**N.M.S.S.VELLAICHAMY NADAR COLLEGE**

**DEPARTMENT OF MICROBIOLOGY AND BIOTECHNOLOGY**

**SYLLABUS FOR THE AY 2023 – 2024**

**BIOTECHNOLOGY**

**SEMESTER – I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** | **CODE** | **CREDIT** | **HOURS** |
| Part – I | Language – Tamil |  | 3 | 6 |
| Part – II | English |  | 3 | 4 |
| Part – III | Core – 1 Cell and Molecular developmental Biology |  | 4 | 5 |
| Core Practical – 1 Cell and Molecular developmental Biology |  | 2 | 3 |
| **Elective – (Generic/Discipline specific) EC-1 Any one** |  | 3 | 4 |
| 1. Biological Chemistry |  |  |  |
| 1. Basics in Biotechnology |  |  |  |
| **Elective Practical – I** Lab in Biological Chemistry |  | 2 | 2 |
| Part – IV | **Skill Enhancement Course SEC – 1 (NME) Any one** |  | 2 | 2 |
| 1. Food and Nutrition |  |  |  |
| 1. Biotechnology for society |  |  |  |
| Part – IV | **Foundation Course FC** |  | 2 | 2 |
| Microbial Taxonomy |  |  |  |
| **Ability Enhancement compulsory course (AECC) Soft skill – 1** |  | 2 | 2 |
|  | **Total** |  | **23** | **30** |

**SEMESTER – II**

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| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** |  | **CREDIT** | **HOURS** |
| Part – I | Language – Tamil |  | 3 | 6 |
| Part – II | English |  | 3 | 4 |
| Part – III | Core – 2 Genetics |  | 4 | 5 |
| Core Practical – 2 Lab in Genetics |  | 2 | 3 |
| **Elective – (Generic/Discipline specific) EC-2 Any one** |  | 3 | 4 |
| 1. Fundamentals of Microbiology |  |  |  |
| 1. Applied Biotechnology |  |  |  |
| **Elective Practical – II** Lab in Fundamentals of Microbiology |  | 2 | 2 |
| Part – IV | **Skill Enhancement Course SEC – 2 (NME)** |  | 2 | 2 |
| Good Laboratory Practices |  |  |  |
| **Skill Enhancement Course SEC – 3 (NME)** |  | 2 | 2 |
| Public health and hygiene |  |  |  |
| **Ability Enhancement compulsory course (AECC) Soft skill – 2** |  | 2 | 2 |
|  | **Total** |  | **23** | **30** |

**SEMESTER – III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** |  | **CREDIT** | **HOURS** |
| Part – I | Language – Tamil |  | 3 | 6 |
| Part – II | English |  | 3 | 4 |
| Part – III | Core – 3 Immunology and Immunotechnology |  | 4 | 5 |
| Core Practical – 3 Lab in Immunology and Immunotechnology |  | 2 | 3 |
| **Elective – (Generic/Discipline specific) EC-3** |  | 3 | 4 |
| Bioinstrumentation |  |  |  |
| **Elective Practical – III** Lab in Bioinstrumentation |  | 2 | 2 |
| Part – IV | **Skill Enhancement Course SEC – 4 (Entrepreneurial based)** |  | 1 | 1 |
| Organic farming and biofertilizer technology |  |  |  |
| **Skill Enhancement Course SEC – 5** |  | 2 | 2 |
| Aquaculture |  |  |  |
| **Ability Enhancement compulsory course (AECC) Soft skill – 3**  Medical Coding - I |  | 2 | 2 |
| Environmental Studies (EVS) |  | 1 | 1 |
|  | **Total** |  | **23** | **30** |

**SEMESTER – IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** |  | **CREDIT** | **HOURS** |
| Part – I | Language – Tamil |  | 3 | 6 |
| Part – II | English |  | 3 | 4 |
| Part – III | Core – 4 Genetic Engineering and rDNA technology |  | 4 | 5 |
| Core Practical - 4 Lab in Genetic Engineering and rDNA technology |  | 2 | 3 |
| **Elective – (Generic/Discipline specific) EC-4** |  | 2 | 3 |
| Bioinformatics and Biostatistics |  |  |  |
| **Elective Practical – III** Lab in Bioinformatics and Biostatistics |  | 2 | 2 |
| Part – IV | **Skill Enhancement Course SEC – 6** |  | 2 | 2 |
| Vaccine technology |  |  |  |
| **Skill Enhancement Course SEC – 7** |  | 2 | 2 |
| Apiculture |  |  |  |
| **Ability Enhancement compulsory course (AECC) Soft skill – 4**  Medical Coding - II |  | 2 | 2 |
| Environmental Studies (EVS) |  | 1 | 1 |
|  | **Total** |  | **23** | **30** |

**SEMESTER – V**

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| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** |  | **CREDIT** | **HOURS** |
| Part – III | Core – 5 Plant Biotechnology |  | 5 | 5 |
| Core – 6 Animal Biotechnology |  | 5 | 5 |
| Core – 7 Environmental and Industrial biotechnology |  | 5 | 6 |
| Core Practical – 5 Lab in Plant Biotechnology and Animal Biotechnology |  | 2 | 4 |
| Core Practical – 6 Lab in Environmental and Industrial Biotechnology |  | 2 | 4 |
| **Elective – (Generic/Discipline specific) EC-5** |  | 4 | 4 |
| Nano biotechnology |  |  |  |
| Part IV | Value Education |  | 2 | 2 |
| Internship / Industrial Training |  | 2 |  |
| **Total** |  | **27** | **30** |

**SEMESTER – VI**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PART** | **LIST OF COURSES** |  | **CREDIT** | **HOURS** |
| Part – III | Core – 8 Bioentreprenurship |  | 5 | 5 |
| Core – 9 Pharmaceutical Biotechnology |  | 5 | 5 |
| **Elective – (Generic/Discipline specific) EC-7** |  | 4 | 4 |
| Food Technology |  |  |  |
| **Elective – (Generic/Discipline specific) EC-8** |  | 4 | 4 |
| Medical Biotechnology |  |  |  |
| Part IV | Project |  | 5 | 10 |
| Part V | Skill Based Activities – Online Courses – NPTEL/MOOC |  | 1 | -- |
| Part VI | Extension Activities |  | 1 | 2 |
|  | **Total** |  | **25** | **30** |
|  | **Overall Total** |  | **144** |  |

**SEMESTER – I**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **Core -I** | Year | | I | **Credits** | | 2 | | **Course Code** | | **CCI** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 5 | - | | -- | 5 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell | | | | | | | | | | | | | | |
| **LO2** | Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane. | | | | | | | | | | | | | | |
| **LO3** | Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication,Transcription and Translation and post translational modifications of proteins. | | | | | | | | | | | | | | |
| **LO4** | Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways. | | | | | | | | | | | | | | |
| **LO5** | Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells). | | | | | | | | | | | | **15 Hrs** | | |
| **II** | Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton. | | | | | | | | | | | | **15 Hrs** | | |
| **III** | Structure and functions of DNA and RNA -Central Dogma of the cell. DNA -Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation. | | | | | | | | | | | | **15 Hrs** | | |
| **IV** | Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways. | | | | | | | | | | | | **15 Hrs** | | |
| **V** | Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis. | | | | | | | | | | | | **15 Hrs** | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Describe the discovery and diversity of cells. |
| **CO2** | Summarize the micro and macro molecules. |
| **CO3** | Know about the structure and function of DNA and RNA |
| **CO4** | Outline the goals of cell cycle and signal transduction pathway. |
| **CO5** | Gain knowledge about Fertilization and formation of germ layers in animals |

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| **Text Books** | |
| 1 | T. Devasena (2012), Cell Biology, Oxford University Press. |
| 2 | Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual. |
| 3 | Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA. |
| 4 | Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company. |
| 5 | James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers. |
| **References Books** | |
| 1 | Karp’s Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications. |
| 2 | James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications. |
| 3 | Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press. |
| 4 | Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications. |
| 5 | Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press. |
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| **Web Resources** | |
| 1 | <http://www.cellbiol.com/education.php> |
| 2 | <https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/> |
| 3 | <https://dnalc.cshl.edu/websites/> |
| 4 | <https://www.cellsignal.com/contents/science/cst-pathways/science-pathways> |
| 5 | <https://nptel.ac.in/courses/102/106/102106025/>11. |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | 3 | 2 | 1 | 3 | - | 3 | 3 | 2 | 3 |  |
| **CO 2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |  |
| **CO 3** | 3 | 3 | 3 | 2 | - | 3 | 3 | 2 | 2 |  |
| **CO 4** | 3 | 2 | 3 | 2 | - | 3 | 3 | 2 | 3 |  |
| **CO 5** | 3 | 3 | 2 | 2 | - | 3 | 3 | 2 | 3 |  |

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 |  |  | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 |
| **CO3** |  |  | 2 | 3 | 3 |
| **CO4** | 3 |  | 2 | 3 | 2 |
| **CO5** | 3 |  |  | 3 | 3 |
| **Weightage** |  |  |  |  |  |
| **Weighted percentage of Course Contribution to Pos** |  |  |  |  |  |

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| Title of the Course | | | | **CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **Core –II Practical** | Year | | I | **Credits** | | 2 | | **Course Code** | | **CCII** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| - | - | | 3 | 3 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | Demonstrate the operation of Light Microscope | | | | | | | | | | | | | | |
| **LO2** | Identify blood cells and its components | | | | | | | | | | | | | | |
| **LO3** | Describe the isolation and identification of plant cells. | | | | | | | | | | | | | | |
| **LO4** | Observation of sperm & Egg | | | | | | | | | | | | | | |
| **LO5** | Demonstrate the cell organelle identification. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Components of a Compound / Light Microscope. | | | | | | | | | | | | 9 | | |
| **II** | Blood smear preparation and Identification of Blood cells  Buccal smear preparation and Identification of squamous epithelial cells. | | | | | | | | | | | | 9 | | |
| **III** | Isolation and Identification of plant cells. | | | | | | | | | | | | 9 | | |
| **IV** | Observation of sperm & Egg  Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.  Types of placenta in mammals. | | | | | | | | | | | | 9 | | |
| **V** | Cell fractionation and Identification of cell organelles (Demo) | | | | | | | | | | | | 9 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Describe the concepts of componenets of light microsope. |
| **CO2** | Summarize the Blood smear preparation and Identification of Blood cells. |
| **CO3** | Know about the identification of plant cells. |
| **CO4** | Observe the sperm and egg cells. |
| **CO5** | Gain knowledge about cell organelles. |

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| **Text Books** | |
| 1. | K.V. Chaitanya, (2013), *Cell and molecular biology*: Lab manual, PHI publishers,. ISBN 978-81-203-800-4 |
|  | |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |  |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |  |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |  |
| **CO 4** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |  |
| **CO 5** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |  |

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 |  |  | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 3 | 3 |
| **CO3** |  |  | 2 | 3 | 3 |
| **CO4** | 3 |  | 3 | 3 | 2 |
| **CO5** | 3 |  |  | 3 | 3 |
| **Weightage** |  |  |  |  |  |
| **Weighted percentage of Course Contribution to Pos** |  |  |  |  |  |

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| Title of the Course | | | | **BIOLOGICAL CHEMISTRY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **Elective -I** | Year | | I | **Credits** | | 3 | | **Course Code** | | **ECI** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 4 | - | | - | 4 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding. | | | | | | | | | | | | | | |
| **LO2** | Demonstrates the formation of different types of solutions, concentrations of solution sand preparation of buffer solutions | | | | | | | | | | | | | | |
| **LO3** | Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism | | | | | | | | | | | | | | |
| **LO4** | Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism. | | | | | | | | | | | | | | |
| **LO5** | Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization. Electrophilic substitution reaction in benzene, nitration and sulphonation. | | | | | | | | | | | | 12 | | |
| **II** | Acids & Bases properties and differences, Concepts of acids and bases- Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer | | | | | | | | | | | | 12 | | |
| **III** | Importance to Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori’s cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism | | | | | | | | | | | | 12 | | |
| **IV** | Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. B-oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids, Salvage pathway. | | | | | | | | | | | | 12 | | |
| **V** | Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins and Hormones. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation. | | | | | | | | | | | | 12 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Able to know the atomic theory, electronic configuration and types of reactions. |
| **CO2** | Differentiate the properties of acids and bases. Assess the buffer solutions and its mechanism. |
| **CO3** | Gain the knowledge about the chemical foundation of life. Illustrate the structure and metabolism of carbohydrates. |
| **CO4** | Explain the classification and metabolism of lipids, fatty acids and nucleic acids. |
| **CO5** | Discuss the classification of aminoacids and proteins. To analyse the role of hormones in metabolism. |

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| **Text Books** | |
| 1. | P.L. Soni , A Text-book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications |
| 2. | Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition |
| 3. | J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition |
| 4. | A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition. |
| 5. | Satyanarayana .U, 2016, Biochemistry, MJ publishers 3rd edition (2006). |
| **References Books** | |
| 1. | Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY |
| 2. | Murray *et al.,* (2003) Harper’s biochemistry 26 th edition Appleton and Lange Publishers Florida USA |
| 3. | Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition. |
| 4. | Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco |
| 5. | Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications |
| **4.Web Resources** | |  |
| 1. | http/dwb4.unl.edu/chem869p/chem869plinks/s |
| 2. | [www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp](http://www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp) |
| 3. | [https://www.britannica.com](https://www.britannica.com/) › science › biochemistry |
| 4 | [https://]ww.sciencedirect.com](https://www.sciencedirect.com/) › topics › agricultural-and-biological-sciences |
| 5. | [https://biochemistry.org](https://biochemistry.org/) › education › careers › becoming-a-bioscientist › w |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | 3 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |  |
| **CO 2** | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |  |
| **CO 3** | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |  |
| **CO 4** | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 |  |
| **CO 5** | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |  |

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 1 | 3 | 2 |
| **CO2** | 3 | 2 | 1 | 3 | 2 |
| **CO3** | 3 | 1 | 2 | 3 | 2 |
| **CO4** | 3 | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 2 | 3 | 2 | 2 |
| **Weightage** | **15** | **10** | **10** | **14** | **10** |
| **Weighted percentage of Course Contribution to Pos** | **3** | **2** | **2** | **2.8** | **2** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **BASICS IN BIOTECHNOLOGY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **Elective -I** | Year | | I | **Credits** | | 3 | | **Course Code** | | **ECI** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 4 | - | | -- | 4 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | Explain the basic concepts of biotechnology and how to set up to a biotechnology laboratory. | | | | | | | | | | | | | | |
| **LO2** | To know about cell structure, types and difference between prokaryotic and eukaryotic cell. | | | | | | | | | | | | | | |
| **LO3** | Describe the types of microscope and its functions. | | | | | | | | | | | | | | |
| **LO4** | Understating of DNA and RNA structure and transfer of gene by conjugation process. | | | | | | | | | | | | | | |
| **LO5** | Clarification of genetic engineering process and role of PBR322 Plasmid vector. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Biotechnology-Histroy, Branches and Scope of Biotechnolgy. Designing of Biotechnology Laboratory. | | | | | | | | | | | | 12 | | |
| **II** | Structure of Prokaryotic cell (Bacteria) and Eukaryotic cells (Plant and animal cell) – Difference between Prokaryotic and Eukaryotic cell - T4 Bacteriophage structure. | | | | | | | | | | | | 12 | | |
| **III** | Microscopy – Bright field Microscope – Principle and application. Incubator - Laminar air flow, Autoclave and Hot air oven. | | | | | | | | | | | | 12 | | |
| **IV** | Central dogma of life, Watson and Crick model of DNA – Structure of RNA, Gene transfer process - Conjugation (F+ x F-). | | | | | | | | | | | | 12 | | |
| **V** | Steps involved in genetic Engineering - Type II restriction endonuclease, Ligase enzyme, PBR322 vector. Overview of steps involved in plant tissue culture. | | | | | | | | | | | | 12 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Understand the scope of Biotechnology and demonstrate the principle design, procedures of Biotechnology laboratory. |
| **CO2** | Gain the knowledge on various structural differences between prokaryotic and eukaryotic cells**.** |
| **CO3** | Identify and understand the principle components of a light microscope and laboratory instruments. |
| **CO4** | Describe the basic structure of Watson and Crick model of DNA and understand the Gene transfer methods. |
| **CO5** | Understand the core concepts of Genetic engineering; analyze the restriction enzymes and vectors for genetic manipulations and fundamentals of plant biotechnology. |

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| **Text Books** | |
| 1. | Kumaresan.V., Biotechnology, Saras Publication, Nagarcoil, 2016. |
| 2. | PelczarJ.R.,Chan E.C.S., and Krieg R., Microbiology,5th Edition, Tata McGraw-Hill publishing company Limited, Delhi, 2004. |
| **References Books** | |
| 1. | Old R.W., Prime Rose S.B., Principles of Gene Manipulation, Blackwell Science. |
| 2. | Prescott L.M., Harley J.P., and Klein B.A., Microbiology,6th Edition ,McGraw-Hill Companies,New York,1993. |
| **Web Resources** | |
| Unit-I | <https://www.careerindia.com/courses/unique-courses/what-is-biotechnology-scope-career-opportunities-017583.html> |
| Unit-II | <https://www.thoughtco.com/what-are-prokaryotes-and-eukaryotes-129478> |
| Unit-III | <https://en.wikipedia.org/wiki/Microscopy>  <http://www.biologydiscussion.com/micro-biology/laboratory-equipment/8-basic-laboratory-equipment-used-in-microbiology-biology/85753> |
| Unit-IV | <https://study.com/academy/lesson/watson-crick-model-of-dna.html> |
| Unit-V | <https://en.wikipedia.org/wiki/Genetic_engineering>  <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/transgenic-plant> |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Pos**  **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | **M** |  | **M** | **S** | **L** |
| **CO2** | **S** | **M** |  | **L** | **S** |
| **CO3** | **M** | **S** |  | **L** | **M** |
| **CO4** | **S** | **M** | **L** | **M** | **S** |
| **CO5** | **M** | **M** |  |  |  |

**S - STRONG M - MEDIUM L - LOW**

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** |  |  |  |  |  |
| **CO2** |  |  |  |  |  |
| **CO3** |  |  |  |  |  |
| **CO4** |  |  |  |  |  |
| **CO5** |  |  |  |  |  |
| **Weightage** |  |  |  |  |  |
| **Weighted percentage of Course Contribution to Pos** |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | | | **BIOLOGICAL CHEMISTRY** | | | | | | | | | | | | |  |
|  | | | | | |  | | | | | | | | | | | | |  |
| **Category** | | | | | **Elective Practical - I** | Year | | I | **Credits** | | 2 | | **Course Code** | | **EPI** | | | |  |
| **Semester** | | I |  |
| **Instructional Hours**  **per week** | | | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |  |
| - | - | | 2 | 2 | | 25 | | 75 | | | 100 | |  |
| **Learning Objectives** | | | | | | | | | | | | | | | | | | |  |
| **LO1** | | | | Perform and estimate the amount of chemical substance present in a  solution qualitatively. To analyze and detect the nature of various organic class  of compounds qualitatively. | | | | | | | | | | | | | | |  |
| **LO2** | | | | Qualitatively analyze the carbohydrates and amino acids and report the type  Of carbohydrate based on specific tests. Differentiate the carbohydrates  based microscopic examination of the crystal. | | | | | | | | | | | | | | |  |
| **LO3** | | | | Understand the methods of acidimetry, alkalimetry and permanganometry. | | | | | | | | | | | | | | |  |
| **LO4** | | | | Quantify Ascorbic acid in lemon by Dichlorophenol indo phenol dye method,  Glycine by sorensons formal titration method. | | | | | | | | | | | | | | |  |
| **LO5** | | | | Estimate Glucose, Cholesterol and Proteins. | | | | | | | | | | | | | | |  |
| **UNIT** | | | | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |  |
| **I** | | | | **Systematic analysis of Organic compounds**  Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam)  Detection of elements (N, Halogens)  Distinguish between aliphatic and aromatic compounds.  Distinguish between Saturated and unsaturated compounds | | | | | | | | | | | | 9 | | |  |
| **II** | | | | **Qualitative Analysis**  Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen.  Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine. | | | | | | | | | | | | 7 | | |  |
| **III** | | | | **Volumetric Analysis**:  1. Estimation of Glycine- Formal Titration.  2. Determination of Ascorbic acid – DCPIP method.  3. Estimation of Ferrous sulphate using standard Mohr's salt | | | | | | | | | | | | 7 | | |  |
| **IV** | | | | **Colorimetric Analysis**  1. Estimation of glucose  2. Estimation of Cholesterol- Zak's method  3.Estimation of proteins – Bradford’s method. | | | | | | | | | | | | 7 | | |  |
| **Course Outcomes** | | | | | | | | | | | | | | | | | |  |
| **Course Outcomes** | | On completion of this course, students will be able; | | | | | | | | | | | | | | | |  |
| **CO1** | | Practice the Systematic analysis of Organic compounds. | | | | | | | | | | | | | | | |  |
| **CO2** | | Learn the qualitative analysis of carbohydrates and amino acids. | | | | | | | | | | | | | | | |  |
| **CO3** | | Study on volumetric analysis of glycine, ascorbic acid and ferrous sulphate. | | | | | | | | | | | | | | | |  |
| **CO4** | | Estimation of glucose, cholesterol and proteins by calorimetric analysis. | | | | | | | | | | | | | | | |  |
| **Text Books** | | | | | | | | | | | | | | | | | |  |
| 1 | J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011. | | | | | | | | | | | | | | | | |  |
| 2 | S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005. | | | | | | | | | | | | | | | | |  |
| 3 | Irwin H.Segel, Biochemical calculations,Liss, Newyork,1991. | | | | | | | | | | | | | | | | |  |
| **References Books** | | | | | | | | | | | | | | | | | |  |
| 1 | Dr. O P Panday, D N Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S Chand, Revised edition 2016. | | | | | | | | | | | | | | | | |  |
| 2 | Hands Thacher Clarke, A hand book of Oraganic:Qualitative and quantitative Analysis, 2007. | | | | | | | | | | | | | | | | |  |
| 3 | N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Lab manual, S.Viswanathan Co. Pvt. Ltd., 1998. | | | | | | | | | | | | | | | | |  |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CLO5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **TOTAL** | 15 | 15 | 14 | 14 | 14 | 14 | 15 | 14 | 14 |
| **AVERAGE** | 3 | 3 | 2.8 | 2.8 | 2.8 | 2.8 | 3 | 2.8 | 2.8 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **Food and Nutrition** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **SEC-I**  **NME** | Year | | I | **Credits** | | 2 | | **Course Code** | | **SECI** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 2 | - | | -- | 2 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | The student can determine the relationship between food , health and immunity | | | | | | | | | | | | | | |
| **LO2** | Able to explain the classification of foods and their deficiency | | | | | | | | | | | | | | |
| **LO3** | Can analyse the importance of BMR | | | | | | | | | | | | | | |
| **LO4** | Can outline the basic food groups and their adulteration | | | | | | | | | | | | | | |
| **LO5** | Apply the concepts of food to prepare different food plans | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Definition of food, Nutrition, Nutrient, Nutritional status, Dietetics, Balance diet, Malnutrition, Energy (Unit of energy-Joule, Kilocalorie). Health, Immunity by food and function of food. | | | | | | | | | | | | 6 | | |
| **II** | Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine) -Sources, Classification, Function, Deficiencies of these nutrients. Function of water and dietary fiber. | | | | | | | | | | | | 6 | | |
| **III** | BMR: Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals) | | | | | | | | | | | | 6 | | |
| **IV** | Basic five food groups, nutritional significance of cereals, pulses, milk, meat, fish, vegetables, egg, nuts, oils and sugars. Food toxins, Food additives, Food quality, Safe food handling, Food adulteration, Preservatives and Packaging. | | | | | | | | | | | | 6 | | |
| **V** | Principles and Objectives of meal planning. Diet for an infant, preschool child, School child, normal male and female of different occupations. | | | | | | | | | | | | 6 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able to; |
| **CO1** | Understand the basis of nutrition and components of food for a healthy life |
| **CO2** | Study the types, sources and importance of biological molecules in food. |
| **CO3** | Know the energy requirements and factors influencing BMR |
| **CO4** | Learn the importance of food groups, food adulterations and food preservation |
| **CO5** | Create awareness on the diet plan for different age groups and occupations. |

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| **Text Books** | |
| 1 | Vidya & D.B. Rao, 2010. A textbook of nutrition by, Discovery Publishing house, |
| 2 | Handbook of Nutrition & Food, third edition, CRC Press (Taylor and Francis group) by Carolyn D.Berdanier |
| 3 | Food science and Nutrition, Oxford publication by Sunetra Roday |
| 4 | Janet D Ward & Larry T Ward, Principles of food science by, Good heart-Wilcox publishing. |
| 5 | Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press. |
| **References Books** | |
| 1 | Joshi, V.K. and Singh, R.S., A. (2013), Food Biotechnology- Principles and practices, I.K.International Publishing House Pvt. Ltd., New Delhi,. |
| 2 | RavishankarRai, V,( 2015), Advances in Food Biotechnology, (First edition), John Wiley & Sons, Inc, ISBN 9781118864555 |
| 3 | Foster, G.N., (2020), Food Biotechnology, ( First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348 |
| 4 | Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin (2005), Food Biotechnology, (2nd edition), CRC Press, ISBN 9780824753290 |
| 5 | Perry Johnson-Green (2018), Introduction to Food Biotechnology, Special Indian Edition, CRC Press, ISBN 9781315275703 |
| **Web Resources** | |
| 1 | Nutrition and Dietetics  https://www.jaypeedigital.com/eReader/chapter/9789351522997/ch1 |
| 2 | Components of food.  https://www.vedantu.com/biology/components-of-food |
| 3 | Basal Metabolic Rate  https://online.upsmfac.org/UploadedFiles/Tutorials/40.pdf |
| 4 | Food groups and Food quality  <https://www.hsph.harvard.edu/wp-content/uploads/sites/84/2012/09/ewkm_training_2_session_4_points.pdf>, https://ncert.nic.in/textbook/pdf/kehe103.pdf |
| 5 | Diet Planning  https://www.nios.ac.in/media/documents/srsec321newE/321-E-Lesson-5.pdf |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | 3 | 2 | 1 | 1 | 3 | 2 |  |  |  |  |
| **CO 2** | 3 | 2 | 1 | 1 | 3 | 3 |  |  |  |  |
| **CO 3** | 3 | 2 | 1 | 1 | 3 | 3 |  |  |  |  |
| **CO 4** | 3 | 2 | 1 | 1 | 3 | 3 |  |  |  |  |
| **CO 5** | 3 | 2 | 1 | 1 | 3 | 3 |  |  |  |  |

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 3 |  |  |
| **CO2** | 3 | 3 | 3 |  |  |
| **CO3** | 3 | 3 | 3 |  |  |
| **CO4** | 3 | 3 | 3 |  |  |
| **CO5** | 3 | 3 | 3 |  |  |
| **Weightage** | 15 | 15 | 15 |  |  |
| **Weighted percentage of Course Contribution to Pos** | 3 | 3 | 3 |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **Biotechnology for Society** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **SEC-I**  **NME** | Year | | I | **Credits** | | 2 | | **Course Code** | | **SECI** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 2 | 1 | | -- | 2 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation | | | | | | | | | | | | | | |
| **LO2** | Will gain knowledge about the production of Bio fertilizer and advantages of Biopestisides | | | | | | | | | | | | | | |
| **LO3** | Will understand the significance of microorganisms in Biodegradation | | | | | | | | | | | | | | |
| **LO4** | Will get know about History of Antibiotics | | | | | | | | | | | | | | |
| **LO5** | Will able to comprehend about Transgenic Plants | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Introduction to Biotechnology- Role of Biotechnology in sericulture-  Rearing of silkworms- Importance and applications- Role  of Biotechnology in Apiculture- Bee hive hierarchy- Bee keeping process- Products obtained-Mushroom farming stages- Cultivation of paddy  straw mushroom- Importance of mushroom cultivation. | | | | | | | | | | | | 6 | | |
| **II** | Bio fertilizer- Definition- Mass production of *Rhizobium*-Advantages and  D disadvantages- Biopesticides- Definition- Microbial biopesticides  - *Bacillus thuringiensis*- Single cell protein- Introduction- history  - production of  *Spirulina.* SCP- Applications- Advantages & disadvantages. | | | | | | | | | | | | 6 | | |
| **III** | Biodegradation- Definition- Process-role of microorganisms  in biodegradation biodegradable plastics-advantages-  Bioweapons introduction- history- potential agents- delivery methods  - harmful effects. | | | | | | | | | | | | 6 | | |
| **IV** | Antibiotics- Definition- Introduction and history of antibiotics- sources- clclassification – spectrum - production of Penicillin - definition of  antibiotic resistance. | | | | | | | | | | | | 6 | | |
| **V** | Transgenic plants – Definition of transgene and transgenesis –  Bt cotton - Flavr-Savr tomato and Golden rice- history – importance,  Applications, advantages and disadvantages. | | | | | | | | | | | | 6 | | |

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| --- | --- |
| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able to; |
| **CO1** | Understand the role and importance of biotechnology in various fields. |
| **CO2** | Know the sources in production of Bio fertilizers and its importance. |
| **CO3** | Study the role of Microorganisms in Biodegradation and Bio weapons. |
| **CO4** | Learn the classes, sources, production and application of antibiotics. |
| **CO5** | Analyse the positive effects of transgenesis in plant varieties. |

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| **Text Books** | |
| 1 | Sathyanarayana, U., Chakrapani, U., (2008). *Biotechnology,* First edition, Books and allied (P) Ltd, Kolkata. |
| 2 | A.K. Chatterji, (2011).*Introduction to Environmental Biotechnology,* Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9 |
| 3 | R.C. Dubey, (2014*). A text book of Biotechnology*, *S.Chand& Company, New Delhi.* ISBN 9788121926089 |
| 4 | H. Patel, (2011).*Industrial Microbiology*,( 2nd edition), MacMillan Publishers |
| 5 | Thakur, I.S., (2019).*Environmental Biotechnology- Basic principles and applications- (*2nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9 |
| **References Books** | |
| 1 | Basics of Biotechnology Paperback – 1 January 2004  by A.J. Nair (Author) Publisher  Laxmi Publications |
| 2 | Basic Biotechnology Paperback – 2 February 2008  by Ratledge Colin (Author) Publisher  Cambridge University Press |
| **Web Resources** | |
| 1 | Role of Biotechnology in various fields  https://byjus.com/neet/important-notes-of-biology-for-neet-application-of-biotechnology/#:~:text=With%20the%20advancement%20of%20various,crop%2C%20waste%20management%2C%20etc. |
| 2 | Biofetrilizers and Biopesticides  <https://courseware.cutm.ac.in/wp-content/uploads/2020/06/Lec-11-Biofertilizer-and-biopesticide.pdf> |
| 3 | Biodegradation andBioplastics  https://www.greendotbioplastics.com/biodegradation-explained/ |
| 4 | Role of Microbes in Antibiotic production  https://unacademy.com/content/cbse-class-11/study-material/biology/microbes-in-antibiotics/ |
| 5 | Transgenic plants  https://unacademy.com/content/csir-ugc/study-material/life-sciences/transgenic-plants/ |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  |
| **CO 2** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  |
| **CO 3** | **3** | **2** | **3** | **3** | **3** | **3** |  |  |  |  |
| **CO 4** | **3** | **3** | **3** | **3** | **3** | **3** |  |  |  |  |
| **CO 5** | **3** | **3** | **3** | **3** | **2** | **3** |  |  |  |  |

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | **3** | **3** | **3** |  |  |
| **CO2** | **2** | **3** | **3** |  |  |
| **CO3** | **3** | **2** | **3** |  |  |
| **CO4** | **3** | **3** | **3** |  |  |
| **CO5** | **2** | **3** | **3** |  |  |
| **Weightage** | **13** | **14** | **15** |  |  |
| **Weighted percentage of Course Contribution to Pos** | **2.6** | **2.8** | **5** |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **MICROBIAL TAXONOMY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **FC** | Year | | I | **Credits** | | 2 | | **Course Code** | | **FC** | | | |
| **Semester** | | I |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 2 | - | | -- | 2 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | To understand the theory and practice of describing, naming and the different taxonomic  groups of Microorganisms. | | | | | | | | | | | | | | |
| **LO2** | To learn about the Bacterial characteristics and classification. | | | | | | | | | | | | | | |
| **LO3** | To acquire knowledge on Classification and understanding the importance of prokaryotic  organisms. | | | | | | | | | | | | | | |
| **LO4** | To Gain the knowledge on virus and bacteriophage. | | | | | | | | | | | | | | |
| **LO5** | To impart knowledge on economic importance of algae and fungi. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the**  **Unit** | | |
| **I** | Taxonomy -hierarchy of taxonomy - Taxonomic Ranks - Binomial nomenclature –Bergey’s Classification systems – Numerical taxonomy. | | | | | | | | | | | | 6 | | |
| **II** | Major characteristics used in taxonomy- Morphological, Physiological and Molecular characteristics. Haeckel’s Three kingdom and Whittaker Five Kingdom Classification. | | | | | | | | | | | | 6 | | |
| **III** | Bacteria – characteristics, Difference between Archeabacteria and Eubacteria. Over view of classification and economic importance. | | | | | | | | | | | | 6 | | |
| **IV** | Virus-General structure, characteristics and classification of animal virus, plant virus and bacteriophage. | | | | | | | | | | | | 6 | | |
| **V** | Algae - characteristics, classification (Fritz) and economic importance.  Fungi - characteristics, classification (Alexopolus) and economic importance. | | | | | | | | | | | | 6 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Exert the concept of classification systems of biological organisms and rules of binomial nomenclature |
| **CO2** | Impart knowledge on major characteristics and classification of microorganisms. |
| **CO3** | Describe the knowledge on the General characters, classification and economic importance of bacteria. |
| **CO4** | Study the structure, characteristics and classification of virus. |
| **CO5** | Deliver knowledge on characteristics, classification and economic importance of algae and fungi. |

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| **Text Books** | |
|  | Prescott L.M., Harley J.P., and Klein B.A., Microbiology, 6th edition, McGraw- Hill Companies, New York |
|  | Schlegel G., General microbiology, 7th Edition, Cambridge University press, UK |
| **References Books** | |
|  | Jordan E.L., and Verma P.S., Invertebrate Zoology, S.Chand and company Pvt Ltd, Ram nagar, New Delhi, 2013. |
|  | Jordan E.L., and Verma P.S., Chordate Zoology, S.Chand and company Pvt Ltd, Ram nagar, New Delhi, 2013 |
|  | Vashishta B.R., Botany for Degree Students- Algae, S.Chand and company Pvt Ltd, Ram nagar, New Delhi, 1973 |
|  | Vashishta B.R., Botany for Degree Students- Fungi, S.Chand and company Pvt Ltd, Ram nagar, New Delhi, 1973. |
| **Web Resources** | |
| 1 | <https://www.britannica.com/science/taxonomy> |
| 2 | <https://en.wikipedia.org/wiki/Virus_classification> |
| 3 | <http://www.biologydiscussion.com/fungi/classification-fungi/classification-of-fungi-with-diagram/69720> |
| 4 | <https://www.toppr.com/guides/biology/diversity-in-living-organisms/animal-kingdom/> |
| 5 | <https://www.toppr.com/guides/biology/diversity-in-living-organisms/plant-kingdom/> |

**Mapping with Programme Outcomes:**

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|  | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO1 0** |
| **CO 1** | **3** | **3** |  | **2** | **3** |  |  |  |  |  |
| **CO 2** | **2** |  | **2** | **2** |  |  |  |  |  |  |
| **CO 3** |  | **2** | **1** | **3** | **3** |  |  |  |  |  |
| **CO 4** | **1** | **3** | **3** | **1** | **2** |  |  |  |  |  |
| **CO 5** | **2** | **2** | **3** | **3** | **3** |  |  |  |  |  |

3 – Strong, 2 – Medium , 1 – Low

**Mapping with Programme Specific Outcomes:**

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| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** |  |  |  |  |  |
| **CO2** |  |  |  |  |  |
| **CO3** |  |  |  |  |  |
| **CO4** |  |  |  |  |  |
| **CO5** |  |  |  |  |  |
| **Weightage** |  |  |  |  |  |
| **Weighted percentage of Course Contribution to Pos** |  |  |  |  |  |

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**SEMESTER – II**

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| Title of the Course | | | | **GENETICS** | | | | | | | | | | | |
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| **Category** | | | **Core – III** | Year | | I | **Credits** | | 4 | | **Course Code** | | **CC- III** | | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | **Total** |
| 5 | - | | - | 5 | | 25 | | 75 | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | |
| **LO1** | Learn about the classical genetics and transmission of characters from one generation to the next. | | | | | | | | | | | | | |
| **LO2** | Obtain a strong foundation for the advanced genetics. | | | | | | | | | | | | | |
| **LO3** | Explain the properties of genetic materials and storage and processing of genetic information. | | | | | | | | | | | | | |
| **LO4** | Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human. | | | | | | | | | | | | | |
| **LO5** | Categories Eugenics, Euphenics and Euthenics and indepth Knowledge on population Genetics. | | | | | | | | | | | | | |

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| **UNIT** | **Details** | **No. of Periods for the Unit** |
| **I** | Mendel’s experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel’s laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man. | 15 |
| **II** | Linkage - linkage in Drosophila- Morgan’s experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex- Determination in Man. | 15 |
| **III** | Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction | 15 |
| **IV** | Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy) | 15 |
| **V** | Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics. | 15 |
| **Total** | | 75 |

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| **Course Outcomes** | **Course Outcomes**  On completion of this course, students will be able; |
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| **CO1** | They can have a comprehensive understanding of Mendel's experiments, the principles of inheritance, various patterns of genetic inheritance, and how genes interact to shape phenotypic outcomes. |
| **CO2** | Understanding of chromosome mapping techniques and their applications in determining gene positions. They will understand the phenomena of interference and coincidence in genetic recombination. Students will have a clear understanding of sex-linked inheritance patterns and sex determination in humans, including the genetic basis of related disorders. |
| **CO3** | Familarized with evolution of gene concept and they will have knowledge on microbial genetics |
| **CO4** | Gained the knowledge on the different types of mutations, chromosomal structural and number variations and to know the disorders. |
| **CO5** | They will be able to analyze the factors that influence gene frequencies in populations and understand the concepts of eugenics, euphenics, and euthenics. This knowledge will equip students to critically evaluate genetic and population-related issues and contribute to discussions on population genetics and its applications in society. |

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| **Text Books** | |
| 1 | Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram |
| 2 | Nath Publications, Meerut, 250001. www.knrnpublications.com, ISBN-978-81-907011-2-9 |
| 3 | Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S.Chand & Co., New Delhi – 10055. |
| 4 | Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S.Chand and Co., New Delhi, 110055. |
| **References Books** | |
| 1 | Gardener E.J. Simmons M.J. Slustad D. P. 2006. Principles of Genetics |
| 2 | Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill. |
| 3 | Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H.Freeman. New York. |
| 4 | Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd |
| 5 | Good enough U. 1985. Genetics. Hold Saunders international. |
| **Web Resources** | |
| 1 | <https://nptel.ac.in/courses/102/106/102106025/> |
| 2 | [http://www.ocw.mit.edu](http://www.ocw.mit.edu/) |
| 3 | [http://enjoy.m.wikipedia.org](http://enjoy.m.wikipedia.org/) |
| 4 | [https://www.acpsd.net](https://www.acpsd.net/) |

**MAPPING WITH PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| **CLO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO5** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| **TOTAL** | 15 | 14 | 14 | 15 | 13 | 14 | 14 | 13 | 13 |
| **AVERAGE** | 3 | 2.8 | 2.8 | 3 | 2.6 | 2.8 | 2,8 | 2.6 | 2.6 |

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| Title of the Course | | | **GENETICS** | | | | | | | | | | |
|  | | |  | | | | | | | | | | |
| **Category** | | **Core –IV Practical** | Year | | I | **Credits** | | 2 | | **Course Code** | | **CC - IV** | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | **Total** |
| - | - | | 3 | 3 | | 25 | | 75 | | 100 |
| **Learning Objectives** | | | | | | | | | | | | |

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| --- | --- | --- |
| **LO1** | Demonstrate the basic principles of important techniques in Molecular biology and Genetics. | |
| **LO2** | Analyze the Polytene chromosome of the organisms | |
| **LO3** | Identify Barr bodies from Buccal smear | |
| **LO4** | Demonstrate the Preparations and maintenance of culture medium | |
| **LO5** | Demonstrate Human karyotyping | |
| **UNIT** | **Details** | **No.of Periods for the Unit** |
| **I** | 1. Mitotic stages of onion (*Allium cepa*) root tip 2. Meiotic stages of cockroach testes/ Flower bud | 9 |
| **II** | Giant chromosomes from Chironomus larvae/ Drosophila salivary glands | 9 |
| **III** | Identification of Barr bodies from Buccal smear | 9 |
| **IV** | 1. Preparations of culture medium and culture of Drosophila – methods of maintenance. 2. Identifications of mutants of Drosophila | 9 |
| **V** | Human karyotyping (Demo) | 9 |

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| **Course Outcomes** | **Course Outcomes**  On completion of this course, students will be able; |
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| **CO1** | They will be equipped with the knowledge and skills necessary to study and analyze mitosis in plant cells and apply their understanding to broader concepts of cell division and growth in plants. |
| **CO2** | Understand and analyze the unique characteristics and significance of giant chromosomes found in Chironomus larvae and Drosophila salivary glands. |
| **CO3** | Familarized with isolation and identification of barr bodies from buccal smear |
| **CO4** | Gain the practical knowledge to prepare the different media for Drosophila culturing and maintenance. Expertise to identify the mutant Drosophila |
| **CO5** | Detailed demonstration on human karyotype |

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| **Text Books** | |
| 1 | Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CLO5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **TOTAL** | 15 | 15 | 14 | 14 | 14 | 14 | 15 | 14 | 14 |
| **AVERAGE** | 3 | 3 | 2.8 | 2.8 | 2.8 | 2.8 | 3 | 2.8 | 2.8 |

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| Title of the Course | | | | | **FUNDAMENTALS OF MICROBIOLOGY** | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | | | | | | | |
| **Category** | | | | **Elective - II** | Year | | I | **Credits** | | 3 | | **Course Code** | | **EC - II** | | | | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** | |
| 4 | - | | -- | 4 | | 25 | | 75 | | | 100 | | |
| **Learning Objectives** | | | | | | | | | | | | | | | | | |
| LO1 | | Understand the classification of Microorganisms and structure of bacteria | | | | | | | | | | | | | | | | |
| LO2 | | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | | | | | | | | | | | | | | | | |
| LO3 | | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes. | | | | | | | | | | | | | | | | |
| LO4 | | Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizers prebiotics and probiotics. | | | | | | | | | | | | | | | | |
| LO5 | | Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications. | | | | | | | | | | | | | | | | |
| **UNIT** | | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | | | |
| I | | History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology. | | | | | | | | | | | | 12 | | | | |
| II | | Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram’s, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae. | | | | | | | | | | | | 12 | | | | |
| III | | Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL. | | | | | | | | | | | | 12 | | | | |
| IV | | Bioinsecticides - *Bacillus thuringiensis*, Baculoviruses- Biofertilizers -*Azospirillum* and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt). | | | | | | | | | | | | 12 | | | | |
| V | | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). | | | | | | | | | | | | 12 | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | | |
| 1 | | Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York. | | | | | | | | | | | | | | | | |
| 2 | | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. | | | | | | | | | | | | | | | | |
| 3 | | Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013. | | | | | | | | | | | | | | | | |
| 4 | | Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. | | | | | | | | | | | | | | | | |
| 5 | | Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC | | | | | | | | | | | | | | | | |
| Reference Books | | | | | | | | | | | | | | | | | | |
| 1 | | Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017. | | | | | | | | | | | | | | | | |
| 2 | | Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012. | | | | | | | | | | | | | | | | |
| 3 | | Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis. | | | | | | | | | | | | | | | | |
| 4 | | Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson. | | | | | | | | | | | | | | | | |
| 5 | | Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York. | | | | | | | | | | | | | | | | |
| Web Resources | | | | | | | | | | | | | | | | | | |
| 1 | | | Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB) | | | | | | | | | | | | | | | |
| 2 | | | <http://www> ejb.org/content. | | | | | | | | | | | | | | | |
| 3 | | | Www. Biotech.kth.se Electronic Journal of biotechnology | | | | | | | | | | | | | | | |
| 4 | | | https://www.cliffsnotes.com/study guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology | | | | | | | | | | | | | | | |
| 5 | | | <https://bio.libretexts.org/@go/page/9188> | | | | | | | | | | | | | | | |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CLO5** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **TOTAL** | 15 | 15 | 14 | 14 | 14 | 14 | 15 | 14 | 14 |
| **AVERAGE** | 3 | 3 | 2.8 | 2.8 | 2.8 | 2.8 | 3 | 2.8 | 2.8 |

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| Title of the Course | | | | **APPLIED BIOTECHNOLOGY** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **Elective - II** | Year | | I | **Credits** | | 3 | | **Course Code** | | **EC-II** | | | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 4 | - | | -- | 4 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | To know about role of biotechnology in agriculture such as biofertilizer, biopesticides etc., | | | | | | | | | | | | | | |
| **LO2** | Consideration of environment biotechnology and its importance | | | | | | | | | | | | | | |
| **LO3** | Development of industries based on biotechnological techniques | | | | | | | | | | | | | | |
| **LO4** | Explain the significance of biotechnology in medicine | | | | | | | | | | | | | | |
| **LO5** | To become familiar with genetically modified organisms and their uses | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Biotechnology in agriculture- Production and application of Biofertilizers – *Rhizobium* and Vermicompost; Bacterial Pesticide –  *Bacillus thuringiensis*. | | | | | | | | | | | | 12 | | |
| **II** | Biotechnology in environment – Biodegradation of hydrocarbon -Petrol; Biofuel – methane gas production; waste water treatment. | | | | | | | | | | | | 12 | | |
| **III** | Industrial Biotechnology – Production and application of SCP - Spirulina; Mushroom production- Oyster mushroom; Wine production. | | | | | | | | | | | | 12 | | |
| **IV** | Biotechnology in medicine –Penicillin production; vitamin B12 production, Gene therapy; Vaccine- types and schedule. | | | | | | | | | | | | 12 | | |
| **V** | Transgenic animal (Sheep), Transgenic plant (Golden rice) Bio war; Patenting of Biotechnological products, Intellectual Property Rights (IPR) | | | | | | | | | | | | 12 | | |

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| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Understand the uses of Biotechnology in Agriculture. |
| **CO2** | Realize the processes of Biotechnology in cleaning up the environment. |
| **CO3** | Appreciate the methods involved in the production of valuable food and other bio-products through biotechnology. |
| **CO4** | Explicate the techniques adopted in producing human healthcare products. |
| **CO5** | Demonstrate the methods of transgenesis in plants and animals and understanding the patenting & intellectual property rights. |

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| **Text Books** | |
| 1. | Kumaresan.V., Biotechnology, Saras Publication, Nagarcoil, 2016. |
| 2. | PelczarJ.R.,Chan E.C.S., and Krieg R., Microbiology,5th Edition, Tata McGraw-Hill publishing company Limited, Delhi, 2004. |
| **References Books** | |
| 1. | Old R.W., Prime Rose S.B., Principles of Gene Manipulation, Blackwell Science. |
| 2. | Prescott L.M., Harley J.P., and Klein B.A., Microbiology,6th Edition ,McGraw-Hill Companies,New York,1993. |
| **Web Resources** | |
| Unit-I | <https://www.careerindia.com/courses/unique-courses/what-is-biotechnology-scope-career-opportunities-017583.html> |
| Unit-II | <https://www.thoughtco.com/what-are-prokaryotes-and-eukaryotes-129478> |
| Unit-III | <https://en.wikipedia.org/wiki/Microscopy>  <http://www.biologydiscussion.com/micro-biology/laboratory-equipment/8-basic-laboratory-equipment-used-in-microbiology-biology/85753> |
| Unit-IV | <https://study.com/academy/lesson/watson-crick-model-of-dna.html> |
| Unit-V | <https://en.wikipedia.org/wiki/Genetic_engineering>  <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/transgenic-plant> |

**Mapping with Programme Outcomes:**

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

3 – Strong, 2 – Medium , 1 - Low

**Mapping with Programme Specific Outcomes:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** |  |  |  |  |  |
| **CO2** |  |  |  |  |  |
| **CO3** |  |  |  |  |  |
| **CO4** |  |  |  |  |  |
| **CO5** |  |  |  |  |  |
| **Weightage** |  |  |  |  |  |
| **Weighted percentage of Course Contribution to Pos** |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | | | **FUNDAMENTALS OF MICROBIOLOGY** | | | | | | | | | | | | |
|  | | | | | |  | | | | | | | | | | | | |
| **Category** | | | | | **Elective Practical –II** | Year | I | **Credits** | 2 | | **Course Code** | | | | **EP - II** | | | |
| **Semester** | II |
| **Instructional Hours**  **per week** | | | | | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | | | **CIA** | **External** | | | **Total** | | |
| - | - | 2 | 2 | | | 25 | | 75 | | 100 | | |
| **Learning Objective** | | | | | | | | | | | | | | | | | | |
| **LO1** | | | Describe the general Laboratory safety & Sterilization Techniques | | | | | | | | | | | | | | | |
| **LO2** | | | Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure  Culture Techniques | | | | | | | | | | | | | | | |
| **LO3** | | | Microscopically analyze the morphological features of Bacteria and fungi and define  various Staining Techniques. | | | | | | | | | | | | | | | |
| **LO4** | | | Perform the Motility of organisms. | | | | | | | | | | | | | | | |
| **LO5** | | | Able to characterize and identify bacteria using Biochemical tests. | | | | | | | | | | | | | | | |
| **UNIT** | | | | | **Contents** | | | | | | | **No. of Hours** | | | | | | | |
| **I** | | | | | Sterilization techniques – Preparation of Media | | | | | | | 6 | | | | | | | |
| **II** | | | | | Inoculation techniques- Pour plate, spread plate  Isolation of bacteria from various sources and dilution techniques. | | | | | | | 6 | | | | | | | |
| **III** | | | | | Staining techniques: Simple, Gram’s, Capsule (Negative), Spores,  Preparation of temporary mounts- Lacto phenol cotton blue staining. | | | | | | | 6 | | | | | | | |
| **IV** | | | | | Motility tests: Hanging drop technique. | | | | | | | 6 | | | | | | | |
| **V** | | | | | Biochemical characterization - catalase, oxidase, IMVIC test and TSI. Antibiotic sensitivity test (demonstration). | | | | | | | 6 | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | |
| 1 | | | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. | | | | | | | | | | | | | | |
| 2 | | | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. | | | | | | | | | | | | | | |
| 3 | | | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. | | | | | | | | | | | | | | |
| 4 | | | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. | | | | | | | | | | | | | | |
| 5 | | | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | | | |
| 1 | | | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. | | | | | | | | | | | | | | |
| 2 | | | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India. | | | | | | | | | | | | | | |
| 3 | | | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS. | | | | | | | | | | | | | | |
| 4 | | | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. | | | | | | | | | | | | | | |
| 5 | | | Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications. | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | |
| 1 | | | <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>. | | | | | | | | | | | | | | |
| 2 | | | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> | | | | | | | | | | | | | | |
| 3 | | | [https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry/files/essential_microbiology.pdf) | | | | | | | | | | | | | | |
| 4 | | | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> | | | | | | | | | | | | | | |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 3 |
| **CLO2** | 3 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 |
| **CLO3** | 3 | 2 | 1 | 1 | - | 1 | 3 | 3 | 3 |
| **CLO4** | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CLO5** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| **TOTAL** | 15 | 11 | 8 | 10 | 8 | 8 | 15 | 14 | 14 |
| **AVERAGE** | 3 | 2.2 | 1.6 | 2 | 1.6 | 1.6 | 3 | 2.8 | 2.8 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | **GOOD LABORATORY PRACTICES** | | | | | | | | | | | | |
|  | | | |  | | | | | | | | | | | | |
| **Category** | | | **SEC – 2**  **NME** | Year | | I | **Credits** | | 2 | | **Course Code** | | **SEC - II** | | | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 2 | - | | -- | 2 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | |
| **LO1** | The student will know the types of labs associated with Biotechnology | | | | | | | | | | | | | | |
| **LO2** | Will know to use and maintain lab Instruments | | | | | | | | | | | | | | |
| **LO3** | Will know the calculations needed in a laboratory | | | | | | | | | | | | | | |
| **LO4** | Will know about good lab Guidelines | | | | | | | | | | | | | | |
| **LO5** | Will know how to safely dispose bio waste | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base,  fine chemicals like dyes, protein and enzyme storage units),Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire  and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique. | | | | | | | | | | | | **6** | | |
| **II** | Methods and types of documentation (pre-lab writes, result recording and  post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and  vice -versa). | | | | | | | | | | | | **6** | | |
| **III** | Principles, use and maintenance of laboratory instruments like Autoclave,  hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtomes, Electronic balances, Biosafety cabinets. SOP preparation for instrumentation. | | | | | | | | | | | | **6** | | |
| **IV** | Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control,  Internal audit basics, ISO, BIS and HACCP standards. | | | | | | | | | | | | **6** | | |
| **V** | Definition of waste, types of waste: Biological andchemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions,  Perchloric acid, Nanoparticle wastes, Spill management, Awareness  and training for personnel. | | | | | | | | | | | | **6** | | |

|  |  |
| --- | --- |
| **Course Outcomes** | |
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Known about the types of labs associated with Biotechnology |
| **CO2** | To use and maintain lab Instruments |
| **CO3** | Explained about the calculations needed in a laboratory |
| **CO4** | Clarification of good lab Guidelines |
| **CO5** | Learn about safely dispose bio waste |

|  |  |
| --- | --- |
| **Text Books** | |
| 1. | WHO training manual on Good Laboratory Practices, 2nd Edition. |
| **References Books** | |
| 1. | Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press. |
| **Web Resources** | |
| Unit-I | [https://www.who.int/tdr/publications/documents/glp-trainer.pdf"tdr](https://www.who.int/tdr/publications/documents/glp-trainer.pdf%22tdr) |
| Unit-II | https://www.who.int/tdr/publications/documents/glp-trainer.pdf"›publications › documents |
| Unit-III | [https://www.who.int/tdr/publications/documents/glp-trainer.pdf"glp](https://www.who.int/tdr/publications/documents/glp-trainer.pdf%22glp) |
| Unit-IV | https://www.who.int/tdr/publications/documents/glp-trainer.pdf"-trainer |
| Unit-V | [www.who.int/tdr/publications/documents/glp-handbook.pdf](http://www.who.int/tdr/publications/documents/glp-handbook.pdf) |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |
| **CLO2** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |
| **CLO3** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |
| **CLO4** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |
| **CLO5** | **3** | **3** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Title of the Course | | | | | | **PUBLIC HEALTH AND HYGIENE** | | | | | | | | | | | | |
|  | | | | | |  | | | | | | | | | | | | |
| **Category** | | | | | **SEC – 3**  **NME** | Year | | I | **Credits** | | 2 | | **Course Code** | | **SEC - III** | | | |
| **Semester** | | II |
| **Instructional Hours**  **per week** | | | | | | **Lecture** | **Tutorial** | | **Lab Practice** | **Total** | | **CIA** | | **External** | | | | **Total** |
| 2 | - | | -- | 2 | | 25 | | 75 | | | 100 | |
| **Learning Objectives** | | | | | | | | | | | | | | | | | |
| **LO1** | can explain the importance of health and hygiene | | | | | | | | | | | | | | | | | |
| **LO2** | can analyze the importance of food and malnutrition | | | | | | | | | | | | | | | | | |
| **LO3** | can understand the cause of diseases | | | | | | | | | | | | | | | | | |
| **LO4** | Will get know about lifestyle diseases | | | | | | | | | | | | | | | | | |
| **LO5** | Will get awareness about various Health Services Organizations | | | | | | | | | | | | | | | | | |
| **UNIT** | | | **Details** | | | | | | | | | | | | **No. of Periods for the Unit** | | |
| **I** | | | Scope health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell, tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene. | | | | | | | | | | | | 6 | | |
| **II** | | | Classification of food into micro and macro nutrients. Balanced diet,  Importance of dietary fibres.Significance of breast feeding. Malnutrition abnormalities – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure). | | | | | | | | | | | | 6 | | |
| **III** | | | Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus,plague, whooping cough, diphtheria, leprosy. Sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases. | | | | | | | | | | | | 6 | | |
| **IV** | | | Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy) Obesity (Definition and consequences). Mental illness(depression and anxiety). Oral and lung cancer and their preventive measures. | | | | | | | | | | | | 6 | | |
| **V** | | | Health Services Organizations: World Health Organization (WHO), United Nations International Children’s Emergency Fund (UNICEF) and Indian Red Cross (IRC). | | | | | | | | | | | | 6 | | |
| **Text Books** | | | | | | | | | | | | | | | | | | | |
| 1. | | | Mary Jane Schneider (2011) Introduction to Public Health. | | | | | | | | | | | | | | | | |
| 2. | | | Muthu, V.K. (2014) A Short Book of Public Health. | | | | | | | | | | | | | | | | |
| 3. | | | Gibney, M.J. (2013) Public Health Nutrition. | | | | | | | | | | | | | | | | |
| 4. | | | Detels, R. (2017) Oxford Textbook of Public Health (6th edition). | | | | | | | | | | | | | | | | |
| 5. | | | Wong, K.V. (2017) Nutrition, Health and Disease. | | | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | | | |
| 1. | | | S. Lal, (2018), Vikas. Public Health Management Principles And Practice, 2nd  Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2. | | | | | | | | | | | | | | | | |
| 2. | | | Mary-Jane Schneider (2016), Introduction to Public Health,( 5th Edition), Jones &amp;  Bartlett Learning,. ISBN-13: 978-1284197594 | | | | | | | | | | | | | | | | |
| 3. | | | Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), Handbook of  Nutrition and Food, (3rd Edition), CRC Press,. ISBN 9781466505711 | | | | | | | | | | | | | | | | |
| 4. | | | Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), Principles of  Occupational Health and Hygiene: An Introduction, ( 2nd Revised ed. Edition), Allen  &amp;Unwin. | | | | | | | | | | | | | | | | |
| 5. | | | V. Kumaresan, R. Sorna Raj, (2012) Public Health and Hygiene,( 1st Edition), Saras  Publication. | | | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | | | |
| Unit-I | | | https://www.edf.org › health › effects-of-air-pollution  https://en.wikipedia.org/wiki/Health\_education | | | | | | | | | | | | | | | | |
| Unit-II | | | <https://www.narayanahealth.org/blog/importance-of-balanced-diet-for-a-healthy-lifestyle/>  <https://www.healthline.com/health/rickets> | | | | | | | | | | | | | | | | |
| Unit-III | | | <https://www.healthline.com/health/viral-diseases>  <https://www.slideshare.net/prkppt/communicable-disease-85471063> | | | | | | | | | | | | | | | | |
| Unit-IV | | | <https://www.slideshare.net/prkppt/noncommunicable-diseases-85471101>  https://fac.ksu.edu.sa/sites/default/files/12-public\_health\_non\_communicable\_disease\_0.pptx | | | | | | | | | | | | | | | | |
| Unit-V | | | [www.who.int/tdr/publications/documents/glp-handbook.pdf](http://www.who.int/tdr/publications/documents/glp-handbook.pdf)  <https://www.slideshare.net/saurabhsingh1153/unicef-234908488>  <https://www.indianredcross.org/program.htm> | | | | | | | | | | | | | | | | |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | - | 2 | 3 | 3 | 3 | 3 | 3 |
| **CLO2** | 3 | 3 | - | 2 | 3 | 3 | 3 | 3 | 3 |
| **CLO3** | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CLO5** | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 |
| **TOTAL** | 14 | 15 | 4 | 11 | 15 | 15 | 14 | 14 | 15 |
| **Average** | 2.8 | 3 | 0.8 | 2.2 | 3 | 3 | 2.8 | 2.8 | 3 |

<https://www.edf.org › health › effects-of-air-pollution>