation and sterilization of airDownstream processing: solid-liquid separation, release of intracellular compartments, concentration of biological products, purification, preservation and stabilization, product formulation.  |
| **UNIT-IV** | MICROBIAL PRODUCTS | **[8Hrs]** |
| Microbial products: Production of citric acid, lactic acid and acetic acid. Bacterial, fungal polysaccharides, alcohol, alcoholic beverages-wine production.Single cell protein and edible mushroom cultivation. |
| **UNIT-V** | **MICROBES ON ENVIRONMENTAL MANAGEMENTS** | **[7Hrs]** |
| Microbial mining – Bioleaching–mechanism,advantages and disadvantages. Oil recovery using microbes. Soil microbiota. Bio - geochemical role of soil microorganisms. Microbial degradation of xenobiotics in the environment. |

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| TEXT BOOKS: |
| 1 | Perczar M.J., Chand ECS,Kleig (1993). *Microbiology,* Tata McGraw Hill. |
| **REFERENCE BOOKS:** |
| 1 | B.TomBesty,&Jim Keogh, (2005) *Microbiology* Demystefied, McGraw Hill |
| 2 | C.R.C Tilton, (2002) *Microbiology* (10thed) McGraw Hill |
| 3 | D. Stuart Hoggy, (2005) *Essential Microbiology,* Willey. |

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| **MAPPING WITH PROGRAMME OUTCOMESS (POS)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **1** | **3** | **3** | **2** |
| **CO2** | **3** | **1** | **3** | **3** | **2** |
| **CO3** | **3** | **2** | **3** | **3** | **2** |
| **CO4** | **3** | **2** | **3** | **3** | **2** |
| **CO5** | **3** | **2** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-III****INTERNAL ELECTIVE -II** | **22UBIOE36-2: HISTOPATHOLOGICAL TECHNIQUES** **(45Hrs)** | **HRS/WK-3****CREDIT-3** |

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| **OURSE OBJECTIVES*** To study the basic requirements of histopathological laboratory.
* To study the various steps involved in the histopathological techniques
* To learn the process involved in fixation and decalcification
* To gain knowledge about the tissue processing and dehydration
* To gain knowledge about the staining and mounting techniques.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Understand the general organization and requirements of histopathological lab. |
| **CO2** | Comprehend the basic steps in tissue processing, fixation, embedding,microtome, staining and mounting. |
| **CO3** | Acquire knowledge on essential steps involved in the fixation and decalcification processes. |
| **CO4** |  Understand the steps involved in tissue processing |
| **CO5** |  Apprehend the mounting methods and the different steps involved in the staining process. |
|  |
| **UNIT - I** | **INTRODUCTION** | **[10hrs]** |
| Introduction **–** Histology, histopathology and steps involved in histopathology.General organization and basic requirements of histopathology laboratory - Glass wares, chemical and reagent, equipment and instruments. Responsibilities of a histopathologist. |
| **UNIT- II** | **TISSUE PROCESSING** | **[10hrs]** |
| Tissue reception, labeling, fixation and section cutting, Preparation of paraffin blocks - Dehydration, clearing, embedding, blocking. Handling and care of microtome, types of microtome, sharpening of knives, and section cutting. Frozen section techniques - CO2 freezing, cryostat. In vitro processing of Membrane protein, nuclear protein and cytoplasmic protein. |
| **UNIT- III** | **FIXATION AND FIXATIVES** | **[ 9hrs]** |
| Fixation and fixatives- Aim of fixation, classification of fixation, different types of fixatives, advantages and disadvantages. Decalcification- Aim of decalcification, selection of tissue, fixation, and decalcifying agents used in decalcification techniques. Difference between fixative and preservatives. |
| **UNIT- IV** | **TISSUE PROCESSING** | **[10hrs]** |
| Tissue processing- Technique of dehydration, cleaning (Aim of cleaning, different cleaning agents), Impregnation, Embedding, techniques of casting Blocking. Section cutting- Different types of microtomes, microtome knives. Cryopreservation- Principles, methods used, freezing sections. |
| **UNIT- V** | **STAINING AND MOUNTING** | **[6 hrs]** |
| Preparation of common stains. H & E, Congo red, methyl violet, Leishman stain, Giesma and staining techniques.Mounting:types of mounting media and mounting techniques. |

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| **TEXT BOOKS** |
| 1 | Kanai L. Mukherjee, 2007, *Medical laboratory technology*Vol.I& III Tata McGraw Hill, New Delhi.  |
| 2 | J Ochei and Kolhatkar, 2002. *Medical laboratory science theory and practice*, Tata McGraw-Hill, New Delhi |
| **REFERNCE BOOKS** |
| 1 | Sood R, *Medical Laboratory Methods and Interpretation*, 2005, Jaypee Brothers Medical Publications, New Delhi |
| 2 | RamadasNayak, *Histopathology techniques & its management*, 1st Edition, 2018, Jaypee Brothers Medical publishers. |
| 3 | Neelamvasudeva, Sabita Mishra, *Text book of Human Histology*, Kote, 8th Edition, 2015, Jaypee Brothers Medical publishers. |
| 4 | Darhanp.Godkarpraful B. Godkar, *Text book of Medical Laboratory Technology*Vol 1&2 3rd Edition 2014, Bhalani Publishing House. |
| 5 | R.P Jayaswal, *Instant notes on Histopathology and Medical laboratory science*, 2019, Notion press |

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| **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | **3** | **2** | **3** | **3** | **3** |
| CO2 | **3** | **2** | **3** | **3** | **3** |
| CO2 | **3** | **2** | **3** | **3** | **3** |
| CO3 | **3** | **2** | **3** | **3** | **3** |
| CO4 | **3** | **2** | **3** | **3** | **3** |
| CO5 | **3** | **2** | **3** | **3** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-III****INTERNAL ELECTIVE -II** | **22UBIOE36-3: NANOMATERIALS AND NANOMEDICINE****[45 hours]** | **HRS/WK-3****CREDIT-3** |
| **COURSE OBJECTIVES*** To learn the basics about nanoscience and nanomaterials.
* To study the synthesis and characterization of nanomaterials.
* To gain knowledge about the types of nanomaterials and its applications.
* To know the techniques in nanotechnology.
* To gain insight about the uses of nanomaterials in medical field.
 |
| **EXPECTED COURSE OUTCOMES** |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Comprehend the advantages and challenges with nanomaterials in medical and pharmaceutical applications. |
| **CO2** | Understand biomaterials and interaction of biomaterials with cells, body fluids and tissues. |
| **CO3** | Apprehend the different types of nano vehicles and nanocarriers as well as their use in nanomedicine for diagnosis and therapy. |
| **CO4** | Understand the specific features of nanomedicine required for treating various diseases. |
| **CO5** | Analyze the mechanisms of how nanomaterials can cause toxicity. |
|  |
| **UNIT - I** | **INTRODUCTION TO NANOSCIENCE** |  **[10hrs]** |
| Atomic structure and atomic size. Nanobiology - concepts, definitions. Bionano particles - basics of nanobiotechnology. Emergence and challenges of nanoscience and nanotechnology. Carbon to age-new form of carbon (CNT to Graphene). Influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. |
| **UNIT -II** | **PRODUCTION AND CHARACTERIZATION OF NANOMATERIAL**  |  **[8hrs]** |
| Production of nanoparticles: collision/coalescence mechanism. Nanoparticle agglomerates and aerogels. Biological synthesis of nanoparticles by fungi, bacteria, yeast.Characterization of nanomaterials: XRD, SEM, TEM, UV-Visible Spectrophotometer |
| **UNIT - III** | **NANOMATERIALS AND BIOMATERIALS** |  **[10hrs]** |
| Types of nanostructure and properties of nanomaterials - One dimensional, two dimensional and three dimensional nanostructured materials, Quantum dots shell structures, metal oxides, semiconductors, composites mechanical-physical-chemical properties. Structure, property and relationship of biological materials - tissues, bones and teeth. Preparation of nanobio materials – polymeric scaffolds collagen, elastins. |
| **UNIT - IV** | **NANOMEDICINE** |  **[10hrs]** |
| Basic concepts in the design of nanomedicine, specification and desired features of nanomedicine, nanomaterials and general process steps involved in the preparation of nanomedicines. Applications of nanotechnology in life sciences and medicine. Nanomolecular diagnostics– use of nanoparticles as molecular imaging probes. Nanoparticles for drug delivery, gene delivery. |
| **UNIT - V** | **NANOMEDICINES FOR VARIOUS DISEASES** |  **[7hrs]** |
| Infectious diseases, neurological diseases (challenges of blood brain barrier), pulmonary disorders, cardiovascular diseases, cancer: nano-chemotherapy, radiation therapy, immunotherapy, nuclear medicine therapy, photodynamic therapy, photothermal and RF hyperthermia therapy. Gene therapy- DNA, RNA delivery. |
| **TEXT BOOK** |
| 1 | Rob Burgess, (2012).*Understanding Nanomedicine:* An Introductory Textbook, CRC Press. |
| 2 | Geoffrey A. Ozin, Andre C. Arsenault (2005).*Nanochemistry: A Chemical Approach to Nanomaterials,* Royal Society of Chemistry, Cambridge, UK. |
| 3 | C. N. R. Rao, Achim Muller, A. K, (2004).*Chemistry of nanomaterials: Synthesis, properties and applications,*Cheetham, Wiely-VCH. |
| 4 | Daniel L. Fedlheim, Colby A. Foss, Marcel, (2002).*Metal Nanoparticles: Synthesis Characterization & Applications,* Dekker. |
| 5 | Cao, Guozhong, ying Wang, (2011).*Nanostructures and Nanomaterials - Synthesis, Properties and Applications* - World Scientific.  |
| **REFERENCE BOOKS** |
| 1. | Piyush Kumar, RohitSrivastava, (2017).*Nanomedicine for Cancer Therapy:From Chemotherapeutic to Hyperthermia-Based Therapy*, Springer.  |
| 2. | Nanotoxicology, *Materials, Methodologies, and Assessments*, Editors: Durán, Nelson, Guterres, Silvia S., Alves, OswaldoLuiz (Eds.). |
| 3. | CNRRaoet.al., Chemistry of nanomaterials: Synthesis, properties and applications. |
| 4. | SchmidtG., Wiley Weinheim (2004).*Nanoparticles: From theory to applications*. |
| 5. | *Nanochemistry*: *A Chemical Approach to Nanomaterials*, Royal Society of Chemistry, Cambridge UK 2005. |

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| **MAPPING WITH PROGRAMME OUTCOMESS (PO)**  |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **1** | **3** | **3** | **2** |
| **CO2** | **3** | **1** | **3** | **3** | **2** |
| **CO3** | **3** | **2** | **3** | **3** | **2** |
| **CO4** | **3** | **2** | **3** | **3** | **2** |
| **CO5** | **3** | **2** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER- III****NME - I** | **22UBION37: FOOD AND NUTRITION** | **HRS/WK-2****CREDIT-2** |

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| **COURSE OBJECTIVES:** |  |
| * Understand the fact that food as medicine
* To analyse the importance of nutrients with their sources
 |
| **EXPECTED course outcomes** |
| On the successful completion of the course, student will be able to |
| 1 |  Understand carbohydrates sources and functions in the body. | K2 |
| 2 | Grasp fats classification and function in the body | K2 |
| 3 | Analyse the importance of protein in the maintenance of health  | K4 |
| 4 |  Recognize vitamins in food and their significance in health | K2 |
| 5 | Analyse importance of major, minor and trace elements (Minerals) in the food | K4 |
| **K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate; K6-Create** |
| **UNIT -I** |  **Carbohydrates** | **6Hrs** |
|  Food -Definition. Balanced diet and its composition. Carbohydrates - Sources, classification, RDA and nutritional significance in the body. Glucose as a chief source of energy. Dietary fibre and its importance |
| **UNIT- II** | **Lipids** | **6Hrs** |
|  Lipids, Classification. Sources of dietary lipids. Essential fatty acids and their importance. Saturated and unsaturated fatty acids. Mono unsaturated and Poly unsaturated fatty acids and their importance. |
| **UNIT-III** | **Proteins** | **6Hrs** |
|  Proteins as a body building food. Classification of proteins. Major functions of proteins in the body. Rich sources of protein. RDA for protein. Protein deficiency disorders-Kwashiorkor and marasmus.  |
| **UNIT-IV** | **Vitamins** | **6Hrs** |
|  Vitamins- Fat soluble - Vitamin A, D, E and K. - Sources, RDA and functions. Water soluble vitamins- Thiamine, riboflavin, folic acid, cobalamine and pantothenic acid- Sources, RDA and function. Ascorbic acid as a free radical scavenger- Sources and RDA |
| **UNIT-V** | **Minerals** | **6Hrs** |
|  Minerals - Macro and micro minerals. Sources, RDA and biological functions of Iron, Calcium, Iodine, Magnesium, Sodium, Potassium and Chlorine.  |
| TEXT BOOKS / REFERENCE BOOKS |
| 1 | Murray R.K., Granner D.K. Mayes P.A., Rodwell D.W. (2006), *Harper’s Biochemistry*, (25th ed), Prentice Hall, New Jersey |
| 2 | Nelson D.L. and Cox M.M. Lehninger (2008) *Principles of Biochemistry*, (5th ed), W.H. Freeman and Company, New York. |
| 3 | Sathyanarayanan. U (2002), *Essentials of Biochemistry* Books and allied (p) Ltd.. |
| 4 | Voet D., and Voet G., (2006), *Biochemistry,* John Wiley and Sons, New York. |
| 5 | Zubay G.L., (1999) *Biochemistry*, (4th ed), WCB, McGraw-Hill, New York. |

Mapping with Programme Outcomes

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| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | S | M | S | S | M | M | S | M | S | S |
| CO2 | S | S | S | S | S | S | S | S | S | S |
| CO3 | M | S | S | S | M | S | S | M | S | S |
| CO4 | M | M | S | S | M | S | S | S | S | M |
| CO5 | S | S | S | S | M | M | S | S | S | S |

PO – Programme Outcome, CO – Course outcome

S – Strong, M – Medium, L – Low (may be avoided)

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| **SEMESTER-III****SKILL BASED SUBJECT: I** | **22UBIOS38**: **BIOSTATISTICS****(30 Hrs)** | **HRS/WK-2****CREDIT-2** |
| **COURSE OBJECTIVES*** + To understand the commonly used statistical tools.
	+ To know the concept of hypothesis testing and the importance of statistical significance in interpreting researchdata.
	+ To gain information about probability
	+ To study the importance of correlation in the research.
	+ To analyse the role of ANOVA in biological research.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to understand : |
| **CO1** | Understand the definition of biostatistics and its scope. Ascertain the methods and importance of data collection and preservation. |
| **CO2** | Examine the usage of statistical tools like measure of central tendency and measure of dispersion. |
| **CO3** | Apply hypothesis testing. |
| **CO4** | Recognize the results of correlation. |
| **CO5** | Analyze ANOVA and make statistical decision. |
|  |
| **UNIT -I** | **INTRODUCTION TO BIOSTATISTICS** | **6 hrs** |
| Introduction- definition of statistics -population – Sample – collection, classification of data. Representation of data – tabulation and diagrammatic – graphical representation of statistical data (bar diagram, line diagram, pie diagram, and histogram). |
| **UNIT- II** | **CENTRAL TENDENCY, DISPERSIONANDCORRELATION** |  **6 hrs** |
| Measure of location – mean, median mode. Measure of dispersion – Range, standard deviation, variance and co-efficient of variance. |
| **UNIT-III** | **TESTING OF HYPOTHESIS** | **6 hrs** |
|  Probability –Basic concept. Theoretical distribution – Binomial, Poisson and normal – introduction and application. Test of significance – Null and Alternative hypothesis – “t” test chi – square test introduction and application. |
| **UNIT-IV** | **CORRELATION ANALYSIS** | **6 hrs** |
| Correlation – Introduction – types – methods of correlation. Karl Pearson’s correlation.Rank correlation. |
| **UNIT-V** | **ANALYSIS OF VARIANCE** | **6 hrs** |
|  Analysis of Variance (ANOVA) – Introduction one way classification and two way classification |

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| REFERENCE BOOKS: |
| 1. | Daniel, W.W.,& Cross, C.L.(2019). *Biostatistics: a foundation for analysis in the healthsciences*(11th ed.). Hoboken: Wiley |
| 2. | Zar, J.H. (2010).*Biostatistical analysis* (5th ed.). Upper Saddle River: Prentice-Hall |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **2** | **3** | **2** | **2** | **3** |
| **CO2** | **2** | **3** | **2** | **2** | **3** |
| **CO3** | **2** | **3** | **2** | **2** | **3** |
| **CO4** | **2** | **3** | **2** | **2** | **3** |
| **CO5** | **2** | **3** | **2** | **2** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER: IV****CORE: V** | **22UBIOC43: BIOCHEMICAL TECHNIQUES -II****( 75hrs )** | **HRS/WK-5****CREDIT-4** |
| **COURSE OBJECTIVES*** To know the basic principles of colorimetric technique.
* To acquire knowledge and skill about the instrumentation and operation of spectroscopy.
* To learn the importance of chromatographic technique for analysis of molecules.
* To study the instrumentation and application of chromatography.
* To study about radioisotopes and techniques based on isotopes.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand electromagnetic spectrum and electromagnetic radiation. |
| **CO2** | Comprehend the uses of spectroscopy for determination of molecules concentration. |
| **CO3** | Perceive idea about chromatographic separation of simple molecules. |
| **CO4** | Acquire knowledge about the separation of wide range of molecules. |
| **CO5** | Understanding the biological uses of radioisotopes and its hazards. |
|  |
| **UNIT- I** | **SPECTROSCOPY TECHNIQUES - I** | **[15hrs]** |
| Definition – wavelength, wave number, frequency, Stokes shift. Electromagnetic spectrum, properties of electromagnetic radiation, Absorption and emission spectra. Beer-Lambert law. Principle, instrumentation, and applications - Colorimetry, UV - Visible spectroscopy and Spectrofluorimetry. |
| **UNIT- II**  | **SPECTROSCOPY TECHNIQUES - II** | **[15hrs]** |
| Principle, instrumentation, and applications – Luminometry, Atomic absorption and emission spectroscopy, and Circular Dichroism.Principle and applications - Electron Spin Resonance spectroscopy, Nuclear Spin Resonance spectroscopy and Mass spectroscopy |
| **UNIT-III** | **CHROMATOGRAPHIC TECHNIQUES - I** | **[15hrs]** |
| Principle of chromatography. Partition and distribution coefficient. Principle, procedure and applications - Paper chromatography, Thin layer chromatography, Molecular gel exclusion chromatography and Affinity chromatography. |

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| **UNIT -IV** | **CHROMATOGRAPHIC TECHNIQUES - II** | **[15hrs]** |
| Principle, instrumentation, and applications - Ion-exchange chromatography, Gas liquid chromatography, Column chromatography and High performance liquid chromatography. |
| **UNIT - V** | **RADIOISOTOPES TECHNIQUES** | **[15hrs]** |
| Isotopes, Radioisotopes, type of radioactive decay, units of radioactivity. Detection and measurement of radioactivity - Methods based upon ionization (GM counter), excitation (Scintillation counter) and autoradiography. Biological applications of radioisotopes. Hazards and safety aspects in handling radio isotopes. |

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| **TEXTBOOKS** |
| 1 | Wilson and Walker (2018). Principles and techniques of Biochemistry and Molecular Biology. (8th ed) Cambridge University Press.  |
| 2 | Upadhyay, Upadhyay and Nath. (2010). Biophysical Chemistry principles and Techniques. Himalaya Publ.  |
| **REFERENCE BOOKS** |
| 3 | Friefelder and Friefelder (1983). Physical Biochemistry - Applications to Biochemistry and Molecular Biology. WH Freeman. (2nd ed) |
| 4 | Pavia, Lampman, Kriz, Vyvyan. (2015). Introduction to Spectroscopy. Cengage Learning.(5th ed).  |
| 5 | Rodney. Boyer F. Modern Experimental Biochemistry. Pearson Education. Inc. (3rd ed).  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **3** | **3** |
| **CO2** | **3** | **3** | **2** | **3** | **3** |
| **CO3** | **3** | **3** | **2** | **3** | **3** |
| **CO4** | **3** | **3** | **2** | **3** | **3** |
| **CO5** | **3** | **3** | **2** | **3** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER - III &IV****CORE PRACTICAL: II** | **22UBIOP44: CORE PRACTICAL-II****(45 hrs /60 hrs)** | **HOURS-4****CREDIT-3** |
| **COURSE OBJECTIVES*** To know the preparation of buffers and testing its pH.
* To gain knowledge on chromatographic separation of biological compounds.
* To learn the procedure and technique used for isolation of nucleic acids.
* To learn the techniques for estimation of biological molecules colorimetrically.
* To learn how to separate charged molecules electrophoretically.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand the preparation of method of various buffers. |
| **CO2** | Comprehend the chromatographic separation techniques of simple molecules. |
| **CO3** | Understand the procedure and technique used for isolation of nucleic acids. |
| **CO4** | Grasp the estimation techniques of biological molecules. |
| **CO5** | Apprehend the methods to separate charged molecules electrophoretically. |
|  |
| **I** | **PREPARATION OF BUFFERS** | **6 hours** |
| * Preparation of phosphate buffer, tris buffer, carbonate and citrate buffer.
* Determination prepared buffer pH using glass electrode.
* Preparation of phosphate buffered saline.
 |
| **II** | **CHROMATOGRAPHIC SEPARATION** | **6 hours** |
| * Separation and identification of amino acids and simple sugars by paper chromatography.
* Separation and identification of amino acids and phospholipids by thin layer chromatography.
* Separation of chlorophylls and carotenes pigments using column chromatography.
 |
| **III** | **COLORIMETRIC ESTIMATION** | **9 hours** |
| * Estimation of carbohydrates by Anthrone method.
* Estimation of protein by Biuret and Lowery methods.
* Determination of DNA by Diphenylamine method.
* Determination of RNA by Orcinol method.
 |
| **IV**  |  **ISOLATION OF NUCLEIC ACIDS** |  **12 hours** |
| * Extraction and isolation of DNA from chicken liver.
* Extraction and isolation of RNA from yeast.
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| **V** |  **ELECTROPHORETIC SEPARATION** | **6 hours** |
| * Separation of DNA by agarose gel electrophoresis.
* Separation of proteins by SDS-PAGE (Demonstration).
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| **REFERENCE BOOKS** |
| **1** | Dr. Jayaraman J., *Manuals in Biochemistry* (2011) New Age International pub, Bangalore. |
| **2**  | David T., Plummer (2000). *Introduction to practical Biochemistry* New Delhi: Tata McGraw Hill Publishing Company,  |
| **3** | Pattabiraman, *Laboratory manual in biochemistry.* |

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|  **MAPPING WITH PROGRAMME OUTCOMES (POS)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **2** | **2** |
| **CO2** | **3** | **3** | **3** | **2** | **2** |
| **CO3** | **3** | **3** | **3** | **2** | **2** |
| **CO4** | **3** | **3** | **3** | **2** | **2** |
| **CO5** | **3** | **3** | **3** | **2** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER – II****ALLIED: 2** | **22UMICA02: MICROBIOLOGY – II** | **HOURS-4/W****CREDIT-3** |

**Course outcomes**

1. To gain knowledge about the importance of microorganisms in soil and agriculture

2. To understand the role of microorganisms in air and water

3. To learn about foodborne microorganisms

4. To gain knowledge on microbial production of industrially important compounds

5. To learn about various microorganisms causing diseases in humans

**UNIT - I**

Soil Microbiology – Microbes in soil formation, Microorganisms found in soil and their importance; Plant growth promoting bacteria – Nitrogen fixation, Phosphate solubilization, Biofertilizers, Biopesticides; Microrganisms and plant diseases, transmission and control.

**UNIT - II**

Microorganisms in air, Distribution and Source of Airborne Organisms; Aquatic Microbiology, Sewage Treatment - Physical and Biological methods; Drinking water treatment, Waterborne diseases, role of microorganisms in biogeochemical cycles.

**UNIT - III**

Food Microbiology - Microbial Spoilage of food, food preservation techniques, Microbes in Milk, microbial product of milk fermentation – Cheese, butter, curd; Pasteurization techniques; Foodborne infections caused by bacteria, fungi and viruses.

**UNIT - IV**

Microbial Fermentations, Fermentors, Microbial production of Organic acids – Citric acid, Antibiotics – Penicillin, Vitamins – Cyanocobalamin, Amino acid production - glutamic acid, alcohol - Ethanol and beverages - wine; SCP production, Bioremediation, Biodeterioration.

**UNIT - V**

Morphology, Cultural Characteristics, Pathogenecity, Laboratory diagnosis and prevention of Infections caused by the following organisms *Mycobacterium tuberculosis*, *Vibrio cholerae*, *Salmonella* sp., dermatophytes, *Candida albicans*, *Entamoeba histolytica*, *Plasmodium falciparum*, Rabies virus, Hepatitis B Virus and HIV.

**Textbook**

* Prescott’s Microbiology. 10th Edition, 2016. Willey J., Sherwood L., Woolverton C.J. McGraw Hill Education, New York.

**Reference Books**

* Modern food microbiology. 7th Edition, 2005. James M. Jay, Martin J. Loessner, David A. Golden. Springer Science & Business.
* Environmental Aspects of Microbiology. 1996. Joseph C. Daniel. Brightsun Publications, Chennai.
* Biotechnology. 2nd Edition, 2000. Crueger W. and A Crueger. Panima Publishing Corporation, New Delhi.
* Text Book of Microbiology. 9|h Edition, 2013. Ananthanarayanan, R and C.K.J. Panicker. Orient Longman Private Ltd., Chennai.
* Soil Microbiology - Soil microorganisms and Plant growth. 4th Edition, 2017. Subba Rao, N.S. Oxford & IBH publishing Co. Pvt. Ltd.

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| **SEMESTER – II****ALLIED: II****ALLIED PRACTICAL II** | **22UMICP01: MICROBIOLOGY PRACTICAL** | **HOURS-3/W****CREDIT-2** |

**Course outcomes**

1. To gain knowledge about laboratory procedures in Microbiology

2. To use microscopes in the study of microorganisms

3. To learn about media preparation

4. To observe and isolate microorganisms from samples

5. To learn about enumeration of microorganisms

**List of Experiments**

1. Cleaning of glasswares, sterilization techniques

2. Gram staining

3. Motility (Hanging drop)

4. Lactophenol cotton blue mounting of fungi – *Mucor, Rhizopus, Penicillium, Aspergillus*

5. Observation of wet mount for algae

6. Serial dilution techniques

7. Pour plate and spread plate techniques

8. Preparation of culture media, Slant preparation

9. Streak plate and pour plate techniques

10. Assessment of milk quality by MBRT test

11. Microscopic observation of curd

12. Cross sectioning of Root nodules for *Rhizobium*

13. Assessment of air quality by open plate method

**Manuals for Reference**

1. Experimental Procedures in Life Sciences. Rajan. S and Selvi Christy. 2015. Anjanaa Book House Publishers, Chennai.

2. Microbiology: A Laboratory Manual. Cappuccino and Sherman. 7th edition, 2004. Benjamin Cummings Publications, US

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| **SEMESTER- III****NME - II** | **22UBION47: LIFESTYLE DISEASES & PREVENTION** | **HRS/WK-2****CREDIT-2** |

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| **COURSE OBJECTIVES:** |  |
| * To understand the basics of lifestyle diseases.
* To understand the importance of maintaining good health
* To lead a healthy life style to cope up with modern life
 |
| **Course outcomes** |
| On the successful completion of the course, student will be able to |
| 1 | Understand the importance of vitamins and minerals |
| 2 | Recognize lifestyle Prone Disorders |
| 3 | Understand physiological and psychological disorders |
| 4 | Communicable And Non-Communicable Disease |
| 5 | understand the importance of maintaining good health |
| **K1- Remember; K2- Understand; K3-Apply; K4-Analyse; K5-Evaluate; K6-Create** |
| **UNIT -I** |  **Nutrients and their importance** | **6Hrs** |
|  Types of nutrients- Macronutrients- carbohydrates, proteins, fats. Vitamins and minerals Importance of water. Dietary fibre and its major role in the body. |
| **UNIT- II** | **LIFE STYLE IMPACT ON DISEASES** | **6Hrs** |
|  Lack of physical activity, Incompatible food, irregular food habits, fast foods. Alcohol intake, cigarette smoking- Consequences. Technology in health deterioration-Computer vision syndrome, mobile vision syndrome |
| **UNIT-III** | **PHYSIOLOGICAL DISORDERS AND PSYCHOLOGICAL DISORDER** | **6Hrs** |
|  Physiological disorders**:** Food poisoning- Intestinal disorder, hormonal imbalance, premenstrual syndrome, Renal Calculi and gall stones.**Psychological disorder-** Stress, Anxiety Memory dysfunction. Depression, Mood swings, Lack of confidence suicidal thoughts Self-medications. |
| **UNIT-IV** | **COMMUNICABLE AND NON-COMMUNICABLE DISEASES** | **6Hrs** |
|  Communicable diseases and Non-communicable diseases - Definition and examples Communicable diseases - AIDS, Tuberculosis, Cholera, typhoid- Causes and treatment. Non-communicable diseases- Type 2 diabetes, Cancer, Coronary heart diseases, Stroke, Obesity- Definition, causes and treatment |
| **UNIT-V** | **GOOD HEALTH MAINTENANCE** | **6Hrs** |
|  **Good health-** Improved life style, Improved Food habits, Proper sleep, Exercise for good health stress management -Yoga, Swimming, Walking, Outdoor games.  |
| REFERENCE BOOKS |
| 1 | Srilakshmi B., (2019) *Dietetics* - Multi Colour Edition, New age inter Pbs  |
| 2 | Srilakshmi B.,(2017) *Food Science* (Multi Colour Edition) , New age inter Pbs  |
| 3 | SHARMA D.C., and DEVANSHI SHARMA (2017)*Nutritional Biochemistry*, CBS Publisher and Distributers,  |
| 4 | Kumar B., Meenal Kumar, (2004)*Guide to prevention of lifestyle diseases* b. kumar, Deep and Deep Publications,. |

**Mapping with Programme Outcomes**

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| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | M | S | M | M | M | S | S | S | S | S |
| CO2 | M | M | M | S | M | S | S | S | S | S |
| CO3 | M | S | M | M | M | S | S | S | S | S |
| CO4 | S | M | S | S | M | S | S | S | S | S |
| CO5 | S | S | S | M | S | S | S | S | S | S |

PO – Programme Outcome, CO – Course outcome

S – Strong, M – Medium, L – Low (may be avoided)

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| **SEMESTER-IV****SKILL BASED SUBJECT: II** | **22UBIOS48: TOXICOLOGY AND HERBAL MEDICINE** **(30hrs)** | **HRS/WK-2****CREDIT-2** |
| **COURSEOBJECTIVES:**  |
| * To study various harmful chemical agents in environment and its impacts.
* To study the basics of medicinal and therapeutic use of plants.
* To study various food additives, preservatives and their toxicity.
* To expose the importance of medicinal plants and herbs.
* To study the phytomedicine role in life style diseases.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand and gain knowledge about the toxic substances, types, and mechanism. |
| **CO2** | Understand the Toxic substances, sources and routes of exposure  |
| **CO3** | Comprehend toxicity of drugs, food additives and preservatives. |
| **CO4** | Acquire knowledge about the herbs, characterization, active constituents of plants. |
| **CO5** | Gain insights about the herbal drugs for dengue fever,urinogenital disorders, memory stimulants, dissolving kidney stones, inflammatory and anticancer drugs. |
|  |
| **UNIT- I** | **GENERAL TOXICOLOGY** | **[6hrs]** |
| Introduction to toxicology- Definitions, Fundamentals and scope of toxicology. Toxic substances: degradable and non-degradable. Factors influencing toxicity. Acute and chronic toxicity. |
| **UNIT- II** | **TOXIC SUBSTANCES IN ENVIRONMENT**  | **[6hrs]** |
| Toxic substances in environment- sources and route of exposure, toxicity caused by metal and non-metals, ransport of toxicants through food chain- bioaccumulation and bio-magnification. |
| **UNIT- III** | **DRUG TOXICITY** | **[6hrs]** |
| Drug toxicity- LC50, LD50. Toxic effect of agrochemicals (organophosphates and organochlorine). Toxicity caused by food additives and preservative |
| **UNIT- IV** | **MEDICINAL PLANTS AND HERBS** | **[6hrs]** |
|  Characterization of herbs based on plant properties, usage and active constituents. Classification of medicinal plants and herbs-Alkaloids, Glycosides, Polyphenols, terpenes and flavanoids. |
| **UNIT- V** |  **PHYTOMEDICINE** | **[6hrs]** |
| Drugs for urinogenital disorders – *With aniasomnifera* – Memory stimulants – *Centellaasiatica,* Herbal drugs for dissolving kidney stones – *Musa paradisica,* Anti-inflammatory drugs from plants– *Curcuma longa*, Cardiospermum – Anticancer drugs from plants –*Catharanthusroseus* and A*zardicaindica*. Covid-19-kabasurakudineer , Dengue fever – Papaya leaves. |

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| **TEXT BOOKS** |
| **1** | David Hoffmann.,(2003).*Medical Herbalism: The Science Principles and Practices of Herbal Medicine,*(1sted)Healing Arts Press publishers. |
| **2** | Kumar N.C. (1993) An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi. |
| **3** | [Agnes Arbe](https://www.amazon.com/s/ref%3Ddp_byline_sr_book_1?ie=UTF8&field-author=Agnes+Arber&search-alias=books&text=Agnes+Arber&sort=relevancerank), (1987), *Herbals: Their Origin and Evolution*, (3rded) Cambridge University Press |
| **REFERENCE BOOKS** |
| **1** | Gupta, P.K. and Salunka, D.K. (1985). *Modern toxicology*. Vol I and II. Metropolitan, New Delhi. |
| **2** | Ming-Ho Yu, [HumioTsunoda](https://www.amazon.com/s/ref%3Ddp_byline_sr_book_2?ie=UTF8&text=Humio+Tsunoda&search-alias=books&field-author=Humio+Tsunoda&sort=relevancerank), [Masashi Tsunoda](https://www.amazon.com/s/ref%3Ddp_byline_sr_book_3?ie=UTF8&text=Masashi+Tsunoda&search-alias=books&field-author=Masashi+Tsunoda&sort=relevancerank), (2011).*Environmental Toxicology: Biological and Health Effects of Pollutants,*  (3rded) CRC Press;  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **2** | **3** | **2** | **2** | **3** |
| **CO2** | **2** | **3** | **2** | **2** | **3** |
| **CO3** | **2** | **3** | **2** | **2** | **3** |
| **CO4** | **2** | **3** | **2** | **2** | **3** |
| **CO5** | **2** | **3** | **2** | **2** | **3** |

**3-Strong;2- Medium;1-Low;**

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| **SEMESTER-V****CORE: VI** | **22UBIOC51 INTERMEDIARY METABOLISM** **( 60 hrs )** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES*** To gain knowledge about the principle and mechanism of energy production in cells.
* To study about the energy production in carbohydrate metabolism.
* To analyze the energy production by lipid.
* To know how the synthesis and degradation of amino acids occur in the system.
* To study the synthesis and degradation of nucleic acid and their products.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand the basic principles of bioenergetics and mitochondrial mechanisms in energy production. |
| **CO2** | Apprehend the pathways of carbohydrates anabolism and catabolism. |
| **CO3** | Comprehend the metabolic fates of lipids and the features of lipid catabolism. |
| **CO4** | Analyze the synthesis, types and degradation of amino acids and structure of proteins. |
| **CO5** | Recognize the synthesis and degradation of nucleotides. |
|  |
| **UNIT - I** | **BIOENERGETICS AND BIOLOGICAL OXIDATION** | **[12 hrs]** |
| Free energy and entropy, endergonic and exergonic reactions. High energy phosphates–ATP. The components of electron transport chain. Oxidative phosphorylation. The chemiosmotic theory. uncouplers and ionophores. Mitochondrial transport systems - ATP/ADP exchange, malate/glycerophosphate shuttle. |
| **UNIT - II**  | **CARBOHYDRATE METABOLISM** | **[12 hrs]** |
| Glycolysis and gluconeogenesis. Citric acid cycle. Glycogenesis and glycogenolysis. Pentose phosphate pathway (HMP shunt). Glucuronic acid cycle and glyoxylate cycle (Entner- Duodoroff pathway).  |
| **UNIT - III** | **LIPID METABOLISM** | **[12 hrs]** |
| Oxidation of fatty acids - Carnitine cycle. Beta oxidation, alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids. Biosynthesis of unsaturated fatty acids: monounsaturated and polyunsaturated fatty acids. Biosynthesis and functions - Lecithin, cephalin, phosphatidyl serine and cholesterol. |
| **UNIT - IV** | AMINO ACID METABOLISM | **[12hrs]** |
| Biosynthesis of non-essential amino acids. Catabolism of amino acid: Oxidative deamination, non – oxidative deamination, transamination, decarboxylation. Urea cycle and catabolism of carbon skeleton of amino acids. Catabolism of glycine, phenylalanine and tyrosine. |
| **UNIT - V** | METABOLISM OF NITROGEN BASES AND METABOLIC INTEGRATION | [**12hrs]** |
| De novo and salvage pathways of purine biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines. Integration of metabolism - Interconversion of major molecules. Metabolic profile of the liver, adipose tissue and brain. Brief account on metabolomics. |

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| **TEXTBOOKS** |
| 1 | Nelson and Cox (2017). Lehninger Principles of Biochemistry. (7th ed) Freeman. |
| 2 | Rodwell et al., (2018). Harper’s Illustrated Biochemistry (31st ed) McGraw Hill. |
| **REFERENCE BOOKS** |
| 1. | David A. Bender. Introduction to Nutrition and Metabolism. CRC Press. 5th ed. 2014. |
| 2. | Kuchel et al., (2011) Schaum’s Outline of Biochemistry. (3rd ed) McGraw Hill. |
| 3. | Voet and Voet (2018). Fundamentals of Biochemistry. (5th ed) Wiley. |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **2** | **2** | **1** | **2** |
| **CO2** | **3** | **2** | **2** | **1** | **2** |
| **CO3** | **3** | **2** | **2** | **1** | **2** |
| **CO4** | **3** | **2** | **2** | **1** | **2** |
| **CO5** | **3** | **2** | **2** | **1** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V****CORE: VII** | **22UBIOC52: ENZYMES****( 60 hrs )** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES*** To study the classification of enzymes.
* To know the kinetics of the enzymes.
* To gain knowledge on the mechanism of enzyme action.
* To acquire an idea about concepts of enzyme inhibition.
* To analyze the industrial application of enzymes.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Understand the classification and characteristics of enzymes. |
| **CO2** | Analyze the kinetics of the enzymes. |
| **CO3** | Understand the mechanism of enzyme action. |
| **CO4** | Analyze the concept of enzyme inhibition |
| **CO5** | Evaluate the enzyme role in industry and clinical diagnosis |
|  |
| **UNIT - I** | **CHARACTERISTICS OF ENZYMES** | **[12 hrs]** |
| Definition, nomenclature, and IUB classification. Enzyme units- IU, Katal. Specific activity. Active site - investigation of active site structure and salient features. Non-protein enzymes - abzymes, ribozymes, DNA enzymes.  |
| **UNIT- II** | **COFACTORS AND MECHANISM OF ENZYME ACTION**  | **[12hrs]** |
| Structure and functions of TPP, NAD, NADP, FAD, FMN, Coenzyme A and metal cofactors. Enzyme specificity - Absolute, group and optical specificity. Lock and key model and induced fit model. Enzyme-substrate complex formation, Mode of action of lysozyme and chymotrypsin. Bisubstrate reactions.  |
| **UNIT -III** | **ENZYME KINETICS** | **[12 hrs]** |
| Enzyme kinetics steady state kinetics. Effect of pH, temperature, enzyme and substrate concentration. Michaelis - Menten derivation and plot, Line weaver-Burk plot, significance of Km and Vmax. |
| **UNIT- IV** | **ENZYME INHIBITION** | **[12 hrs]** |
| Irreversible and reversible, competitive, non competitive, uncompetitive, mixed inhibition (derivation not required). Allosteric enzymes, multienzyme complex - Pyruvate dehydrogenase, Isoenzymes of lactate dehydrogenase. |
| **UNIT-V** | **IMMOBILIZED AND CLINICAL ENZYMOLOGY** | **[12hrs]** |
| Immobilized enzymes- methods of immobilization, applications. Biosensors, enzymes as a marker in clinical diagnosis – LD, CK, transaminases, phosphatases asparginase, streptokinase and amylases. Industrial applications of enzymes.  |

**Text Books**

* 1. RenukaHarikrishnan, (1995). Introduction to Biomolecules and Enzymes.Indraji Publications.
	2. Sathyanarayana U., (2019). Fundamentals of Biochemistry. Allied & Books Pvt. Ltd, Calcutta.
	3. Jain J.L., (2005). Fundamentals of Biochemistry. (6thed). S.Chand Publications.

**Supplementary Readings**

* + 1. Trevor Palmer (1991). Understanding enzymes (3rd edition).
		2. Stryer (1995). Biochemistry (4th edition).

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| **MAPPING WITH PROGRAMME OUTCOMES (POS)** |
| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V****CORE: VIII** | 22UBIOC53: MOLECULAR BIOLOGY**(60 hrs)** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES*** To familiar with the central dogma of molecularbiology.
* To gain knowledge about the steps involved in replication, transcription and translation.
* To acquire knowledge of gene and chromosomal mutation.
* To study the salient features of genetic code.
* To aware of the regulation of gene regulation and amplification.
 |
| **EXPECTED COURSE OUTCOMES** |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Understand the steps involved in prokaryotic replication and inhibitors. |
| **CO2** | Infer the central dogma of molecular biology and the process of prokaryotic transcription. |
| **CO3** | Define genetic code and relate it to translation process and explain protein biosynthesis. |
| **CO4** | Understand the regulation of gene expression in prokaryotes using lac and trp operon. |
| **CO5** | Gain knowledge on gene mutation and DNA Repair mechanisms. |
|  |
| **UNIT - I** | **REPLICATION** |  **[14 hrs]** |
| Central dogma of molecular biology.DNA as a genetic material - experimental evidence.Replication – definition, types - Conservative, semi conservative and dispersive; unidirectional and bidirectional mode of DNA replication. Experimental evidence to prove DNA replication is semi conservative. Mechanism of replication in prokaryotes, DNA polymerases other enzymes and protein factors involved in replication.Inhibitors of replication. |
| **UNIT - II** | DNA MUTATION AND REPAIR | **[12 hrs]** |
| Mutation – Definition, Types of mutation - transition, transversion, frame shift, insertion, deletion, duplication, suppresser sensitive, germinal and somatic. Molecular basis of mutation - spontaneous and induced mutation. DNA repair - Excision repair, uracil DNA glycoxylase, Repair of thymine dimerS.  |
| **UNIT-III** | **TRANSCRIPTION** | **[12 hrs]** |
| Definition, Prokaryotic RNA polymerase, promoter sequence, Mechanism of Transcription - template recognition, initiation, elongation and termination. Transcription in eukaryotes: RNA polymerases - I, II and III. Promoters, transcription factors. Steps in transcription. Inhibitors of transcription.Post-transcriptional processing. RNA splicing in eukaryotes. |
| **UNIT -IV** | **GENETIC CODE, TRANSLATION** | **[12 hrs]** |
| Genetic code - Salient features, Wobble hypothesis. Mechanism of protein synthesis in bacteria - amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Post-translational modifications.  |
| **UNIT -V** | **GENE REGULATION AND OPERON** | **[10 hrs]** |
| Definition, Positive and negative control of gene expression, repression and attenuation. Operon – Definition, Mechanism, Lac operon and Trp operon.  |

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| **TEXT BOOKS** |
| 1 | Watson (2013). *Molecular Biology of the Gene*. (7thed ) Pearson Edu.  |
| 2 | Nelson and Cox. Lehninger (2017). *Principles of Biochemistry*. (7thed) Freeman. |
| **REFERENCE BOOKS** |
| 1 | Alberts et al. (2014). *Molecular Biology of the Cell*. (6th ed) Garland Sci. |
| 2 | Richard Twyman. *Advanced Molecular Biology*. Garland Science. 2018. |
| 3 | Lodish (2016). *Cell and Molecular Biology*. (8thed) Macmillan Learning.  |
| 4 | Krebs JE et al. Lewin’s. (2017). *Genes XII.* Jones & Bartlett Publ.  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **2** | **3** |
| **CO2** | **3** | **3** | **2** | **2** | **3** |
| **CO3** | **3** | **3** | **2** | **2** | **3** |
| **CO4** | **3** | **3** | **2** | **2** | **3** |
| **CO5** | **3** | **3** | **2** | **2** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER - V****CORE: IX** | **22UBIOC54: CLINICAL BIOCHEMISTRY****(60hrs)** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES*** To translate the knowledge learned in multiple courses such as intermediary metabolism and physiology into the diagnosis of human health and disease.
* To employ biochemical investigations systematically in clinical diagnosis and prognosis.
* To gain training in the estimation of clinically relevant biomolecules in body fluids.
* To learn about the abnormalities in the various metabolism.
* To gain knowledge about the molecular basis of cancer.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will be able to: |
| **CO1** |  Acquire knowledge on diagnosis, prognosis and disorders of carbohydrate metabolism. |
| **CO2** | Gain knowledge on normal and abnormal level of proteins and its disorders. |
| **CO3** | Acquire information about abnormalities of lipid and nucleic acid metabolism. |
| **CO4** | M Comprehend renal, liver and gastric function tests, and how they are employed in systematic diagnosis of diseases. |
| **CO5** | Understand the molecular basis of cancer. |
|  |
| **UNIT - I** | **DISORDERS OF CARBOHYDRATE METABOLISM**  |  **12 hrs** |
| Blood glucose level - Normal fasting and post-prandial, mechanism of blood glucose homeostasis. Diabetes mellitus: classification, metabolic abnormalities, diagnosis, acute (diabetic ketoacidosis) and long term (nephropathy, neuropathy, retinopathy, diabetic foot) complications, management. Glycosuria, fructosuria, pentosouria, galactosemia and glycogen storage diseases. |
| **UNIT - II** | **DISORDERS OF PROTEIN METABOLISM** | **12 hrs** |
| Clinical significance and variation of plasma and serum proteins. Abnormal non-protein nitrogen - Urea, uric acid, creatinine. Clinical features of phenylketonuria, alkaptonuria, albinism, cysteinuria, maple syrup disease, Hartnup disease and tyrosinosis. Urea clearance test.  |
| **UNIT - III** | **DISORDERS OF LIPID AND NUCLEIC ACID METABOLISM** | **12 hrs** |
| Disorders of lipoprotein metabolism. Atherosclerosis - risk factors, biochemical findings and management. Lipid storage diseases and fatty liver. Obesity - risk factors, biochemical findings and management.Disorders of purine metabolism - Normal level of uric acid in blood and urine, hyper uricemia and Gout. Hypouricemia – Xanthinuria and Liathiasis. Disorders of pyrimidine metabolism - Oroticaciduria |
| **UNIT- IV** | **LIVER AND GASTRIC FUNCTION TESTS**  | **12 hrs** |
| Functions of the liver and classification of liver function tests. Abnormalities in bile pigment metabolism- differential diagnosis of jaundice (hemolytic, hepatic and obstructive). Changes in plasma proteins, clotting factors and prothrombin time. Serum enzymes in liver diseases: ALP, SGOT, SGPT and γ-GTP. Bile pigment levels in urine and faeces. Gastric function tests - Collection and examination of gastric contents after stimulation. Fractional test meal analysis and its interpretation, and tubeless gastric analysis. |
| **UNIT - V** | **MOLECULAR BASIS OF CANCER** | **12 hrs** |
| Differences between benign and malignant tumours. Hall mark properties of cancer cells. Morphological and biochemical changes in tumour cells. Cancer cell – in situ, invasion, metastasis. Tumor markers- oncofetal proteins, hormones, enzymes, tumor-associated antigens. Cancer causing agents - radiation, viruses and chemicals. Multistage carcinogenesis. Mechanisms of activation and functions of protooncogenes and tumor suppressor genes.  |

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| **TEXT BOOKS** |
| 1. | Chatterjea, M.N. and RanaShinde (2012). *Text Book of Medical Biochemistry* (8th ed.). New Delhi: Jaypee Brothers Medical Publishers (P) LTD. |
| 2. | Devlin, T.M. (2010). *Text book of biochemistry with clinical correlations* (7th ed.). New York: John Wiley & Sons. |
| **REFERENCE BOOKS** |
| 1. | Murphy, M.J., Srivastava, R. and Deans, K (2019). *Clinical biochemistry: an illustrated color text* (6th ed.). Edinburgh: Elsevier. |
| 2. | Mayne, Philip.D (1994). *Clinical Chemistry in diagnosis and treatment* (6th ed.). London: ELBS Publication. |
| 3. | [Tietz, Norbert W.](https://voyagercatalog.kumc.edu/Author/Home?author=Tietz%2C+Norbert+W.%2C+1926-), [Burtis, Carl A.](https://voyagercatalog.kumc.edu/Author/Home?author=Burtis%2C+Carl+A.), [Ashwood, Edward R (1994).](https://voyagercatalog.kumc.edu/Author/Home?author=Ashwood%2C+Edward+R.%2C+1953-) *Text book of clinical chemistry* (2nd ed.). Philadelphia: W.B. Saunders company. |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V****INTERNAL ELECTIVE -III** | **22UBIOE58-1: MEDICAL LAB TECHNOLOGY****( 60 hours )** | **HRS/WK-4****CREDIT-3** |
| **COURSEOBJECTIVES*** To provide insights in the basic techniques involved in medical diagnostics.
* To learn about the sample collection and quality control.
* To gain knowledge about the significance of hematological parameters.
* To learn the techniques of estimation of biomolecules in blood.
* To learn about the preparation of culture media and culturing microorganisms
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Grasp knowledge about the molecular analysis techniques. |
| **CO2** | Understand the significance and diagnostic importance of hematological parameters. |
| **CO3** | Understand the disease, pathology and diagnosis. |
| **CO4** | Comprehend the relationship between disease and their diagnostic markers. |
| **CO5** | Acquire information regarding pathogenic organism. |
|  |
| **UNIT I** | **QUALITY CONTROL &SAMPLE COLLECTION** | **[12hrs]** |
| Introduction to laboratory technology- Unit of measurement, calibration, validation, measurements, quality control & GLP. Reagent preparation and standardization. Ethics of laboratory technician, specimen collection and procedure - blood, urine, sputum, throat swab, stool and CSF.  |
| **UNIT II**  | **HEMOTOLOGY** | **[12hrs]** |
| Hematology - Compatibility testing- cross matching, clotting time, bleeding time, hemoglobin estimation, RBC count and WBC - total and differential count, platelet count. Erythrocyte sedimentation rate (ESR), Hematocrit value (Packed cell volume). HbA1c. |
| **UNIT-III** | **HISTOPATHOLOGY** | **[12 hrs]** |
| Tissue excision, labeling, preservation (cryopreservation and formalin), embedding, tissue slicing by microtome, slide mounting. Preparation of common staining- H and E, giemsa, leishman, methyl violet. Frozen section techniques- CO2 freezing, cryostat. |
| **UNIT IV** | **CLINICAL BIOCHEMISTRY** | **[12 hrs]** |
| Blood quantitative analysis and its clinical significance - glucose, GTT, ketone bodies, urea, cholesterol, total protein, calcium, and phosphorous. Enzyme assay- AST, ALT, serum alkaline and acid phosphatases, amylase, lactate dehydrogenase.  |
| **UNIT V** | **MICROBIOLOGY** | **[12hrs]** |
| Culture media-basic composition and its types, culturing of organisms from specimens - saliva, pus, urine. Antibiotic sensitivity test (pus, urine, blood, sputum, throat swab).Gram staining&Ziehl-Neilson staining method (TB,Mycobacterium leprae).Safety procedure in microbiological techniques. |

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| **TEXTBOOKS** |
| **1** | Kanai L. Mukherjee,1996. *Medical Laboratory Technology* Vol. I, II & III Tata McGraw Hill New Delhi. |
| **2** | GradWohl, *Clinical Laboratory-Methods and Diagnosis*, 8th edition, Mosby year book publisher, Vol-I. |
| **3** | Darshan P. GodkarPraful B. Godkar, 2014. *Textbook of Medical Laboratory Technology*Vol 1 &2, Bhalani Publishing House; 3rd edition  |
| **REFERENCE BOOKS:** |
| **1** | Mukherjee, 2000. *Medical Laboratory Technology*,Tata McGraw Hill Education  |
| **2** | Henry, John Bernard, Todd Sanford and Davidson, 2002. *Clinical diagnosis and management by laboratory methods.* W.B. Saunders & Co. |
| **3** | Fischbach Francis A, 2003. *Manual of laboratory and diagnostic tests*. |
| **4** | Gradwohls, 2000. *Clinical laboratory methods and diagnosis*. Alex.C. |
| **5** | Sood R, 2005, *Medical Laboratory methods and interpretation*, Jaypee Brothers Medical Publications, New Delhi. |

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| **MAPPING WITH PROGRAMME OUTCOMES (POS)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **3** | **3** | **3** |
| **CO2** | **3** | **3** | **3** | **3** | **3** |
| **CO3** | **3** | **3** | **3** | **3** | **3** |
| **CO4** | **3** | **3** | **3** | **3** | **3** |
| **CO5** | **3** | **3** | **3** | **3** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V****INTERNAL ELECTIVE- III** | **22UBIOE58-2: HOSPITAL MANAGEMENT** **(60 Hours)** | **HRS/WK-4****CREDIT-3** |
| **COURSE OBJECTIVES*** To study the basic principles of hospital management.
* To provide conceptual understanding of hospital management.
* To familiarize with the hospital management system.
* To understand the types of healthcare services.
* To introduce the current issues in health management.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to : |
| **CO1** | Acquire the skills required for hospital management. |
| **CO2** | Enable the student to take decisions using management system. |
| **CO3** | Understand the pathology lab management. |
| **CO4** | Apprehend the knowledge about health care services |
| **CO5** | Comprehend about disaster management |
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| **UNIT -I** | **INTRODUCTION TO HOSPITAL MANAGEMENT** | **[12hrs]** |
| Introduction to hospital management - Eligibility and personal skills required for hospital management. Job opportunities in hospital management. Important hospital management institutes in India and around the World. |
| **UNIT- II** | **HOSPITAL MANAGEMENT SYSTEM** | **[12 hrs]** |
| Hospital management system - Benefits and modules of hospital management systems. Interfacing of analyzer. Pathology lab management. Radiology, Blood bank, Pharmacology, management softwares. |
| **UNIT-III** | **HEALTH CARE SERVICES** | **[12 hrs]** |
| Health care services - Health and hospitals services. Classification and characteristics of service organizations. Healthcare revolution. Indicators of health- Composition of health sector, types of care, pyramidal structure of health services, hospitals, types of hospitals and role of hospital in healthcare. |
| **UNIT-IV** | **HEALTH CARE FACILITIES** | **[12 hrs]** |
| Health care facilities - Functioning of modern hospitals and changing need of patients. Hospitality in hospital care, Invasive and non-invasive diagnostic facilities in modern hospital. Care offered in specialty and super specialty hospitals. |
| **UNIT-V** | **HEALTH AND MANAGEMENT** | **[12 hrs]** |
| Health and management: Current issues in healthcare. Accreditation-Tele medicine-Health tourism-Health insurance and managed care. Disaster management. Hospital wastes management. |

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| TEXT BOOKS |
| 1. | John V. Basmajian and Charles E. Slonecker. Grant’s *Method of Anatomy: A Clinical Problem-solving Approach* (BI Waverly Pvt. Ltd., New Delhi).  |
| 2. | Watson, Roger (2013). *Anatomy and Physiology for Nurses.* |
| **REFERENCE BOOKS** |
| 1. | M/S BanarsidasBhanot Elaine La Monica, J.E. Park and K. Park, (2011) *Textbook of Preventive and Social MedicineManagement in Health Care*. Macmillan Press Ltd, London. |
| 2. | Sakharkar B.M., (2009) *Principles of Hospital Administration and Planning*Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi. |
| 3. |  Francis C.M and et al., (2004). *Hospital Administration.*Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.  |
| 4. | Srinivasan S. *Management Process in Health Care.* Voluntary Health Association of India, (ed.), New Delhi, 1992. |

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| **MAPPING WITH PROGRAMME OUTCOMESS (POS)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V****INTERNAL ELECTIVE -III** | **22UBIOE58-3: MICROBIOLOGY****(60 Hours)** | **HRS/WK-4****CREDIT-3** |
| **COURSE OBJECTIVES*** To know the morphology and structure of microorganisms.
* To learn the economical values of microorganisms.
* To learn about the pathogenesis of microbes in the environment.
* To gain knowledge about the microbial diseases.
* To know the presence of microbes in water, soil and food.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to : |
| **CO1** | Understand the basics in microscopy, culture methods and staining techniques. |
| **CO2** | Acquire knowledge on the morphology of bacteria, algae and fungi. |
| **CO3** | Understand the morphology of virus. |
| **CO4** | Apprehend microbial diseases, their etiology and prevention. |
| **CO5** | Understand the pathogenesis of microbes in water, soil and food. |
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| **UNIT -I** | **MICROSCOPY AND MICROBIAL CULTURE** | **[12hrs]** |
| Microscopy – Principle and uses of light, phase contrast, fluorescence and electron microscopy. Sterilization techniques. Isolation and maintenance of pure culture. Culture media - selective and enrichment media. Staining and smearing- Simple staining and Gram’s staining, Acid – fast Staining and spore staining. |
| **UNIT- II** | **PROKARYOTES AND EUKARYOTES** | **[12 hrs]** |
| Prokaryotes - Types of bacteria, cell wall structure and cell organelles. Eukaryotes - Morphological characteristics and importance of algae; Characteristics, reproductive structures and importance of fungi. |
| **UNIT-III** | **MORPHOLOGY OF VIRUSES** | **[12 hrs]** |
| Morphology of viruses, classification and cultivation of viruses, plaque assay. Phages - T4 phages lifecycle; synthesis and assembly of protein. Lambda phages - Life cycle, switch between lysogenic and lytic cycle. RNA viruses - Influenza and corona viruses, HIV. DNA viruses- Oncogenic viruses. |
| **UNIT-IV** | **MICROBIAL DISEASES** | **[12 hrs]** |
| Microbial diseases - Normal human micro flora. Host - parasitic interaction. Epidemics -Exo and endotoxins. Air borne diseases - Etiology, symptoms and prevention of Tuberculosis, Diphtheria, Poliomyelitis and Influenza. Waterborne diseases - Etiology, symptoms and pathogenesis of Typhoid, Cholera, Bacillary dysentery and Hepatitis. Direct contact disease-Etiology and symptoms of Rabies. |
| **UNIT-V** | **MICROBIOLOGY OF WATER, SOIL AND FOOD** | **[12 hrs]** |
| Water microbiology - Microbes in water, bacteriological examination of water, purification of drinking water. Soil microbiology - Symbiotic and non- symbiotic nitrogen fixing organisms. Rhizosphere and phosphate solubilizing microbes. Microbiology of food borne diseases- Botulism, Salmonellas, Staphylococcal poisoning and Mycotoxins. |

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| TEXT BOOKS |
| 1. | Pelczer J, R E. C .S John Noel R Krieg, (2006). *Microbiology* (5th ed) MC Graw Hill Book Company. |
| 2. | Anantha Narayanan R; C .K Jayaram Panicker, (2017), *Text Book of Microbiology* (10th ed) Orient Longman Publication. |
| **REFERENCE BOOKS** |
| 1. | Prescott L. M; J.H Harley and D. A Klein, (2006). *Microbiology*, (5thed) C. Brown Publishers. |
| 2. | Ronald M. Atlas, Microbiology (1993). *Fundamentals and Applications*, Macmillan Publishing Company, New York. |
| 3. | Joanne M.Willey, Linda Sherwood, Christopher.J Woolverton, (2017) *Prescott’s**Microbiology*, (10th Ed) Tata McGraw Hill Publishing Company Ltd, New Delhi |

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| **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-IV****SKILL BASED SUBJECT: III** | **22UBIOS59: BIOINFORMATICS****(30Hours )** | **HRS/WK-2****CREDIT-2** |
|  **COURSE OBJECTIVES** |
| * To study about the basics of bioinformatics.
* To learn about the biological databases and their associated tools.
* To gain knowledge on tools and software used in sequence similarity analysis.
* To understand the concept of conservation analysis and evolutionary relationships.
* To explore the concept of computational methods of protein structure prediction and available bioinformatics online resources for proteomic data analysis.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Gain knowledge aspects of the application of bioinformatics. |
| **CO2** | Understand the essential features and applications of different types of biological databases. |
| **CO3** | Apply the bioinformatics tools used in sequence alignment to generate alignment between a nucleotide or protein  |
| **CO4** | Apply, interpret and evaluate the evolutionary relationship among species and molecular taxonomical studies using bioinformatics software. |
| **CO5** | Able to predict, analyze and validate the tertiary structures of a protein by using bioinformatics tools and software. |
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| **UNIT- I** | **INTRODUCTION TO BIOINFORMATICS** | **[6hrs]** |
| Definition, history and scope of bioinformatics. Application of bioinformatics. Biological databases: Introduction to Biological Databases – Definition, classification and features of biological databases – Human Genome Project (HGP) – Goals, techniques, findings, applications and ELSI. |
| **UNIT- II** | **INTRODUCTION TO BIOLOGICAL DATABASES** | **[6hrs]** |
| Sequence databases – Introduction. Types – Nucleic acid sequence databases – NCBI, GENBANK, Pubmed, EMBL, EBI. Protein sequence databases – SWISS, PROT, EXPASY, PDB. Metabolic sequence databases –KEGG, MMDB.  |
| **UNIT- III** | **PAIR WISE SEQUENCE ALIGNMENT**  | **[6hrs]** |
|  Sequence alignment – Introduction to sequence alignments. Pairwise alignment – local and global alignment – BLAST and FASTA.Multiple sequence alignment (Clustal W algorithm). |
| **UNIT- IV** | **PROTEOMICS** | **[6hrs]** |
| Proteomics - protein structure classification. Databases-SCOP, CATA. Protein structure analysis –RASMOL. Protein structure prediction – Abinition –Homology modeling – threading. |
| **UNIT- V** | **PHYLOGENETIC ANALYSIS**  | **[6hrs]** |
| Phylogenetic Analysis **–** Concepts of phylogency- Methods software- Applications. Phylogenetic Tools – PHYLIP, PAUP, MEGA7 (Introduction only). |

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| **TEXT BOOKS** |
| **1** | Zhumur Ghosh and Bibekan and Mallick, (2008) *Bioinformatics: principles and applications* Oxford University Press.  |
| **2** | RastogiS. C (2006) *Bioinformatics –Methods and applications, Genomics proteomics and Drug Discovery*, (2nded) , Printice Hall of India Private limited, New Delhi. |
| **REFERENCE BOOKS** |
| **1** | Jonathan Pevsner(2009). *Bioinformatics and functional genomics* (2nded)., Wiley Blackwell publications2009 |
| **2** | Baxevanis D and Ouellette BFF, (2005) Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd Edition, John Wiley & Sons, Inc.,2005 |
| **3** | D. Higgins and W. Taylor (2000), *Bioinformatics- Sequence, structure and databanks, Oxford University Press,* New Delhi.  |
| **4** | Arthur M. Lesk, (2003).*Introduction to Bioinformatics,* Oxford University Press, NewDelhi. |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **2** | **2** | **2** | **3** |
| **CO2** | **3** | **2** | **2** | **2** | **3** |
| **CO3** | **3** | **2** | **2** | **2** | **3** |
| **CO4** | **3** | **2** | **2** | **2** | **3** |
| **CO5** | **3** | **2** | **2** | **2** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-VI****CORE: X** | **22UBIOC61: ENDOCRINOLOGY****(75hrs)** | **HRS/WK-5****CREDIT-4** |
| **COURSE OBJECTIVES*** To learn in detail about the physiological and biochemical effects of hormones.
* To know the role of endocrine system in maintaining homeostasis.
* To gain the significance of molecular, biochemical and physiological effects of hormones on cell.
* To identify the consequences of hypo and hyper secretion of hormones.
* To study and analyze the disorders related to hormone action.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Understand the role of hypothalamo-pituitary axis in the coordination of nervous and endocrine system.  |
| **CO2** | Apprehend the functions of pituitary, thyroid and parathyroid secretions and associated disorders. |
| **CO3** | Gain an understanding of the actions of adrenal and gonadal, gastrointestinal tract and pancreatic hormones and disorders associated with their hypo and hyper secretion. |
| **CO4** | Understand the role of hypothalamo - pituitary axis in the coordination of nervous and endocrine system.  |
| **CO5** | Analyse the synthesis, function and abnormalities of gonadal hormones.  |
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| **UNIT - I** | **PITUITARY HORMONES** | **[15hrs]** |
| Classification of hormones and mechanism of action. Hypothalamic releasing factors. Anterior pituitary hormones - biological actions, regulation and disorders of growth hormone, ACTH, gonadotropins and prolactin. Leptin.Posterior pituitary hormones - biological actions of vasopressin and oxytocin. Hypopituitarism. |
| **UNIT - II** | **THYROID AND PARATHYROID HORMONES** | **[15hrs]** |
| Thyroid hormones synthesis, secretion, regulation, transport and biological actions. Thyroid function tests. Abnormalities of thyroid function - Hyper and hypothyroidism. Thyroxine supplementation and antithyroid agents. Secretion and biological actions of PTH, calcitonin and calcitriol. Hypercalcemia and hypocalcemia. |
| **UNIT- III** | **GASTROINTESTINAL AND PANCREATIC HORMONES** | **[15hrs]** |
| Gastrointestinal hormones – Gastrin, cholecystokinin, secretin, ghrelin, somatostatinPancreatic hormones - synthesis, regulation, biological effects and mechanism of action of glucagon, somatostatin and insulin. Insulin receptor.  |
| **UNIT- IV** | **ADRENAL HORMONES** | **[15hrs]** |
| Adrenal cortical hormones. Synthesis, regulation, transport, metabolism and biological effects of glucocorticoids and mineralocorticoids. Hypo and hyper function - Cushing’s syndrome, aldosteronism, CAH, aderenal cortical insufficiency, Addison’s disease.Adrenal medullary hormones - synthesis, secretion, metabolism, regulation and biological effects of catecholamines. Phaeochromocytoma. |
| **UNIT-V** | **GONADAL HORMONES** | **[15hrs]** |
| Biosynthesis, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, transport, metabolism and biological effects of estrogen and progesterone. The menstrual cycle. |

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| **TEXT BOOKS** |
| 1 | Nelson and Cox. Lehninger (2017). *Principles of Biochemistry*. (7thed) Freeman |
| 2 | Rodwell et al. (2018). *Harper’s Illustrated Biochemistry*. (31sted) McGraw Hill. |
| **REFERENCE BOOKS** |
| 1. | Marshall W. J., Lapsley M., Bangert S. K. (2016). *Clinical Chemistry*.(8thed) Mosby.  |
| 2. | S. Melmed et al. (2015) *WilliamsText Book of Endocrinology*, (13thed) Saunders.  |
| 3. | Mayne (1994). *Clinical Chemistry in Diagnosis and Treatment*. (6thed) ELBS.  |
| 4. | Kleine and Rossmanith (2016). Hormones and the Endocrine System: *Textbook of Endocrinology*. Springer.  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-VI****CORE: XI** | **22UBIOC62: BIOTECHNOLOGY****(75hrs)** | **HRS/WK-5****CREDIT-4** |
| **COURSE OBJECTIVES*** To know the basic concepts in biotechnology.
* To acquire knowledge on cloning strategies and recombinant gene expression.
* To impart practical knowledge on nucleic acid isolation, digestion and ligation.
* To acquire the techniques applied in biotechnology and its application in genetic engineering.
* To study plant and tissue culture methods. Production of novel products.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will b able to: |
| **CO1** | Understand the basic principles of recombinant technology, |
| **CO2** | Appreciate the mechanisms of cloning. |
| **CO3** | Comprehend the methods of gene transfer. |
| **CO4** | Understand the principle and applications of DNA sequencing, DNA fingerprinting and PCR. |
| **CO5** | Analyse the transgenic plants, animals and novel products. |
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| **UNIT- I** | **RESTRICTION ENZYMES AND CLONING VECTORS** |  **[15hrs]** |
| Basic principles of rDNA technology. Restriction endonucleases. Type II Restriction endonucleases - nomenclature and types of cleavage sites. Cloning vectors - essential features. Basic steps in cloning. Cloning vectors (pBR322, pUC), phages (λ and M13), cosmids, BACs, and YACs. |
| **UNIT- II** | **LIGATION AND rDNA TRANSFER**  | **[15hrs]** |
| Ligation of rDNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation. Linkers and adaptors. Gene transfer methods: calcium phosphate co-precipitation, electroporation, lipofection, viruses, and microinjection. Host organisms for cloning- bacteria, plant, yeast and mammalian cells. |
| **UNIT- III** | **RECOMBINANTS SCREENING AND LIBRARIES** | **[15hrs]** |
| Screening of recombinants: marker inactivation - antibiotic resistance, blue-white selection. Cloning strategies: Construction of genomic and cDNA libraries. Differences between genomic library and cDNA libraries. Cloning of insulin gene in *E. Coli.* |
| **UNIT -IV** | **EXPRESSION OF CLONED GENES**  | **[15hrs]** |
| Factors affecting expression of cloned genes. Expression of cloned genes in bacteria. Fusion proteins, increasing protein stability and secretion. Expression in eukaryotic cells- Expression in yeast - yeast vectors. The GAL system, over expression and secretion of heterologous proteins in yeast. Expression in insect cells- baculovirus system. Mammalian cell expression systems.  |
| **UNIT -V** | **TRANSGENIC PLANTS AND ANIMALS** | **[15hrs]** |
| Transgenic plant technology: Development of insect resistance, virus resistance, herbicide resistance and stress tolerant plants. Delayed fruit ripening. Terminator technology. Production of vaccines and antibodies in plants. Ethics of genetically engineered crops. Transgenic animal technology: Methods of producing transgenic animals- retroviral, microinjection, engineered stem cell. Applications of transgenic animals. Transgenic animals as models of human disease |

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| **TEXT BOOKS** |
| 1 | Glick and Pasternak (2010). Molecular Biotechnology: *Principles and Applications of Recombinant DNA.* (4th ed ) ASM Press. |
| 2 | Dale and von Schantz (2011). *From Genes to Genomes: Concepts and applications of DNA technology*. (3rded) Wiley-Inter science. |
| **REFERENCE BOOKS** |
| 1 | Nicholls DTS. *An Introduction to Genetic Engineering*. (3rded) Cambridge Univ Press.  |
| 2 | Sandy B. Primrose and Richard Twyman (2006). *Principles of Gene Manipulation and Genomics*. (7thed ) Wiley- Blackwell. |
| 3 | Winnacker EL. (2003). *From Genes to Clones* (4thed) VCH Publ.  |
| 4 | Singh B.D. (2010). *Biotechnology. Expanding horizons* (3rded) Kalyani Publ. |
| 5 | Watson et al. (2006).*Recombinant DNA.* (3rded) Sci Am Publ.  |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **2** | **3** |
| **CO2** | **3** | **3** | **2** | **2** | **3** |
| **CO3** | **3** | **3** | **2** | **2** | **3** |
| **CO4** | **3** | **3** | **2** | **2** | **3** |
| **CO5** | **3** | **3** | **2** | **2** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-VI****CORE: XII** | **22UBIOC63: IMMUNOLOGY****(75hrs)** | **HRS/WK-5****CREDIT-4** |
| **COURSE OBJECTIVES*** To study the basic aspects of immune system.
* To know the mechanism of immunity.
* To learn the procedures of immunochemical techniques.
* To gain knowledge on vaccine production.
* To analyze the disease related to immunology.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Understand the role of cells involved in immunity. |
| **CO2** | Acquire knowledge about the immune system. |
| **CO3** | Understand the antigen antibody and their Interactions. |
| **CO4** | Comprehend about the pathogenesis of allergic reactions. |
| **CO5** | Analyze the role of immunochemical techniques in the diagnosis of diseases.  |
|  |
| **UNIT - I** | **IMMUNE SYSTEM** |  **[15hrs]** |
| The immune system – Primary and secondary lymphoid organs, Structure of T- lymphocytes, B-lymphocytes and NK cells, Structure and functions of neutrophils, eosinophils and basophils, Macrophages - phagocytosis and inflammation. |
| **UNIT- II** | **IMMUNITY** | **[15hrs]** |
| Types of immunity – innate and acquired immunity, active and passive immunization, humoral and cell mediated immunity, major histocompatibility complex – HLA molecules. |
| **UNIT- III** | **IMMUNOGLOBULINS** | **[15hrs]** |
| Immunoglobulins - Structure, types and biological functions.Antigens: Properties, Specificity, immunogenicity, antigenic determinants, haptens and adjuvant.Antigen – Antibody interactions – Precipitation, agglutination, opsonisation and complement fixation. |
| **UNIT - IV** | **HYPERSENSITIVITY** | **[15 hrs]** |
| Allergy and hypersensitivity – Types and mechanism, autoimmune diseases – Pathogenesis and treatment, immunology of malignancy – T antigens, immune response in malignancy and Immunotherapy of cancer. |
| **UNIT - V** | **IMMUNOCHEMICAL TECHNIQUES** | **[15 hrs]** |
| Production of antisera, principle, technique and applications of immune diffusion, immune electrophoresis, RIA and ELISA, Production of monoclonal antibodies and its applications. |

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| **TEXT BOOKS** |
| 1. |  Janis Kuby. *Immunology* 4th edition 2000. |
| 2. |  Dulsy Fatima and N. Arumugam, *Immunology*, 2014 |
| **REFERENCE BOOKS** |
| 1. |  Ivan Roitt, *Immunology* 8th edition, Wiley – Blackwell Publisher 2012. |
| 2. |  Tizard, *Immunology*, Saunders College Publishing. 9th edition 2004. |
| 3. |  Kannan J, *Immunology* . MJP Publishers, Chennai. |
| 4. |  Lippincot, *Fundamentals of Immunology,* Praveen Publications, 4th edition. |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **3** | **2** |
| **CO2** | **3** | **3** | **3** | **3** | **2** |
| **CO3** | **3** | **3** | **3** | **3** | **2** |
| **CO4** | **3** | **3** | **3** | **3** | **2** |
| **CO5** | **3** | **3** | **3** | **3** | **2** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V & VI****CORE PRACTICAL-III** | **22UBIOP64: CORE PRACTICAL-III****(45 Hrs/60Hrs)** | **HRS/WK-3/4****CREDIT-4** |
| **COURSE OBJECTIVES:*** To learn the method of enzyme assay.
* To know how enzymes assay useful in disease diagnosis.
* To learn about microbial culture method and its significances.
* To gain knowledge about the inferences of blood molecular levels with disorders.
* To learn the method of serum proteins and enzymes analysis by electrophoresis.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand the technique to determine enzyme activity. |
| **CO2** | Impart skill on enzyme assay and its clinical significances. |
| **CO3** | Apprehend information about microbiology and its importance. |
| **CO4** | Gain knowledge on estimation of blood constituents and its interpretation. |
| **CO5** | Understand the electrophoretic separation of serum proteins and enzymes. |
|  |
| **I** |  **ENZYMOLOGY** | **12 hours** |
| * Determination of salivary amylase activity.
* Effect of substrate concentration, pH and temperature on salivary amylase activity.
* Determination of km value and activity of acid phosphatase.
 |
| **II** | **DIAGNOSTIC ENZYMOLOGY** | **6 hours** |
| * Assay of activity of serum alkaline phosphatase.
* Assay of serum AST and ALT.
 |
| **III** |  **MICROBIOLOGY** | **9 hours** |
| * Preparation of solid and liquid media.
* Culture techniques – Streak plate, pour plate, spread plate.
* Gram staining.
* Antibiotic sensitivity testing.
* Determination B.O.D. and C.O.D. of sewage sample.
 |
| **IV** |  **ESTIMATION OF BLOOD CONSTITUENTS** |  **15 hours** |
| * + Estimation of blood glucose by- Ortho toluidine method.
	+ Estimation of blood urea by Diacetyl monoxime method
	+ Estimation of serum total protein and A/G ratio by Lowry method.
	+ Estimation of serum cholesterol by Zak’s method.
	+ Estimation of serum creatinine by Jaffe’s method.
* Estimation of serum phosphorus by Fiske-Subbarow method.
 |
| **V** |  **DIAGNOSTIC ELECTROPHORESIS** | **3 hours** |
| * + Separation of serum protein by electrophoresis.
	+ Electrophoretic separation of serum LDH and ALP. (Demonstration)
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| **REFERENCE BOOKS** |
| **1** | Dr. Jayaraman J., *Manuals in Biochemistry* (2011) New Age International pub, Bangalore. |
| **2** | RanjanaChawla, *Clinical Biochemistry*. |
| **3** | David T., Plummer (2000). *Introduction to practical Biochemistry* New Delhi: Tata McGraw Hill Publishing Company,  |
| **4** | Harold Varley, *Practical clinical Biochemistry* CBS New Delhi. |

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| **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **1** | **3** |
| **CO2** | **3** | **3** | **2** | **1** | **3** |
| **CO3** | **3** | **3** | **2** | **1** | **3** |
| **CO4** | **3** | **3** | **2** | **1** | **3** |
| **CO5** | **3** | **3** | **2** | **1** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-V & IV****ELECTIVE PRACTICAL: IV** | **22UBIOP65: PRACTICAL (ELECTIVE) - IV****(45 Hrs)** | **HRS/WK-4****CREDIT-4** |
| **COURSE OBJECTIVES** |
| * To learn immunological reactions and its significance.
* To know the blood cells and its enumeration.
* To know the normal and abnormal components of urine and its analysis procedure.
* To learn the basic methods in biotechnology.
* To gain knowledge about advanced molecular techniques.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to: |
| **CO1** | Understand the immune reactions and its clinical significance. |
| **CO2** | Apprehend the skill on analysis of blood components. |
| **CO3** | Acquire knowledge on normal and abnormal constituents of urine and its analysis. |
| **CO4** | Understand the techniques and applications of biotechnology. |
| **CO5** | Understand the importance of advanced molecular techniques. |
|  |
| **I** | **Immunology** | **12 hours** |
| * + Blood grouping and Rh typing.
	+ Radial immunodiffusion.
	+ Double diffusion.
	+ Precipitation and agglutination reactions antigen-antibody interaction.
 |
| **II** | **HAEMOTOLOGY** | **12 hours** |
| * + Enumeration of RBCs, WBCs (Total and differential).
	+ Estimation of bleeding time and clotting time.
	+ Blood haemoglobin.
	+ Determination of ESR.
 |
| **III** | **URINE ANALYSIS** |  **6 hours** |
| * + Collection of urine and faecal samples.
	+ Faecal analysis to detect fats, undigested food and blood.
	+ Qualitative analysis of normal and pathological urine.
 |
| **IV** | **BIOTECHNOLOGY** |  **9 hours** |
| * Isolation of plasmid DNA from E.coli/Yeast.
* Restriction enzyme digestion of DNA.
* Enzyme immobilization using alginate beads.
 |
| **V** | **MOLECULAR TECHNIQUES (Demonstration)** | **6 hours** |
| * Immuno electrophoresis.
* ELISA.
* PCR and analysis of PCR products.
	+ Real-time qPCR.
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| **REFERENCE BOOKS** |
| **1** | Harold Varley, *Practical clinical Biochemistry* CBS New Delhi. |
| **2** | Kanai L. Mukerjee, Tata McGraw *Medical Laboratory Technology*. Hill publications and Co Ltd., Vol, I, II, III. |
| **3** | Dr. Jayaraman J., *Manuals in Biochemistry* (2011) New Age International pub, Bangalore. |
| **4** | RanjanaChawla, *Clinical Biochemistry*. |
| **5** | Sadasivam S and Manickam. *Biochemical methods.* |
| **6** | David T., Plummer (2000). *Introduction to practical Biochemistry* New Delhi: Tata McGraw Hill Publishing Company,  |

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| **MAPPING WITH PROGRAMME OUTCOMESS (POS)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **1** | **3** |
| **CO2** | **3** | **3** | **2** | **1** | **3** |
| **CO3** | **3** | **3** | **2** | **1** | **3** |
| **CO4** | **3** | **3** | **2** | **1** | **3** |
| **CO5** | **3** | **3** | **2** | **1** | **3** |

**3- Strong;2- Medium;1-Low;**

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| **SEMESTER-VI****INTERNAL****ELECTIVE- IV** | **22UBIOE66-1: PLANT BIOCHEMISTRY** **(60 Hours)** | **HRS/WK-4****CREDIT-3** |
| **COURSE OBJECTIVES*** To study the structure of plant cell and their organelles.
* To acquire knowledge about photosynthetic pigments.
* To learn the cycles of elements.
* To gain knowledge the concept of photoperiodism.
* To learn the biochemical aspects of germination, senescence and secondary metabolites.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Understand the influence of light on photosynthesis. |
| **CO2** | Apprehend the significance of Plant growth elements. |
| **CO3** | Understand the biogeochemical cycles. |
| **CO4** | Perceive the importance of plant growth regulators. |
| **CO5** | Analyze the applications of secondary metabolites. |
|  |
| **UNIT -I** | **CELL ORGANELLES PHOTOSYNTHESIS** | **[12hrs]** |
| Plant cell – Structure and function. Photosynthesis – photosynthetic pigments, photosystems I & II, Mechanism of photosynthesis – light and dark reaction, factors affecting photosynthesis. |
| **UNIT- II** | PLANT NUTRITION | **[14hrs]** |
| Plant nutrition – Importance of essential elements and their deficiency symptoms and disorders in plants. Macronutrients –Nitrogen, Sulphur, Phosphorous, Calcium, Potassium, Magnesium and Iron. Micronutrients - Manganese, Boron, Copper, Zinc, Molybdenum and Chlorine. |
| **UNIT-III** | NUTRIENT CYCLE | **[10hrs]** |
| Nitrogen cycle- Ammonification, Nitrification, Nitrate reduction, Denitrification and Nitrogen fixation. Sulphur cycle, Phosphorous cycle and carbon cycle. |
| **UNIT-IV** | PLANT HORMONES | **[12hrs]** |
| Plant Growth Regulators – Chemistry and mode of action of Auxin, Gibberellins, Cytokinins, Abscisic acid and ethylene, Plant growth inhibitors, Photo periodism. |
| **UNIT-V** | **PHYTOCHEMICALS** | **[12hrs]** |
| Biochemistry of seed germination, senescence – Biochemical changes during senescence. Biological functions of alkaloids, terpenes, flavanoids, polyphenols, tannins and steroids. |

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| **TEXT BOOKS** |
| 1 | Dr. VermaS.K .,*Textbook of Plant Physiology, Biochemistry and Biotechnology*. |
| 2 | Swaraj Mandel,Ajit L Basu., *Biochemistry of Plants* |
| 3 | Dr. Verma V., *A Textbook of Plant Physiology* |
| **REFERENCE BOOKS** |
| 4 | Devlin N Robert and Francis H. Witham., *Plant Physiology* CBS Publications. |
| 5 | Hans Walter Heldt, Oxford University. (2010). *Plant Biochemistry and Molecular Biology*(4thed). |

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| **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **3** | **2** | **3** |
| **CO2** | **3** | **3** | **3** | **2** | **3** |
| **CO3** | **3** | **3** | **3** | **2** | **3** |
| **CO4** | **3** | **3** | **3** | **2** | **3** |
| **CO5** | **3** | **3** | **3** | **2** | **3** |

**3-Strong; 2-Medium;1-Low**

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| **SEMESTER-VI****INTERNAL****ELECTIVE-IV** | **22UBIOE66-2: STEM CELL BIOLOGY****(60 HOURS)** | **HRS/WK-4****CREDIT- 3** |
| **COURSE OBJECTIVES*** To know the physiology of stem cells at cellular level.
* To learn the culture of stem cells.
* To gain knowledge on cell lines.
* To identify the diagnosis and management of diseases and disorders with stem cells.
* To learn the role of stem cells in genetherapy.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Understand the characters a stem cell. |
| **CO2** | Apprehend the stem cell niche and its role on growth. |
| **CO3** | Understand the stem cell differentiation in vivo and in vitro. |
| **CO4** | Summarize different types of pluripotent stem cells and how they are induced. |
| **CO5** | Enumerate the applications of stem cells. |
|  |
| **UNIT -I** | **STEM CELLS** | **[14hrs]** |
| Definition, properties, kinds of stem cells - Embryonic and adult stem cells. Characteristics of stem cells. Totipotent, Unipotent, Oligopotent and Pluripotent cells and the potential benefits of stem cell technology , medical applications of stem cells, ethical and legal issues in use of stem cells. |
| **UNIT- II** | GROWTH INDUCING AGENTS | **[10hrs]** |
| Role of bone marrow in cell synthesis, Culture of stem cells, Proliferation, Growth factors – types and their role in cell development. |
| **UNIT-III** | CELL LINES | **[12hrs]** |
| Cell lines – Types, Commonly used cell lines and selection of cell lines; maintenance of cell culture; Sub culture – Mono layer culture, Criteria for sub culture of mono layer, technique; Suspension cultures. |
| **UNIT-IV** | EMBRYONIC STEM CELLS | **[10hrs]** |
| Stem cell culture – Embryonic stem cell, methods to produce differentiated cells, maintenance of stem cells. Stem cell bank. |
| **UNIT-V** | **GENE THERAPY** | **[14hrs]** |
| Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic perspectives for gene therapy. Gene delivery methods: Viral vectors and Non-viral vectors. |

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| TEXT BOOKS  |
| 1 | Daniel Marshak, Richard L. Gardener and David Gottlieb, *Stem Cell Biology*, Cold Spring Harbour Laboratory Press.  |
| 2 | Booth C., *Stem cell biology and gene therapy*, Cell Biology International, Academic Press. |
| 3 | Alexander Battler, Jonathan Leo, *Stem Cell and Gene-Based Therapy*: Frontiers in Regenerative Medicine, Springer. |
| REFERENCE BOOKS |
| 4 | Quesenberry PJ, Stein GS (1998), *Stem Cell Biology and Gene Therapy*. Wiley. |
| 5 | Roger Bertolotti, KeiyaOzawa and H. Kirk Hammond*, Progress in gene therapy*, Volume 2, Pioneering stem cell/gene therapy trials, VSP international science publishers. |
| 6 | Stewart Sell (Oct. 2003), *Stem Cells Handbook*, Humana Press; Totowa NJ, USA;. |
| 7. | Stephen Sullivan and Chad A Cowan, *Human Embryonic Stem Cells*: The Practical Handbook. |

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| **MAPPING WITH PROGRAMME OUTCOMES (POS)** |
| COs | PO1 | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 3 | 2 |
| CO3 | 2 | 3 | 2 | s2 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 |

**\*3-Strong; 2-Medium; 1-Low**

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| **SEMESTER-VI****INTERNAL** **ELECTIVE -IV** | **22UBIOE66-3: LIFESTYLE AND DISEASES****(60 HOURS)** | **HRS/WK-4****CREDIT-3** |
| **COURSE OBJECTIVES*** To learn the basics of lifestyle diseases.
* To identify lifestyle prone disorders
* To gain knowledge on the communicable and non-communicable disease
* To know the importance of maintaining good health
* To know how to choose healthy life style to cope with modern life.
 |
| **EXPECTED COURSE OUTCOMES** |
| On the successful completion of the course, student will be able to |
| **CO1** | Differentiate the communicable and non communicable diseases. |
| **CO2** | Identify lifestyle prone disorders |
| **CO3** | Manage physiological and psychological disorders |
| **CO4** | Explain the causes and types of osteoporosis. |
| **CO5** | Elucidate the causes and types of Anaemia. |
|  |
| **UNIT -I** | **COMMUNICABLE AND NON-COMMUNICABLE DISEASES** | **[12hrs]** |
| Definition and examples Communicable diseases- AIDS, Tuberculosis, Cholera, typhoid- Causes and treatment. Non-communicable diseases- Type 2 diabetes, Cancer, Coronary heart diseases, Stroke, Hypertension, Obesity- Definition, causes and treatment. |
| **UNIT- II** | LIFE STYLE IMPACT ON DISEASE | **[12hrs]** |
| Lack of physical activity, junk food, irregular food habits, fast foods. High calorie & fat diet Alcohol intake, Tobacco usage- consequences. Technology in health deterioration (Computer vision syndrome, mobile vision syndrome). |
| **UNIT-III** | PHYSIOLOGICAL & PSYCHOLOGICAL DISORDERS | **[12hrs]** |
| Physiological disorders-Food poisoning, intestine hormonal imbalance, premenstrual syndrome, Renal Calculi and gall stones.Psychological disorder**-** Stress, Anxiety memory dysfunction. Depression, Mood swings, Lack of confidence, suicidal thoughts. |
| **UNIT-IV** | OSTEOPOROSIS | [12hrs] |
| Definition, types, symptoms, treatment, causes and prevention. Diagnosis, drugs for osteoporosis, Bone diseases, Dietary requirement for osteoporosis  |
| **UNIT-V** | **ANAEMIA** | **[12hrs]** |
| Definition, causes, types, symptoms, and treatment of anaemia. Iron deficiency and pernicious anaemia. Anaemia and pregnancy – prevalence and consequences  |

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| TEXT BOOKS: |
| 1 | M Kumar, R Kumar. (2014). *Guide to prevention of lifestyle diseases*. Deep and Deep Publications. |
| 2 | Tudith stern, Alexendra Kuzaks. (2011). *Obesity: a reference handbook*". ABC-CLIO. |
| REFERENCE BOOKS: |
| 3 | Mindori Hiramatsu, Toshikazu Toshikawa, Lister Packer. (2012). *Molecular interventions in lifestyle related diseases".* CRC Press. |
| 4 | David L Katz, (2014). *Diseases Proof*. Plume. |

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| **MAPPING WITH PROGRAMME OUTCOMES (POS)** |
| COs | PO1 | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 3 | 2 |
| CO3 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 2 | **3** |

**3-Strong; 2-Medium;1-Low;**

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| **SEMESTER-VI****SKILL BASED SUBJECT: IV** | **22UBIOS68: PHARMACEUTICAL BIOCHEMISTRY****(45hrs)** | **HRS/WK-3****CREDIT-2** |
| **COURSE OBJECTIVES*** To understand the chemistry of drugs.
* To illustrate the mechanism of drug absorption, distribution and metabolism.
* To gain knowledge on the novel drug delivery systems.
* To appraise the uses of Plants in traditional medicine.
* To highlight the importance of organic phytochemicals in pharmaceuticals.
 |
| **EXPECTED COURSE OUTCOMES**  |
| Upon successful completion of the course, student will be able to: |
| **CO1** | Define a drug and identify the chemistry of drug molecules and ADMET properties of drugs. |
| **CO2** | Explain the routes of drug administration. Appraise on the novel drug delivery systems compared to the conventional routes. |
| **CO3** | Justify the use of synthetic drugs for different disease systems. |
| **CO4** | Highlight the uses of plants in traditional medicine.  |
| **CO5** | Highlight the importance of organic phytochemicals in pharmaceuticals. |
|  |
| **UNIT - I** | **INTRODUCTION TO PHARMACEUTICAL CHEMISTRY**  |  **[10 hrs]** |
| Drugs - Definition, source and nature, classification and nomenclature. ADMET and DMPK studies of drug. Routes of drug administration, absorption and distribution of drugs, Factors influencing drug absorption and elimination. Determination of IC50, ED50 and LD50. |
| **UNIT - II** | DRUGS AND RECEPTORS  | **[10hrs]** |
| Drug-receptor interactions: Receptor- definition, Types of drug- receptor interaction. G-protein coupled receptor, Receptors with intrinsic ion-channel and enzymatic receptors. Agonist and antagonist of drugs. Adverse drug reaction. |
| **UNIT -III** | **DRUG METABOLISM**  | **[8 hrs]** |
| Microsomal and Non-microsomal reactions. Phase I and phase II reactions of drug metabolism. Physiological significance of xenobiotic metabolism. Excretion of drugs. Drug tolerance and dependence. |
| **UNIT- IV** | **DRUGS FOR VARIOUS DISORDERS**  | **[10 hrs]** |
| Drugs for GI tract disorders. Mechanism of action of drugs used in therapy - Ulcer, irritable bowel syndrome and constipation. Statins as a drug for hyper lipidemia. Antibiotics - sulfonamides, cotrimoxazole and penicillin. Role of insulin in the treatment of diabetes mellitus. Oral hypoglycemic drugs - sulphonylureas (Gliclazide, glimipride, glibenclamidebiguanides (Metformin). |
| **UNIT- V** | **DRUG TESTING**  | **[7 hrs]** |
| Biological testing and bioassays – In vitro and in vivo. In-silico using SWISS-PDB. New biological targets for drug development. Novel drug screening strategies. |
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| **TEXT BOOKS** |
| 1 | Tripathi K. D., (2010) *Essentials of Medical Pharmacology*, (7thed), Jaypee Publishers. |
| REFERENCE BOOKS |
| 1 | Jayashree Ghosh. (2010) *A Textbook of Pharmaceutical Chemistry*, (3rded) Jayashree Ghosh, S.Chand& Company Ltd., New Delhi, 2010. |
| 2 | Donald Cairns,(2012) *Essentials of Pharmaceutical Chemistry*, (4thed), Pharmaceutical Press, 2012. |
| 3 | Gary Waish, (1998) *Biopharmaceuticals: Biochemistry & biotechnology*, (1st ed), John wiley Sons, New York. |
| 4 | Satoskar R.S and Bhandar S.D, (1995) *Pharmacology and Pharmacotherapeutics*, (14thed). |
| 5 | Bertram Katzung, (2012) *Basic and Clinical Pharmacology*, (12thed), Lange Publishers. |

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|  **MAPPING WITH PROGRAMME OUTCOMES (PO)** |
| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **3** | **3** | **2** | **1** | **2** |
| **CO2** | **3** | **3** | **2** | **1** | **2** |
| **CO3** | **3** | **3** | **2** | **1** | **2** |
| **CO4** | **3** | **3** | **2** | **1** | **2** |
| **CO5** | **3** | **3** | **2** | **1** | **2** |

**3- Strong;2- Medium;1-Low;**