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**ANNAMALAI UNIVERSITY**

**(Affiliated Colleges)**

**409 - M.Sc. Biotechnology**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Part** | **Course Code** | **Study Components & Course Title** | **Credit** | **Hours/ Week** | **Maximum Marks** | | |
| **CIA** | **ESE** | **Total** |
|  |  | **SEMESTER – I** |  |  |  |  |  |
| A | 23PBTHC11 | **Core - I:** Biochemistry. | 5 | 7 | 25 | 75 | 100 |
| 23PBTHC12 | **Core - II:** Cell and Molecular Biology | 5 | 7 | 25 | 75 | 100 |
| 23PBTHP13 | **Core - III:** Practical I:Biochemistry and Cell and Molecular Biology | 4 | 6 | 25 | 75 | 100 |
|  | **Elective – I:** |  |  |  |  |  |
| 23PBTHE14-1 | Genetics (or) | 3 | 5 | 25 | 75 | 100 |
| 23PBTHE14-2 | Virology (or) |  |  |  |  |  |
| 23PBTHE14-3 | Basic Analytical Methods |  |  |  |  |  |
|  | **Elective-II :** |  |  |  |  |  |
| 23PBTHE15-1 | Mushroom Cultivation and Apiculture (or) | 3 | 5 | 25 | 75 | 100 |
| 23PBTHE15-2 | Vermiculture Technology(or) |  |  |  |  |  |
| 23PBTHE15-3 | Validation of Medicinal Plants |  |  |  |  |  |
|  |  | **Total** | **20** | **30** |  |  | **500** |
|  |  | **SEMESTER – II** |  |  |  |  |  |
| A | 23PBTHC21 | **Core - IV:** Microbiology | 5 | 6 | 25 | 75 | 100 |
| 23PBTHC22 | **Core - V:** Genetic Engineering | 5 | 6 | 25 | 75 | 100 |
| 23PBTHP23 | **Core - VI:** Practical II: Microbiology and Genetic Engineering | 4 | 6 | 25 | 75 | 100 |
|  | **Elective – III :** |  |  |  |  |  |
| 23PBTHE24-1 | Enzyme Technology (or) | 3 | 4 | 25 | 75 | 100 |
| 23PBTHE24-2 | Diary Technology (or) |  |  |  |  |  |
| 23PBTHE24-3 | Pharmaceutical Biotechnology |  |  |  |  |  |
|  | **Elective – IV :** |  |  |  |  |  |
| 23PBTHE25-1 | Medical Laboratory Technology (or) | 3 | 4 | 25 | 75 | 100 |
| 23PBTHE25-2 | Food and Nutrition (or) |  |  |  |  |  |
| 23PBTHE25-3 | Biodiversity |  |  |  |  |  |
| B (i) | 23PBTHS26 | **Skill Enhancement Course (SEC-I):**  Tissue engineering | 2 | 4 | 25 | 75 | 100 |
|  |  | **Total** | **22** | **30** |  |  | **600** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Part** | **Course Code** | **Study Components & CourseTitle** | **Credit** | **Hours/Week** | **Maximum Marks** | | |
| **CIA** | **ESE** | **Total** |
|  |  | **SEMESTER – III** |  |  |  |  |  |
| A | 23PBTHC31 | **Core VII-** Plant Biotechnology | 5 | 6 | 25 | 75 | 100 |
| 23PBTHC32 | **Core VIII-** Animal Biotechnology | 5 | 6 | 25 | 75 | 100 |
| 23PBTHC33 | **Core IX:** Environmental Biotechnology | 5 | 6 | 25 | 75 | 100 |
| 23PBTHP34 | **Core X:** Practical – III- Plant Biotechnology, Animal Biotechnology & Environmental Biotechnology | 4 | 6 | 25 | 75 | 100 |
| 23PBTHE35-1  23PBTHE35-2  23PBTHE35-3 | **Elective – V:**  Genomics and Proteomics (or)  Herbal Biotechnology (or)  Immunology | 3 | 3 | 25 | 75 | 100 |
| B (i) | 23PBTHS36 | **Skill Enhancement Course (SEC-II):** Gene Manipulation Technology | 2 | 3 | 25 | 75 | 100 |
| B (ii) | 23PBTHI37 | **Summer Internship \*** | 2 | - | 25 | 75 | 100 |
|  |  | **Total** | **26** | **30** |  |  | **700** |
|  |  | **SEMESTER – IV** |  |  |  |  |  |
| A | 23PBTHC41 | **Core XI:** Bioinformatics | 5 | 6 | 25 | 75 | 100 |
| 23PBTHC42 | **Core XII:** Research Methodology | 5 | 6 | 25 | 75 | 100 |
| 23PBTHD43 | Project with Viva-voce | 7 | 10 | 25 | 75 | 100 |
| 23PBTHE44 | **Elective -VI:** Industry /Entrepreneurship  Medical Diagnostics | 3 | 4 | 25 | 75 | 100 |
| B (i) | 23PBTHS45 | **Skill Enhancement Course (SEC-III)/** Professional Competency Skill:  Analytical Biotechnology | 2 | 4 | 25 | 75 | 100 |
| C | 23PBTHX46 | Extension Activity | 1 | - | 100 | - | 100 |
|  |  | **Total** | **23** | **30** |  |  | **600** |

\* Students should complete two weeks of internship before the commencement of III semester.

**Credit Distribution for PG Science Programme**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Part** | **Course Details** | **No. of courses** | **Credit per course** | **Total Credit** |
| **A** | Core Theory | 9 | 5 | **45** |
| Core Practical | 3 | 4 | **12** |
| Elective Course | 6 | 3 | **18** |
| Project Work with VIVA-VOCE | 1 | 7 | **7** |
| **B(i)** | Skill Enhancement Course | 3 | 2 | **6** |
| **B(ii)** | Summer Internship | 1 | 2 | **2** |
| **C** | Extension Activity | 1 | 1 | **1** |
|  |  | 24 |  | **91** |

**Component-wise Credit Distribution**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Part** | **Courses** | **Sem I** | **Sem II** | **Sem III** | **Sem IV** | **Total** |
| **A** | Core (including Practical and Project) | 14 | 14 | 19 | 17 | **64** |
| Elective | 6 | 6 | 3 | 3 | **18** |
| **B(i)** | Skill Enhancement Course | - | 2 | 2 | 2 | **6** |
| **B(ii)** | Summer Internship | - | - | 2 | - | **2** |
| **C** | Extension Activity | - | - | - | 1 | **1** |
|  |  |  |  |  |  | **91** |

**Part A and B(i) component will be taken into account for CGPA calculation for the post graduate programme and the other components Part B(ii) and C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining PG degree**.

**Programme Objectives: (5 Points Compulsory)**

1. To produce competent Biotechnologists who can employ premium processes and applications which will profoundly influence existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society
2. To establish ourselves as a premier biotechnology education, research, and entrepreneurial hub and to impart Biotechnology engineering program based on quality education, research and training
3. To impart quality education to the students and enhance their skills which will make them globally competitive
4. To develop trained biotechnology professionals who can contribute to the continuous improvement of biotechnological services and products
5. To develop scientific and/or technical resources as per biotechnology industry demands

**Programme Educational Objectives: (5 Points Compulsory)**

1. Enable the students to pursue Higher Education such as doctoral & Post doctoral research in reputed National and International Institutes
2. Enable the students to carryout multidisciplinary research activities to execute national & international research projects
3. Find employment opportunities in R&D of Biotech/Pharma industry.
4. To impart knowledge on the importance of intellectual property rights, biosafety and bioethics, information technology for biologists, communication and management skills.
5. This Programme will in turn sculpt the students to fit into the expectation criteria i.e. strategies to achieve company goals and objectives of several biotech industries. In addition, this Programme will enlighten the students to pursue research as their profession.

**Programme Specific Outcomes: (10 Points Compulsory)**

* 1. To enhance student proficiency and encourage them to pursue higher education at reputable National and international levels
  2. The goal of the department is to produce competent, easily employable biotechnologists for the academic, service, healthcare, food, and agricultural sectors.
  3. To foster an innovative and creative mindset in the minds of the next generation in order to direct them towards entrepreneurship and research.
  4. To develop a sense of innovation, creativity and self-confidence to the students in order to help them address the skill gaps in the rapidly expanding field of biotechnology
  5. The student will be able to conduct research in breeding, physiology, production, yield and management of crops and agricultural plants or trees, shrubs, and nursery stock, their growth in soils, and control of pests
  6. The student will be aware of animal experimentation and intellectual property rights.
  7. The student can study the chemical, physical, biological, and mineralogical composition of soils as they relate to plant or crop growth.
  8. The student s can expect jobs at agricultural industries,
  9. The student can scope in manufacturing industries, public and private
  10. The student can be aware of environmental Pollution and its related research

**Programme Outcomes: (10 Points Compulsory)**

1. Students learn about several aspects of biotechnology as part of the knowledge transfer process.
2. Improves Student's capacity to apply their knowledge of a subject to solve current issues on both a local and global scale is a function of their critical thinking abilities.
3. Students will apply their newly learned scientific knowledge for practical purposes in the workplace.
4. Instilling a passion for research and the skills to plan and carry out experiments can help students become more qualified to conduct research.
5. Acquiring technical proficiency to use a variety of sophisticated tools to apply biotechnology to solve complicated biological challenges.
6. Students get fundamental knowledge to evaluate the ethical concerns associated with biotechnology in relation to society, health, safety, legal, and cultural considerations.
7. Students design research problems and conduct individual research projects in specific fields of biotechnology.
8. Students integrate research findings into scientific papers by analyzing the results of their research.
9. Exhibit effective communication skills for interaction with personnel as well as presentation in appropriate forums
10. Demonstrate knowledge for in-depth analytical and critical thinking to identify, formulate and solve the issues related to Biotechnology Industry, Pharma industry, Medical or hospital related organizations, Regulatory Agencies, & Academia.

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE COURSE - I**  **23PBTHC11: BIOCHEMISTRY** | **H/W** | **C** |
| **I** | **7** | **5** |

# **Aim:** To enable the students to understand the basic concepts of biochemistry and biomolecules and also to learn the various metabolic cycles and also to analyze the significance of biochemical findings

**Course Objectives**

1. To learn the physical and chemical nature of Biomolecules
2. To learn various types of biomolecules
3. To develop knowledge on intermediary metabolism of CHO, Proteins, and Lipids
4. To teach the basics and advance of enzymes and their classifications
5. To develop a piece of knowledge in clinical biochemistry.

# **Course Outcomes**

# After studied unit 1, the students will be able to identify the nature of solvents and solutions concerning pH and its important

1. After studied unit 2, the students will be able to classify carbohydrates, proteins lipids, and nucleic acids of biomolecules
2. After studied unit 3, the students will be able to describe the biomolecules involved in intermediary metabolism
3. After studied unit 4, the students will be able to explain enzymes and enzyme kinetics
4. After studied unit 5, the students will be able to apply Biochemistry, in clinical biochemistry procedures.

# **Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | No | Yes | Yes | Yes | No |
| 3 | No | Yes | No | Yes | Yes | Yes |
| 4 | No | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | Basic Concepts: Units of measurements of solutes in solution, e.g. Normality, Molality, Molarity. The hyper and hypotonic solution, pH, pK, acids, bases, ionic bonds, covalent bonds, and secondary bonds (hydrogen bonds and Vander Waal‟ bonds) | **12 hours** |
| **Unit-II** | Biomolecules: Definitions, nomenclature, classification, structure, chemistry, and properties of carbohydrates, Definitions, nomenclature, classification, structure, chemistry, and properties of amino acids and proteins (hemoglobin, myoglobin, and plasma proteins), lipids and Nucleic acids. | **12 hours** |
| **Unit-III** | Metabolism: Metabolism of Carbohydrates, EMP, TCA, HMP. Glycogen metabolism, Gluconeogenesis. Amino Acids- Transamination, Deamination, Urea cycle. Lipids and Nucleic Acids-Their Biosynthesis. Mechanism of Oxidative Phosphorylation and Its Inhibitors, Uncouplers, Photophosphorylation. | **12 hours** |
| **Unit-IV** | Enzymology: Enzymes: general aspects (classifications and structure). The allosteric mechanism, regulatory and active sites, and active energy. Iso-enzymes. Enzyme kinetics (MM, LB plot, Km) and hormones. | **12 hours** |
| **Unit-V** | Clinical biochemistry: Blood sugar level, Factors controlling blood sugar level – hypo, hyperglycemia, Diabetes mellitus, types – GTT. Metabolism of bilirubin- jaundice-types. Differential diagnosis and liver function tests. Renal functional test and gastric function test. | **12 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest lecture** | **05 hours** |
| **Total Teaching hours** | | **65** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

# **Textbook:**

1. J.L. Jain, S. Jain and N. Jain. Fundamentals of Biochemistry. S. Chand & Co, 2016.
2. Ambika Shanmugam. Biochemistry. Published by Wolters Kluwer, 8th Edition, 2016.
3. A.C. Deb. Fundamental of Biochemistry. New Central Book Agency, 2012
4. Biochemistry ,7th Edition, jermy M.Berg John,L .Tymoczko, Lubertstryer 2012.W.H,freeman & company ,newYork 2.
5. Molecular Bio methods handbook,2nd edition R.Rapley & J.M Walker,2 008, Humana press.
6. Principles of Biochmeistry , 5th Edition AL. Lehninger ,D.L. Nelson and M.M Cox ., 2008.worth publishers , NewYork.
7. Biochemistry 4THEdition,G.Zubay,1998.Mc Millan publishing Co.NewYork.
8. Harper‟s Biochemistry,29th Edition-Rober K.Murray,Daryl K.Grammer,2012 McGraw Hill, lange Medical Books.
9. Understanding enzymes -5theditionTrevorpalmer,Prentice Hall/Ellias Horwood1995.
10. Text Book Medical Biochemistry M.N.Chatterjee 8th edition Jaypee brothers Medical publishers 2013

# **Reference Book:**

1. D.L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry, WH Freeman Publishers, 7th Edition, 2017.
2. V.W. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennell and P.A. Weil. Harper’s Illustrated Biochemistry, 30th Edition. McGraw Hill, 2015.
3. Wilson and Walker. Principles and Techniques of Practical Biochemsitry, 6th edition, Cambridge University, Press. 2005.
4. Upadhyaya A Upadhyaya K and Nath. Biophysical Chemistry: Principles and Techniques, 3rd Edition. Himalayan publications, 2009.
5. M.N. Chatterjee and Rana Shinde, Textbook of Medical Biochemistry, 8th Edition. Jaypee Brothers Medical Publishers (P) Ltd., 2012.
6. Biochemistry – 4th edition Donald voet and Judith G.Voet ,VP Publishers 2011 steitz and A.M.Weiner ,The Benjamin /CUMMINGS publ.Co.,Inc.,California,2013
7. Genes VI (9th Ed).Benjamin Lewin, oxford universitypress,uk.,2007 10.
8. Molecular biology of cell (5th edition). Bruce alberts, Alexander johnson, Julianlewis, martinraff, keith Roberts, peter walter, garland science publications. 2008
9. Molecular Biology (5th edition).weaver.R.F, McGraw Hill publications, 2011. Cell and molecular biology : concepts and experiments (5th edition). geraldkarp, wiley publications, 2013.

**Related Online Contents** [MOOC, SWAYAM, NPTEL, Websites, etc.] https://nptel.ac.in/courses/104105076, https://oli.cmu.edu/courses/biochemistry-open-free/, https://onlinecourses.nptel.ac.in/noc20\_cy10/preview,

E-Books: https://[www.pdfdrive.com/biochemistry-books.html](http://www.pdfdrive.com/biochemistry-books.html)

# E-journals: Process Biochemistry (Elsevier), Journal of Cellular Biochemistry (Wiley)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE COURSE - II**  **23PBTHC12: CELL AND MOLECULAR BIOLOGY** | **H/W** | **C** |
| **I** | **7** | **5** |

**Aim:** Understanding the structural and functional aspects of the cell provides the students with a strong foundation in the molecular mechanism underlying cellular functions.

**Course objectives:**

1. To understand the basic concepts of the prokaryotic and eukaryotic cells.
2. To Understand the individual and coordinated functions of various cell organelles.
3. To familiarize the student with various aspects of cell and molecular biology streams including cellular organization and their interactions in DNA replication, protein biosynthesis, and translational regulation
4. To develop a comprehensive understanding of the complete cellular and molecular function of cell organelles in terms of cell-to-cell interaction, gene regulation, cellular signaling
5. To impart the molecular biology knowledge in applications of various human health care.

**Course Outcomes**

1. After studied unit-1, the student will be able to equip with a basic knowledge of the structural and functional properties of cells.
2. After studied unit-2, the student will be able to understand process of cell division and replication process.
3. After studied unit-3, the student will be able to understand the occurrence of central dogma of life in the cell and the machineries involved to initiate and inhibit RNA and protein synthesis.
4. After studied unit-4, the student will be able to control of gene expressions in prokaryotes and eukaryotes and transposable elements.
5. After studied unit-5, the student will be able to understand mechanism of epigenetic controls and cancer biology.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i.Remembering | ii.Understanding | iii. Applying | iv.Analyzing | v.Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | No | Yes | Yes | Yes | No |
| 3 | No | Yes | No | Yes | Yes | Yes |
| 4 | No | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | Cell Biology: Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane - Membrane Model, active and passive, transport channels and pumps., Structure & Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes. | **12 hours** |
| **Unit-II** | Cell division: Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure,Genome Organization. DNA replication: Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models DNA damage, Mutations, DNA repair and recombination. | **12 hours** |
| **Unit-III** | Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post- transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability.Translation-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational  modifications of proteins and localization. | **12 hours** |
| **Unit-IV** | Gene regulation: Prokaryotic gene regulation- Operon concept ; Lac operon and tryptophan operon. Eukaryotic gene regulation: Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins. Biochemistry and applications of ribozyme technologies. Transposable genetic elements. | **12 hours** |
| **Unit-V** | Epigenetics: Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics. Cancer Biology: Viral and cellular oncogenes; Tumor suppressor genes - Structure, function and mechanism of action of pRB and p53, p21, BRACA1.Oncogenes as transcriptional activators. | **12 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lectures** | **5 hours** |
| **Total Teaching hours** | | 65 |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Books**

1. Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books,Inc., 1994.
2. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing Company,1993.
3. Cell and Molecular Biology: Concepts and Experiments 5th Ed,Gerald Karp. Wiley publications, 2013.
4. Cell biology D E SadavaCBS Publishers & Distributors, 2009.

**Reference books**

1. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing Company, 1993
2. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991
3. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford,1991.
4. Molecular Biology of the Gene (4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts,
5. J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California,1987.
6. Genes VI (6th Edition ) Benjamin Lewin, Oxford University Press, U.K.,1998
7. Molecular biology of cell – Albert Bruce et al.,1994 3rdEd
8. Molecular Biology-Weaver. R. F. 3rd ed. Mc Graw Hill publication ,2005
9. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication.2002

**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]**

1. Swayam- Molecular biology course by Dr.Nayan K. Jain, Gujarat University
2. Swayam- Cell Biology by Dr K. Sanatombi
3. NPTEL - Molecular Cell Biology by Prof.D. Karunagaran
4. https://[www.coursera.org/courses?query=molecular%20biology](http://www.coursera.org/courses?query=molecular%20biology)
5. https://[www.cdc.gov/labtraining/training-courses/basic-molecular-biology/index.html](http://www.cdc.gov/labtraining/training-courses/basic-molecular-biology/index.html)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, = 3, M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE COURSE - III**  **23PBTHP13: PRACTICAL-I**  **(Biochemistry and Cell and Molecular biology)** | **H/W** | **C** |
| **I** | **6** | **4** |

**Lab In Biochemistry And Cell & Molecular Biology**

1. Determination of Chl.a, Chl.b & total Chl. By Arnon method.
2. Estimation of Carbohydrates.
3. Estimation of salivary amylase activity in relation to substrate/pH/Temperature.
4. Estimation of blood glucose & urea.
5. Estimation of LDH.
6. Estimation of total serum proteins.
7. Estimation of creatinine in urine.
8. Paper / thin layer chromatography.

**Lab in Cell and Molecular biology**

1. Isolation of Genomic DNA from E.coli
2. Isolation of plasmid DNA from E.coli
3. Elution & quantification of DNA from agarose gel
4. Preparation of competent cells and transformation
5. PCR
6. Isolation of Total RNA from bacteria
7. Synthesis of cDNA by Reverse transcription polymerase chain reaction

**References**

1. Introduction to Practical Biochemistry, E.F Plummer Mu, Plummer Tata McGraw-HillEducation,1998.
2. Molecular cloning: a laboratory manual,4th ed. J.Sambrook, Fritsch and T.Maniatis.coldspring harbor laboratory press ,NewYork,2012
3. Essential cell biology : a practical approach volume 1: cell structure. John Davey,J.Michaellord. Oxford university press, USA,2003
4. Principles and techniques of biochemistry and molecular biology (7th ed).keithWilson(editor), john walker (editor),Cambridge universitypress,2010.

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Discipline Centric Elective – I**  **23PBTHE 14-1: GENETICS** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications in genomics and proteomics.

**Course objectives:**

1. To provide the basic knowledge of genetics in higher eukaryotic domains and over all concepts of Mendelian genetics.
2. To understand about genetic inheritance and linkages
3. To provide the basic concept sex determination
4. To understand about genetic code, mutation and regulations
5. To Enrich the students’ knowledge with respect to genetic engineering, transgenesis and ethics

**Course Out Comes**

1. After studied unit-1, the student will be able to know about Mendelian laws.
2. After studied unit-2, the student will be able to understand how gene inherited
3. After studied unit-3, the student will be able to understand about sex determination.
4. After studied unit-4, the student will be able to gene re1gulations.
5. After studied unit-5, the student will be able to know about ethics and transgenesis.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | History of Genetics: Definition and scope of Genetics- Pre- mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes | **12 hours** |
| **Unit-II** | Blood Groups and their Inheritance in Human – Linkage and Crossing Over:- Drosophila – Morgans‟ Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes – Interference and Coincidence. | **8 hours** |
| **Unit-III** | Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes – Non- Disjunction and Gynandromorphs – Cytoplasmic Inheritance – Meternal Effect on Limnaea(Shell Coiling), Male Sterlity (Rode‟s Experiment) | **9 hours** |
| **Unit-IV** | Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non ambiguous, degenerate triplet code. Fine Structure of the Gene .Gene Regulation – Operon Concept – Lac Operon – Positive and Negative Regulation. Mutation – Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations –  Numerical and Structural Examples from Human. | **8 hours** |
| **Unit-V** | enetic engineering – Objectives, tools, gene cloning, and gene isolation. Transgenic plants and animals, Animal Breeding – Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics- Hardy Weinberg Law – Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and  Ethenics, Bioethics. | **8 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **50 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Books**

1. Gardner et al (1991). Principles of Genetics. John Wiley.
2. Hartl. D.L. A primer of population genetics. III edition, Sinauer associates inc. Sunderland, 2000
3. Human genetics, A. Gardner, R. T. Howell and T. Davies, Published by Vinod Vasishtha for Viva Books private limited, 2008.
4. The science of Genetics by Alan G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald. Sounderscollege publishers.

**Reference Books**

1. Strachan and Read (2003).Human Molecular Genetics. Wiley.
2. Pasternak (2005).An Introduction to Molecular Human Genetics. Fritzgarald.
3. Prichard &Korf (2004).Medical Genetics a ta Glance. Blackwell.
4. Manu L Lothari, Lopa A Mehta, sadhana S Roy Choudhury (2009). Essential of Human Genetics (Universities Press India ltd) Publishing.

**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**

1. https://[www.classcentral.com/course/swayam-genetics-and-genomics-17623](http://www.classcentral.com/course/swayam-genetics-and-genomics-17623)
2. https://nptel.ac.in/courses/102/104/102104052/
3. https://[www.coursera.org/learn/genetics-evolution](http://www.coursera.org/learn/genetics-evolution)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Discipline Centric Elective – I**  **23PBTHE 14-2: VIROLOGY** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** To understand the biology of viruses, pathogenesis, clinical features, epidemiology, and prophylaxis of dreadful viral infections in susceptible hosts.

**Course objectives**

1. Contrast differences in virus architecture and classification.
2. To understand the viral diagnostic and detection methods.
3. Distinguish characteristics of normal cells and virus-infected cells.
4. Explain and apply methods used in research and diagnosis of viral diseases.
5. Describe cellular and therapeutic antiviral strategies and social stigmas against infected individuals.

**Course Outcomes**

1. After studied unit-1, the student will be able to–describe and review the General Virology and cultivation of viruses
2. After studied unit-2, the student will be able to –know the Viral diagnostic and detection methods
3. After studied unit-3, the student will be able to - explain viral replication strategies; and compare and contrast replication mechanisms used by viruses relevant to human disease
4. After studied unit-4, the student will be able to - discuss principles of virus pathogenesis
5. After studied unit-5, the student will be able to - explain host antiviral immune mechanisms at a cellular and molecular level and vaccine strategies and mechanisms of antiviral drugs

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | No | No | No |
| 2 | Yes | Yes | No | No | No | No |
| 3 | Yes | Yes | No | No | No | No |
| 4 | Yes | Yes | No | No | No | No |
| 5 | Yes | Yes | No | No | No | No |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries-icosahedral, polyhedral and helical, structural proteins- matrix proteins and lipoproteins, viral genomic organization and replication- types of nucleic acids, protein-nucleic-acid interactions and genome packaging, Virus related structures-viroids and prions. Cultivation of viruses: Inovo, In vivo, Ex vivo/In vitro. Cytopathic effect-pock forming unit. | **10 hours** |
| **Unit-II** | Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies), electron microscopy, Immuno diagnosis, hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid-based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probe assay. | **08 hours** |
| **Unit-III** | Bacterio phages and plant viruses: Bacterio phage: Morphology, genome organization, classification-Lifecycle-Lytic and Lysogenic Cycle, Head and tail phages-T4 phage- phage-Filamentous Bacteriophages-174-M13,phage therapy for control of bacterial poultry diseases. Viral Disease in Plants: Histological, physiological and cytological changes in infected plants, Behavior of viruses in plants, Methods for detection of plant viruses, Transmission of plant viruses  through vectors-insects, nematodes and fungi. | **13 hours** |
| **Unit-IV** | Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses-pox virus, Herpes Virus, Adenovirus, Hepatitis Virus. RNA Viruses- Picorna Virus, Orthomyxo Virus, Rabies Virus, HIV. Oncogenic viruses; Virus-induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses, Retrovirus mediated oncogenesis. | **08 hours** |
| **Unit-V** | Viral vaccines and anti-viral drugs: Viral vaccines, conventional vaccines-killed and attenuated, Modern vaccines-DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immuno modulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons, 21 designing and screening for antivirals, mechanisms of action, anti retrovirals-mechanism of action and drug resistance. | **05 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest lecture** | **5 hours** |
|  | **Total Teaching hours** | **50** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Reference & Text Books:**

1. Virology principles and application John Carter and Venetia Saunders (2007) John Wiley and Sons publishers.
2. Principles of Virology 4th edition Jane Flint.
3. Real –Time PCR: Current technology and applications 1st edition (2009) edited by Julie Logan *et al*.,
4. Analytical techniques in DNA sequencing edited by Brian K. Nunnally
5. Medical Microbiology: with student consult by Patrick R. Murray Ph.D. (Author), Ken S. Rosenthal PhD Saunders; 7th edition.
6. Antiviral Agents, Vaccines and Immunotherapies. Stephen K. Trying. October 2004. Marcel Dekker.

**Course Material:**

1. International Congress on Taxonomy of Viruses; <http://WWW.ncbi.nlm.nih.gov/ICTV>
2. Knipe David M.,PeterM.Howley, Diane E.Griffin,Rober t A.Lamb,Malcolm A. Martin,BernardRoizman, Stephen E .Straus,(2007),Field’s Virology, 5th Ed. Lippincott Williams &Wilkins
3. Cann Alan j, (2000), DNA virus Replication, Oxford University press
4. https://[www.yourgenome.org/facts/what-is-PCR-polymerase-chain-reaction.](http://www.yourgenome.org/facts/what-is-PCR-polymerase-chain-reaction)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – I**  **23PBTHE 14-3: BASIC ANALYTICAL METHODS** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** To provide knowledge of various analytical techniques in biological research.

**Course Objectives**

1. To learn the principles of the various analytical instrument.
2. To teach the SOP of analytical instruments.
3. To study the different chromatography separation methodologies
4. To study different electrophoresis isolation methodologies
5. To learn advanced microscopic methods in image processing

**Course Outcomes:**

1. After studied unit 1 the students will be able to know the significance of instruments concerning diagnostic procedures.
2. After studied unit 2 the students will be able to handle qualitative and quantitative chromatographic techniques
3. After studied unit 3 the students will be able to handle centrifugation and separate samples for further practical’s/research
4. After studied unit 4 the students will be able to handle different qualitative and quantitative electrophoresis techniques
5. After studied unit 5 the students will be able to handle microscopes and validate microscopic images.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | No | Yes | Yes | Yes | No |
| 3 | Yes | Yes | No | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas- sensing and oxygen electrodes. Elementary details of biosensors. Beer- Lambert law, light absorption, and its transmittance. Basic principles & brief outline of instrumentation of UV- Visible Spectroscopy: Infrared Spectroscopy. NMR. Mass spectrometry. Spectrofluorometric, Flame photometry, Atomic absorption spectrophotometry– Principles, instrumentation, and applications | **10 hours** |
| **Unit-II** | Introduction & classification of chromatography. Theory, instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC, HPLC - detection methods, and systems qualitative and quantitative aspects applications | **08 hours** |
| **Unit-III** | Centrifugation- basic principles-instrumentation-centrifugation units. Nature of particles centrifugation methods and accessories. Sedimentation velocity- sedimentation equilibrium-cell fractionation method. Differential, density gradient, isopycnic, and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Isoelectric focusing, blotting methods, western-southern and northern- applications- methods in life sciences and biotechnology. | **13 hours** |
| **Unit-IV** | General principles. Factors affecting the migration rate – sample, electric field, buffer, and supporting medium. Tiselius moving boundary electrophoresis. PAGE. SDS– PAGE. Pulse-field gel electrophoresis. Cellulose acetate membrane electrophoresis. Agarose gel electrophoresis. | **08 hours** |
| **Unit-V** | Radio isotopic techniques: Introduction to radioisotopes, Detection. Measurement and uses of radioisotopes, Counting efficiency and autoradiography. Principles of microscopy, Fluorescent, Transmission and Scanning electron microscopy, confocal microscopy. Biotechnological applications Microscopy. Microtome analysis and measurement of images. | **05 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest lecture** | **5 hours** |
| **Total Teaching hours** | | **50** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Textbook:**

1. Keith Wilson, John M Walker. Principles and techniques of biochemistry and molecular biology. Cambridge University Press. 7th edition, 2017.
2. Shawney. Practical Biochemistry. Narosa Publishing, 1995.
3. Upadhyaya A Upadhyaya K and Nath. Biophysical Chemistry: Principles and Techniques, 3rd Edition. Himalayan publications, 2009.
4. D. Frifelder and M. Malacinski. Essentials of Molecular Biology, Jones & Bartlett, 5th Edition, 2015.
5. R.D. Braun. Introduction to Instrumental Analysis. Pharma Book Syndicate, 2006.
6. Chatwal and Anand. Instrumental Methods of Analysis. 5th Edition, Himalayan publication, 2007.
7. Jag Mohan. Organic Spectroscopy, Principles and Application. Narosa Publishing House, 2nd Edition, 2007.

**Reference Book:**

1. Principles and Techniques of Practical Biochemistry (Paperback) by KeithWilson (Editor), John Walker (Editor), John M. Walker (Author) “ Fifth Edition2000
2. Introductory Practical Biochemistry (Hardcover).by S. K. Sawhney; RandhirSingh (Editor) 2005
3. Principles of Physical Biochemistry (2nd Edition) by Kensal E van Holde,Curtis Johnson, and Pui Shing Ho (Hardcover – April 16,2005)
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biologyby David M. Freifelder (Paperback – Aug 15,1982)
5. Instrumental Methods of Chemical Analysis by G R Chatwal and S KAnand (Hardcover – Jun1980).

**Course Material:**

* Website links: https://[www.edx.org/course/basic-analytical-chemistry,](http://www.edx.org/course/basic-analytical-chemistry)
* E-Books: <http://shvaiko.ru/wp-content/uploads/2010/02/Analytical-Techniques-Julia-C.-Drees->Alan-H.-B.-Wu.pdf/html, https://[www.uvm.edu/~gpetrucc/courses/chem196/Textbooks/Manahan%20-](http://www.uvm.edu/~gpetrucc/courses/chem196/Textbooks/Manahan%20-)%20Fundamentals%20of%20Environmental%20Chemistry/1491Ch25.pdf,
* E- journals: https://onlinelibrary.wiley.com/series/8247,
* <https://link.springer.com/chapter/10.1007/978-3-642-75490-6_15>

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – II :**  **23PBTHE 15-1: (A) MUSHROOM CULTIVATION AND APICULTURE** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** To exploit possibilities and assist in building up a mushroom cultivation and apiculture industry that will make a significant contribution to the general economy.

**Course objectives**

1. To make the students to know about mushroom and their types.
2. To enable the students to learn the mushroom spawn production conditions.
3. To make the students learn about mushroom cultivation and maintenance.
4. To make the students to know about apiculture scope and bee keeping and types.
5. To enable the students to understand the importance of honey and applications.

**Course Outcomes**

1. The student will be able to differentiate the edible and poisonous mushrooms.
2. The student will be able to develop mushrooms culture conditions.
3. The student will be able to practice the mushroom cultivation and production.
4. The student will be able to practice the bee keeping and culture maintenance.
5. The student will be able to produce and analyze the applications of honey in different Fields.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | History of Mushroom, cultivations and its practice, Introduction to mushroom cultivation, Classification of Mushrooms and different types, Edible Mushrooms, its types and their origin, Poisonous Mushrooms, its types and their origin. | **5 hours** |
| **Unit-II** | Introduction to mushroom cultivation, sources of beds and types, Spawn, Sources, spawn run, cultivation set up, Culture ventilation and humidity management, temperature, lighting, moisture, pH, CO2, Culture chambers preparation, sterilization, Instructions, precautions, handling and sensors. | **5 hours** |
| **Unit-III** | Mushroom cultivation maintenance, conditions, and duration, Spawn collection, preparation, storage, Spawning techniques, Environmental conditions, temperature, moist, Fruiting initiation, monitoring, maintenance and harvest. | **5 hours** |
| **Unit-IV** | Introduction to apiculture, definitions, history, scope, importance of apiculture, Bee Keeping methods practiced in world and in India,  Traditional Bee keeping techniques, Modern Bee keeping methods, Urban Beekeeping methods. | **5 hours** |
| **Unit-V** | Introduction to nutritional product of honey and its constituents, Honey properties biological activities, medicinal values, Applications of Honey in various fields, Honey types and value  added honey products. | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **30 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
2. Tewan and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
3. Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
4. Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.
5. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.
6. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
7. Bisht D.S., Apiculture, ICAR Publication.
8. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi

**Reference Book:**

1. Laidlaw, H.H., 1997. Contemporary queen rearing. Published by Dadant and Sons. R. A. Morse, Rearing queen honey bees. Wicwas press, NY.
2. Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
3. Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S.
4. Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Books.
5. Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & Tomorrows Printers &Publishers, New Delhi.
6. Pandey B P 1996. A textbook of fungi.Chand and Company New Delhi.

**Course Material:**

Website links, e-Books and e-journals:

1.https://books.google.co.in/books/about/Mushroom\_Cultivation\_in\_India.

2.https://books.google.co.in/books/about/Mushroom\_Cultivation\_in\_India.html?id=6AJx99OGTKEC&redirhttps:// books.google.co.in/books/about/Mushroom\_Cultivation\_in\_India.html?id=6AJx99OGTKEC&redir

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – II:**  **23PBTHE 15-2: VERMICULTURE TECHNOLOGY** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** To exploit possibilities and assist in building up a Vermiculture technology in significant contribution to the general economy.

**Course Objectives**

1. To enable the students learn about Vermiculture compositing.
2. To enable the students to know the humus cycle, soil transformation
3. To enable the students analyze the nutritional composition of vermicompost.
4. To enable the students to learn Vermiculture technology.
5. To enable the students to learn the harvest of vermicompost.

**Course Outcomes**

1. The student will be able to understand the Vermiculture and 4R’s of recycling.
2. The student will be able to identify the decomposing organic matter and humus formation.
3. The student will be able to differentiate nutritional value of vermicompost and fertilizer.
4. The student will be able to practice the Vermiculture composting and maintain conditions.
5. The student will be able to produce Vermiculture compost, harvest the compost and application.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | No | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | Introduction to Vermiculture technology, definition, meaning and history, Economic importance of Vermiculture, their value in soil texture, Concept of recycling, Concept of four r’ s reduce, reuse, recycle and restore. | **5 hours** |
| **Unit-II** | Introduction to matter, types of matter, Introduction to Humus, Humus cycle, Sources, quality of products for Humus formation, Ground population, and transformation process in organic matter. | **5 hours** |
| **Unit-III** | Introduction of plant fertilizers, nutritional value and their importance, Vermicompost composition and its nutritional value, Importance of vermicompost as fertilizer for plants, Comparison ofvermicompost with other fertilizers. | **5 hours** |
| **Unit-IV** | Introduction to vermibeds, sources, types, Preparation of vermibeds, measurements, Maintenance of vermicompost, Compositing conditions, moist, temperature, aeration. | **5 hours** |
| **Unit-V** | Vermicompost identification, conditions, and separation, compost packing, sources and methods, Compost storage, conditions and durations, Vermicompost handling and transport. | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **30 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Kevin, A and K.E.Lee (1989) “ Earthworm for Gardeners and Fisherman” (CSIRO, Australia, Division of Soils)
2. Rahudakar V.B. (2004). Gandul khatashivay Naisargeek Paryay, Atul Book Agency, Pune.
3. Satchel, J.E. (1983) “Earthworm Ecology” Chapman Hall, London.
4. Wallwork, J.A. (1983) “Earthworm Biology” Edward Arnold (Publishers) Ltd. London.
5. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India. 2.Bhatnagar & Patla,2007.
6. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi.

**Reference Book:**

1. Bhatt J.V. & S.R. Khambata (1959) “Role of Earthworms in Agriculture” Indian Council of Agricultural Research, New Delhi 2.
2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) “ Verms and Vermicomposting” Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.
3. Edwards, C.A. and J.R. Lofty (1977) “Biology of Earthworms” Chapman and Hall Ltd., London.
4. Lee, K.E. (1985) “Earthworms: Their ecology and Relationship with Soils and Land Use” Academic Press, Sydney. 5. Kevin, A and K.E.Lee (1989) “ Earthworm for Gardeners and Fisherman” (CSIRO, Australia, Division of Soils)
5. Mary Violet Christy,2008. Vermitechnology,MJP Publishers, Chennai.
6. Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.

**Course Material:** website links, e-Books and e-journals

1. Vermiculture Technology, Earthworms, Organic Wastes, and Environmental ManagementEdited By Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman,
2. https://[www.scirp.org/journal/paperinformation.aspx?paperid=2490,](http://www.scirp.org/journal/paperinformation.aspx?paperid=2490) DOI: 10.4236/ti.2010.13019

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – II Generic Centric**  **23PBTHE 15-3: VALIDATION OF MEDICINAL PLANTS** | **H/W** | **C** |
| **I** | **5** | **3** |

**Aim:** The course aims to introduce the students to the identification and validation of medicinal plantand to understand the cultivation and propagation techniques. To understand the importance of medicinal plants in human health care.

**Course Objectives**

1. To enable the students to understand the importance of medicinal plants.
2. To enable the students to identify the medicinal plants.
3. To enable the students to learn the techniques of validation of medicinal plants.
4. To enable the students to learn the cultivation methods and maintenance of medicinal plants.
5. To enable the students to understand the importance of medicinal plant in human health.

**Course Outcomes**

1. The student will be able to gain knowledge about importance of medicinal plant parts and its medicinal value.
2. The student will be able to classify the medicinal plants on Bentham and Hooker and Practice herbarium techniques.
3. The student will be able to identify the medicinal values of plants using different validation Techniques.
4. The student will be able to cultivate and propagate the medicinal plants
5. The student will be able to practice the usage of medicinal plants in treatment of human Diseases.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | No | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit I** | Introduction to Medicinal plants, meaning, definition and types, Medicinal properties of plants and their importance, Medicinal values in plant parts, fruits, stem, leaves and roots, Leaf, fruit, root and stem modifications, aerial and underground. | **5 hours** |
| **Unit-II** | Introduction to Medicinal plant identification, Elementary knowledge of binomial nomenclature, Bentham and Hooker classification, Herbarium, preparation and preservation. | **5 hours** |
| **Unit-III** | Introduction to validation of medicinal plants, Macroscopic characteristics of medicinal plants, Microscopic characteristics of medicinal plants, Chemical compounds and tests of medicinal plants, Chromatographic techniques for validation TLC, HPLC, HPTLC & gas, Chromatography. | **5 hours** |
| **Unit-IV** | Introduction to medicinal plant cultivation, Cultivation techniques, and factors affecting cultivation of medicinal plants, Propagation of medicinal plants and different methods of propagation, Management and Maintenance of medicinal plants. | **5 hours** |
| **Unit-V** | Importance of medicinal value in plants, Medicinal properties of plants in human health and its role, advantages, Role of medicinal plants in prevention and treatment of human diseases, Traditional knowledge and utility of Indian medicinal plants. | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **30 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Indian Medicinal Plants by P.C. Trivedi (2009).
2. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
3. Indian Medicinal Plants (Vol 1- 4) by K.R. Kirtikar and B.D. Basu (2006).
4. Indigenous Medicinal Plants Social Forestry & Tribals by M.P. Singh et al. (2003).
5. Ayurvedic Drugs and their Plant Sources by V.V. Sivarajan & I. Balachandran, Oxford & IBH (1994).
6. The Handbook of Ayurveda Shantha by Godagama, Bishen Singh Mahendrpal Singh, Dehradun (2004).
7. Direct uses of medicinal plants and their identification by Vardhana, Sarup and Sons, Ansari Road, Dariyaganj, New Delhi (2008).
8. Medicinal plants, applied biology of domestication and export by K. Singh, S.K. Tyagi, Bishen Singh Mahendrapal Singh Dehradun.
9. Quality Control Methods for Medicinal Plants Materials, W.H.O. (1998).
10. Evaluation of herbal medicinal products by Houghton

**Reference Book:**

1. A Class Book of Botany. A.C. Dutta. Oxford University Press.
2. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
3. Hartmann, H.T & Kester, D.E (1989). Plant Propagation – Principles and Practices. Prentice Hall of India.
4. Awadesh N, Ghoeami A and Sharma R, Indigenous Health Care and Ethnomedicine, Sarup and Sons.
5. Medicinal Plants Cultivation: A Scientific Approach by S.S. Purohit, (2004).
6. Bruneton Jean, Caroline K. Hatton, Pharmacognosy, Phytochemistry, Medicinal plants. Lavoisier, 1999.ISBN 1898298637.
7. Nikolaus J. Sucher, Maria C. Carles, Genome-Based Approaches to the Authentication of Medicinal Plants. Planta Med., 74: 603–623; 2008.
8. WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants, World Health Organization, Geneva, 2003.
9. Iqbal Ahmad, FarrukhAqil, and Mohammad Owais, Modern Phytomedicine: Turning Medicinal Plants into Drugs. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2006. ISBN-10: 3-527-31530-6.
10. Ved D.K. & Goraya, G.S. Demand & supply of medicinal plants in India, NMPB, New Delhi & FRLHT, Bangalore, India, 2008.

**Course Material:** website links, e-Books and e-journals

1. Planta Medica, Issue 13 · Volume 79 · August 2013. https://www.thieme- connect.com/products/ejournals
2. https://[www.sciencedirect.com/book/9780128008744/evidence-based-validation-of-herbal-medicine.](http://www.sciencedirect.com/book/9780128008744/evidence-based-validation-of-herbal-medicine) 3.https://[www.tandfonline.com/doi/citedby/10.1080/13880200902800196?scroll=top&needAccess=true.](http://www.tandfonline.com/doi/citedby/10.1080/13880200902800196?scroll=top&needAccess=true)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE - IV**  **23PBTHC21: MICROBIOLOGY** | **H/W** | **C** |
| **II** | **6** | **5** |

**Aim**: Studying the diversity and activity of microorganisms in their natural environment, their mutual interactions, and their survival and adaptation strategies.

**Course Objectives**

1. To understand the History of Microbiology.
2. To well understand the Nutritional classification of bacteria, etc.
3. To obtain knowledge about Sterilization and Disinfection.
4. To obtain knowledge of Microbial diversity.
5. To know the basic Microbial community in natural habitats.

**Course Outcomes**

1. After studying unit 1 the students will be able to identify the Classification of microorganisms practical’s.
2. After studying unit 2 the students will be able to identify and differentiate the pure culture technique.
3. After studying unit 3 the students will be able to identify and describe the chemotherapeutic agent
4. After studying unit 4 the students will be able to identify and explain enzymes and their regulations by kinetic parameters
5. After studying unit 5 the students will be able to identify and cross-examine the Biotechnological applications of Extremophiles

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i.Remembering | ii.Understanding | iii.Applying | iv.Analyzing | v.Evaluating | vi.Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | No | No |
| 3 | No | Yes | No | Yes | Yes | Yes |
| 4 | No | No | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | No | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | History of Microbiology - Classification of microorganism – Kingdom - Protista, Prokaryotic and eukaryotic microorganisms, Five kingdom concept of classification, Archaebacteria, Eubacteria, and eukaryotes. Microscope - Light field, Dark field, Fluorescent and Electron microscope, Prokaryotic and Eukaryotic cell structure. Staining techniques- Simple and Differential staining. | **12 hours** |
| **Unit-II** | Nutritional classification of bacteria, Isolation, cultivation, enumeration, and preservation of microbes; Culture media and its types - Pure culture technique - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth. | **12 hours** |
| **Unit-III** | Sterilization and Disinfection: Moist heat, Dry heat, Radiation, Filtration, Phenols, Halogens, Phenol coefficient method. Antibiotics - Inhibitors of Nucleic acid, protein, and cell wall synthesis. Chemotherapeutic agents - Antimicrobial susceptibility test. | **12 hours** |
| **Unit-IV** | Microbial diversity- methods to assess microbial diversity, Culture dependent, and culture-independent methods. Molecular analysis of bacterial community; Denaturating Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T- RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA). | **12 hours** |
| **Unit-V** | Microbial community in natural habitats – air, water, soil, food, and milk. Food and milk-borne diseases, Extremophiles- habitant & Classification, Halophiles, Thermophiles, Alkaliphiles, Acidophiles, Biotechnological applications of  Extremophiles. | **12 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest Lectures** | **05 hours** |
|  | **Total Teaching hours** | **65** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Microbiology 3rd Edition by Dave Wessner (Author), Christine Dupont (Author), Trevor Charles (Author), Josh Neufeld (Author) 3rd edition (December 3, 2020).
2. Fundamentals of Microbiology 12th Edition by Jeffrey C. Pommerville (Author) 12th edition (March 29, 2021)
3. Burton's Microbiology for the Health Sciences 11th Edition by Paul G. Engelkirk (Author) 11th edition (October 10, 2018)
4. Brock Biology of Microorganisms plus Pearson Mastering Microbiology with Pearson eText, Global Edition 15th Edition 15th edition (March 27, 2018)
5. Microbiology: An Evolving Science Fifth Edition by Joan L. Slonczewski (Author), John W. Foster (Author), Erik R. Zinser (Author) Fifth edition (July 1, 2020)
6. Microbiology with Diseases by Taxonomy, Loose-Leaf Plus Mastering Microbiology with Pearson eText -- Access Card Package (6th Edition) 6th Edition 6th edition (January 14, 2019).

**Reference Book:**

1. Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access (Greenwood,Medical Microbiology) 17th Edition by David Greenwood BSc PhD DSc FRCPath (Author), Richard C. B. Slack MA MB BChir FFPHM MRCPath DRCOG (Author), John F. Peutherer BSc MB ChB MD FRCPath FRCPE (Author), & 1 more Churchill Livingstone; 17th edition (June 6, 2007)
2. Microbiology Experiments: A Health Science Perspective Paperback – International Edition, January 1, 2018MC GRAW HILL; 9th edition (January 1, 2018)
3. Hugo and Russell's Pharmaceutical Microbiology, 8th Edition 8th Editionby Denyer (Author) Wiley-Blackwell; 8th edition (August 12, 2011)
4. Clinical Bacteriology Hardcover – August 1, 1980 by E Joan Stokes E Arnold; Fifth Edition (August 1, 1980)
5. Review of Medical Microbiology and Immunology (Medical Microbiology & Immunology (Levinson)) 9th Edition (March 10, 2006)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE COURSE - V**  **23PBTHC22: GENETIC ENGINEERING** | **H/W** | **C** |
| **II** | **6** | **5** |

**Aim:** To modify the genes to enhance the capabilities of the organisms beyond what is normal. Ethical controversy surrounds the possible use of both of these technologies in plants, nonhuman animals, and humans.

**Course Objectives**

1. To understand the basis of Enzyme, Ligases in Genetic Engineering Tools.
2. To well understood the Cloning Vectors.
3. To obtain knowledge about Gene cloning strategies and transformation techniques.
4. To obtain the knowledge of Selection, Screening, and analysis of recombinants.
5. To know the basic Genetic Engineering Techniques- Application of rDNA technology.

**Course Outcomes**

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

1. After studying unit 1 the students will be able to identify the tools which are used in Genetic Engineering and exhibit them their practical’s.
2. After studying unit 2 the students will be able to differentiate methods in Cloning Vector.
3. After studying unit 3 the students will be able to describe the Techniques in Gene cloning – Physical, chemical and methods.
4. After studying unit 4 the students will be able to explain techniques amo recombine recombinants like PCR, DNA sequencing, etc
5. After studying unit 5 the students will be able to analyze and can cross-examine the Genetic Engineering of patients who visit the Lab.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Units | i.Remembering | ii.Understanding | iii.Applying | iv.Analyzing | v.Evaluating | vi.Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | No | Yes | Yes | Yes |
| 4 | Yes | Yes | No | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | No |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching**  **Hours** |
| **Unit-I** | Tools of Genetic Engineering: Enzymes - endo &exo nucleases, Restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action; Isochizomers, Iso customers - star activity, Methylation, and modification. Ligases – types (NAD and ATP dependent), mechanism of action. Role of Kinases, phosphatases, polynucleotide phosphorylase, polynucleotide kinases, terminal transferase, Alkaline phosphatase, Reverse transcriptase - Taq polymerase. | **12 hours** |
| **Unit-II** | Cloning vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. The promoter, MCS, Ori, and Marker genes-lac Z. Construction of pBR 322, pBR325, pBR327, pUC8 , pUC 18 & 19 vectors, and Expression vectors, Bacteriophage vectors, Lambda phage, Insertion vectors, Replacement vectors, Cosmids, Phagemids, Mini chromosomes, BAC‟s, YAC‟s, Shuttle vectors, Ti plasmids, Vectors for animals-SV40 and Bovine  papillomavirus. | **12 hours** |
| **Unit-III** | Gene cloning strategies and transformation techniques: Chimeric DNA, Cloning strategies- ligation, Transformation and selection, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, genomic DNA libraries, Short gun method, Partial digestion, End modification, Cloning from mRNA- Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. cDNA library. Advanced cloning strategies-synthesis and Cloning of cDNA, PCR amplified DNA. Transformation techniques: Preparation of competent cells, Physical methods - Electroporation, Microinjection, Gene gun, chemical methods - PEG, DEAE, CaCl2, calcium  phosphate precipitation method, liposome-mediated method | **12 hours** |
| **Unit-IV** | Selection, screening, and analysis of recombinants: Genetic selection  - Insertional inactivation, Antibiotic Resistant genes, lac Z genes, Blue white screening, α - Complementation, colony hybridization, Immunological screening, Plaque hybridization, Blotting techniques, DNA sequencing - chemical and enzymatic methods, PCR and its variants, Preparation of radio labelled and non - radiolabelled probes and its applications. | **12 hours** |
| **Unit-V** | Applications of rDNA technology: Production of vaccines – Hepatitis B, Edible Vaccine, Hormones – Somatotropin, Humulin, Blood clotting factor VIII, Interferons, Diagnostics of inherited disorders  and infectious diseases, Gene therapy, ADA- Cystic fibrosis. | **12 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest Lecture** | **05 hours** |
|  | **Total Teaching hours** | **65** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Textbook:**

1. Concepts of Genetics (Masteringgenetics) 12th Editionby William Klug (Author), Michael Cummings (Author), Charlotte Spencer (Author), Michael Palladino (Author), Darrell Killian (Author)
2. Genetics: A Conceptual Approach Sixth Edition by Benjamin A. Pierce (Author) W. H. Freeman; Sixth edition (December 19, 2016)
3. Genetics: From Genes to Genomes, 5th edition 5th Editionby Leland H. Hartwell (Author), Michael L. Goldberg (Author), Janice A. Fischer (Author), Leroy Hood (Author), Charles F. Aquadro (Author) McGraw-Hill Education; 5th edition (September 5, 2014)
4. Genetics: Analysis of Genes and Genomes: Analysis of Genes and Genomes 9th Editionby Daniel L. Hartl (Author), Bruce Cochrane (Author) Jones & Bartlett Learning; 9th edition (December 14, 2017)
5. Principles of Genetics 6th Edition by D. Peter Snustad (Author), Michael J. Simmons (Author) John Wiley and Sons; 6th edition (August 23, 2011)
6. An Introduction to Genetic Engineering 3rd Edition, author : Desmonds S.T. Nicholl, University of Paisley May 2008.
7. Gene Cloning and DNA Analysis: An Introduction 7th Editionby T. A. Brown Wiley-Blackwell; 7th edition (January 19, 2016)
8. Biotechnology: Applying the Genetic Revolution 1st Editionby David P. Clark BA (honors)Christ's College Cambridge 1973<br>PhD University of Brsitol (England) 1977 (Author), Nanette Pazdernik Academic Cell; 1st edition (September 19, 2008)

Reference Book:

1. An Introduction to Genetic Engineering (Studies in Biology) 2nd Editionby Desmond S. T. Nicholl
2. Genetically Engineered Foods (Volume 6) (Handbook of Food Bioengineering, Volume 6) 1st Edition by Alexandru Mihai Grumezescu (Editor), Alina Maria Holban (Editor) 2017.
3. Genetically Engineered Foods Hardcover – January 1, 2021 by Armando Mills (Author) ED-Tech Press; 1st edition
4. Genetic Engineering: A Christian Perspective Paperback – December 27, 2019 by Michael Scaife.

Course Material:

* Website links: https://[www.genome.gov/genetics-glossary/Genetic-Engineering](http://www.genome.gov/genetics-glossary/Genetic-Engineering) https://[www.amazon.in/s?k=genetic+engineering+book&hvadid=82669701180826&hvbmt=bp&hvdev=c&hvq](http://www.amazon.in/s?k=genetic%2Bengineering%2Bbook&hvadid=82669701180826&hvbmt=bp&hvdev=c&hvq) mt=p&tag=msndeskstdin-21&ref=pd\_sl\_3hztgcyjhj\_p
* E-journals: Process Biochemistry (Elsevier), Journal of Cellular Biochemistry (Wiley).

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **CORE COURSE - V**  **23PBTHP23: PRACTICAL-II (Microbiology & Genetic Engineering)** | **H/W** | **C** |
| **II** | **6** | **4** |

**Lab in Microbiology**

1. Sterilization techniques
2. Preparation of culture media(Selective and Enriched media)
3. Staining techniques- Simple, Differential, Negative staining and Motility studies
4. Determination of Bacterial growth curve
5. Enumeration of bacteria from environmental samples- soil, water, air and milk.
6. Pure culture techniques - Streak, pour plate and spread plate.
7. Biochemical tests for identification of bacteria (IMViC, TSI, Catalase,Oxidase)
8. Antimicrobial assay, phenol coefficient, agar plate sensitivity method.
9. Water quality analysis – MPN method.
10. Milk quality analysis – MBRT method

**Lab in Genetic Engineering**

1. Isolation of genomic DNA from the given sample and its molecular weightdetermination
2. Isolation of RNA from the given sample and its molecular weightdetermination
3. Isolation of plasmid DNA from the givensample
4. Restriction digestion of Lambda phageDNA
5. Ligation of DNA and analysis byelectrophoresis
6. DNA amplification by PCR andRAPD
7. Preparation of competent cells and transformation by CaCl2 method and Selectionof transformed colony by X-Galmethod
8. Determination of molecular weight of proteins by SDSPAGE

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – III**  **23PBTHE24-1: ENZYME TECHNOLOGY** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To provide knowledge of various enzymes and enzyme technology applied in the industries.

**Course objectives :**

1. To Learn about the classification and structure properties of enzymes
2. To Understand the kinetics, catalysis and inhibitions activities of enzymes
3. To understand physical properties, downstream process and purification of enzymes.
4. To Expedite how enzymes are used as co-factors.
5. To Enrich the students’ knowledge with respect to different applications of Enzymes

**Course Outcomes**

1. After studied unit-1, the student will be able to know about basic knowledge of enzymes
2. After studied unit-2, the student will be able to understand mechanism of enzyme activities
3. After studied unit-3, the student will be able to understand physical properties of enzyme.
4. After studied unit-4, the student will be able to function of enzyme in different processes.
5. After studied unit-5, the student will be able to know various application of enzyme technologies.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | No | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | Introduction to enzymes: History of enzymes, nomenclature and classification of enzymes. Structural features of Enzymes: Chemical nature of Enzymes: amino acids, protein structure: Primary, secondary, tertiary and quartenery structure. Specificity of Enzymes: Types of specificity, the koshland “induced fit” hypothesis, strain or transition-state stabilization hypothesis. | **10 hours** |
| **Unit-II** | Enzyme Catalysis and Kinetics: Factors affecting the rate of chemical reactions, kinetics of un catalyzed chemical reactions, kinetics of enzymes catalyzed reaction, methods for investigating the kinetics of enzyme-catalyzed reaction, nature of enzyme catalysis, inhibition of enzyme activity. | **8 hours** |
| **Unit-III** | Extraction and purification of microbial enzymes : Importance of enzyme purification, different sources of enzymes. Extracellular an intracellular enzymes. Physical and Chemical methods used for cell disintegration. Enzyme fractionation by precipitation(using Temperature ,salt, solvent pH, etc.),liquid-liquid extraction, ionic exchange, gel chromatography, affinity chromatography and other special purification methods, Enzyme crystallization techniques. Criteria of purity of enzymes. Pitfalls in working with pure enzymes. | **12 hours** |
| **Unit-IV** | Enzymes inhibition and Co-factors: Irreversible, reversible, competitive, non-competitive and un-competitive inhibition with suitable examples and their kinetic studies. Allosteric inhibition ,types of allosteric inhibition and their significance in metabolic regulation & their kinetic study Vitamins and their co-enzymes: Structure and functions with suitable examples, Metallo enzymes and Metal ions as co-factors and enzymes activators. | **9 hours** |
| **Unit-V** | Immobilization of microbial enzymes and Enzyme Engineering: Methods viz. adsorption, covalent bonding ,entrapment& membrane confinement and their analytical, therapeutic & industrial applications. Applications of microbial enzymes: Microbial enzymes in textile, leather, wood industries and detergents. Enzymes in clinical diagnostics. Enzyme sensors for clinical processes and environmental analyses. Enzymes as therapeutic agents. | **9 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **50** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Book(s)**

1. Introduction to proteins Structure by Branden and Tooze (1998): GarlandPublishing Group.
2. Biotechnology . Volume 7 A- Enzymes in Biotechnology. 1983 Edited by H.J.Rehm and G.Reed. Verlag Chemie.
3. Methods of Enzymatic analysis by Hans Ulrich, Bergmeyer, AcademicPress.
4. Methods in Enzymology by W.A.Wood, AcdemicPress.
5. Topics in Enzyme and Fermentation Biotechnology by L.N. Wiseman ,John Wileyand sons.

**References Books**

1. Enzymes by palmer(2001): Horwood publishingseries.
2. Fundamentals of Enzymology by price and Stevens (2002): Oxford UniversityPress.
3. Enzyme Technology by Helmut Uling (1998): JohnWiley.
4. Methods in Enzymology. Volume 22-Enzyme purification and related techniques. Edited by William B. Jakoby. Academic press, NewYork.
5. Allosteric Enzymes-Kinetic Behaviour. 1982. By B.I .Kurganov ,John Wiley and Sons. Inc., NewYork.
6. Enzymes as Drugs Edited by John S. Holcenberg and Joseph Roberts, John Wiley& sons NewYork.
7. Advances in Enzmology by Alton Meister, IntersciencePublishers.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – III**  **23PBTHE24-2: DAIRY TECHNOLOGY** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.

**Course objective:**

1. To teach the microbial knowledge in milk
2. To learn the processing of milk microbiological methods
3. To understand how the milk products are in quality make through dairy industry
4. To made knowledge in differentiate the traditional and industrial make dairy products and its processing
5. To aware the students about milk borne diseases

**Course outcome**

1. After studied unit-1, the student will be able to know about basic knowledge of milk microbes and its changes in maintaining the storage of milk.
2. After studied unit-2, the student will be able to understand mechanism of processing of milk through microbiological methods
3. After studied unit-3, the student will be able to understand dairy products quality and its changes through micrbes
4. After studied unit-4, the student will be able to differentiate dairy products in industry and homemade.
5. After studied unit-5, the student will be able to know various application of milk and milk borne microbial diseases.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | Common microbes in milk and their significance .sources of microbial contamination of raw milk in influencing quality of milk during production, collection, transformation and storage. Clean milk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of raw milk. | **12 hours** |
| **Unit-II** | Microbiological processing techniques: bactofugation, thermization  ,pasteurization, sterilization ,boiling ,UHT, non thermal processes and membrane filtration of milk role of psychrophilic mesophilic, thermophilic and thermoduric bacteria in spoilage of processed milks and prevention microbiological standards (BIS/PFA) of heat treated fluid milks. | **12 hours** |
| **Unit – III** | Microbiological quality of dairy products; fat rich (cream and butter),frozen (ice cream),concentrated (evaporated and condensed milk),dried milks(roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution. Pro biotics and pre biotics(GRAS),cloning - sanitation, control of micro organisms in dairy processing | **12 hours** |
| **Unit – IV** | Microbiology quality of traditional dairy products; heat desiccated (khoa, burfi, peda, kheer), acid coagulated (paneer, chhana, rasgulla), fermented (lassi, srikhand)and frozen (kulfi).sources of microbial contaminants and their role in spoilage. Importance of personnel and environmental hygiene on quality of traditional milk products. microbiological standards for indigenous dairy foods. | **12 hours** |
| **Unit-V** | Milk-borne diseases – viral and bacterial, zoonotic infections  ,pathogens associated with fluids milks, dairy products and their public health significance. sources of pathogens and their prevention .importance of bio flims, their role in transmission of pathogens in dairy products and preventive strategies. regulatory control of dairy products, testing of milk and milk products, treatment of dairy wastes. | **12 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **65 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Books:**

1. Adams MR and Moss MO.(1995).food microbiology, the royal society ofchemistry,Cambridge.
2. Andrews AT, Varley J(1994) biochemistry of milk products. Royal society ofchemistry.
3. BanwartGJ(1989),basic food microbiology, Chapman & hall, new York.
4. Frazier WC and Westh off DC.(1988) food microbiology, TATA McGraw hill publishingcompany Ltd. NewDelhi.

**References**

1. Hobbs BC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold(adivision of Hodder and Stoughton),London.
2. May JM. (1987) modern food microbiology, CBS publishers and distributors, NewDelhi.
3. Robinson RK. 1990.the microbiology of milk. Elsevier applied Science.London
4. Edward Harth ,J.T.Steele. Applied dairy microbiology .1998. Marcel DeekerInc.
5. Modi, HA (2009) dairy microbiology pointer publishers, India. Marth, E.H and steel
6. J. L(2001) applied Dairy microbiology, 2nd Edition, Marcel Dekker, Inc.270 MadisonAvenue,new York, New York10016.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – III**  **23PBTHE24-3: PHARMACEUTICAL BIOTECHNOLOGY** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To impart knowledge on the importance of drug during life span. To enlighten on the biotechnological modifications in drugs. To find mechanism of action of drugs used in therapy.

**Course objectives**

1. To learn drugs and its involved detoxification through phase 1 & 2 reactions.
2. To teach drug mechanism like passive and active phases
3. To learn the drugs manufacture biotechnological pharmaceutical industry
4. To understand the importance of drugs in treating various metabolic disorders
5. To teach various applications of drugs in various fields.

**Course outcomes**

1. After studied unit-1, the student will be able to know about basic knowledge of drugs of phase I & II
2. After studied unit-2, the student will be able to understand drug mechanism and its adverse effects.
3. After studied unit-3, the student will be able to understand biotechnology in drug development, especially for AIDS
4. After studied unit-4, the student will be able to know drugs and its importance various treatment like diabetes, cancer, lipidemia and infertility
5. After studied unit-5, the student will be able to know various application of drug dependence and abuse- management

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | Drug- structural feature and pharmacology activity, pro drug concept. Absorption – first – pass effect .distributor , metabolism- phase I, II reactions, action of cyto chrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug- receptor interaction, against & antagonist . | **10 hours** |
| **Unit-II** | Adverse response to drugs, drug tolerance, drug intolerance, Idio SYNERACY (pharmacogenesis), drug allergy. Tachyphylaxis, drug abuse, vaccination against infection | **08 hours** |
| **Unit – III** | Biotechnology and pharmacy: genetically engineered protein and peptide agents. novel drug delivery systems – non conventional routes of administration. Anti AIDS drug development, oncogenes target for drugs, multi- drugs resistance. | **13 hours** |
| **Unit – IV** | Mechanism of action of drugs used in therapy of :respiratory system-cough, bronchial- asthma, pulmonary tuberculosis. GIT– digestents, appetite suppressants. hypolipidemia agents,, vomiting, constipation and peptic ulcer. antimicrobial drugs- sulfonamide s, trimethoprim, cotrimoxazole, penicillin and macrolides. amino glycosides, cephalosporin and bacterial resistance. Insulin and oral diabetic drugs, anti fertility and ovulation inducing drugs. | **08 hours** |
| **Unit-V** | Drugs of plant origin: drug dependence and abuse- management of self poisoning cancer. Chemotherapy- cytotoxic drug. immuno suppressive drug therapy. New biological targets for drug development. Novel drug screening strategies. | **08 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Teaching hours** | **50 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Book:**

1. The pharmacology Vol I and Vol II– Goodman and Gillman, Mc Graw Hillprofessional;12 ed (2010)
2. Basic pharmacology – Foxter cox bulter worth‟s1980.
3. Pharmacology and pharmaco therapeutics – R.S.Satoskar, S.D.Bhandhhakar & S.S.Anilapure popular Prakashar Bombay.

**References**

1. Principles of medical chemistry – William O. Foge. B.I. Waverks Pvt Ltd, NewDelhi.
2. Oxford text books of clinical pharmacology and drug therapy. D.G.Burger‟s Medicalchemistry & drugdiscovery.
3. Principles and practice – Manfred. E. Wolf John Wiley andsons.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – IV**  **23PBTHE25-1: MEDICAL LABORATORY TECHNOLOGY** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To enable the students to learn about the General laboratory and instrumentation. Know the significance of biological samples examination & understand the various types of infection and clinical symptoms caused by microorganisms.

**Course objectives**

1. To teach the physical and chemical nature of Body fluids
2. To teach the safety measures in diagnostic laboratory
3. To learn knowledge about laboratory techniques
4. To learn hematology and pathology laboratory techniques
5. To teach advanced methods in collection and storage, preparation, analysis of body fluids, and results.

**Course outcomes:**

1. After studied unit 1 the students will be able to follow safety precautions in the diagnostic laboratory.
2. After studied unit 2 the students will be able to general laboratory and instrumentation.
3. After studied unit 3 the students will be able to know the significance of biological samples and their importance in the examination
4. After studied unit 4 the students will be able to understand the various types of infection and clinical symptoms caused by microorganisms.
5. After studied unit 5 the students will be able to analyze and can cross-examine the Haematology tests of patients who visit the hospital.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | No | Yes | Yes | Yes | No |
| 3 | Yes | Yes | No | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | General Laboratory and instrumentation: Code of conduct for laboratory personnel-safety measures the laboratory-chemical/Reagents, labeling, storage, and usage. First aid in laboratory accidents-Precautions and first aid equipment. Sterilization, and preparation of reagents. The general approach to quality control, quality control of quantitative data | **5 hours** |
| **Unit-II** | Clinical pathology: Urine analysis: Collection, composition, preservation, gross examination, chemical examination. Significance of sugar in the urine, ketone bodies, bile pigment, hematuria, uric acid, microscopic examination of the urinary sediment: stool Examination-specimen collection, pH, Interfering substance. Test for occult blood, fecal fat, and microscopic examination of a stool specimen. | **5 hours** |
| **Unit-III** | Clinical Hematology: Collection of blood-Anticoagulant, preservation Estimation of Hb, PCV, WBC (TC & DC), RBC, platelets, ESR Clotting time, bleeding time-normal value, clinical interpretation Serology-VDRL, CRP, RA, HIV, HBs Ag. | **5 hours** |
| **Unit-IV** | Histology: Basic concepts of different mammalian tissues and their histological structure. Different human organs and their gross and histological structure and functions. Receiving of biopsy specimens at the laboratory (Clinical notes/fixatives). Fixation of tissue –different fixatives and their mode of action.Methods of decalcification.Use of microtomes, selection, and maintenance of knives, the technique of section cutting &mounting on slides. Staining of tissue sections, preparation of different stains, staining methods for Haematoxylin& Eosin. | **5 hours** |
| **Unit-V** | Blood banking: blood group(ABO & Rh)-methods of grouping & reverse grouping. Basic blood banking procedures- a collection of blood, anticoagulants used, cross-matching, different screening, Tests including Coomb‟s Test for incomplete antibodies preparation of different blood components for use and how to serve a requisition. preparation of red cell suspension. Blood transfusion & hazards. Detect the time when to discard blood in the blood bank, computerized record. | **5 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest lecture** | **05 hours** |
|  | **Total Teaching hours** | **30** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Textbook:**

1. Medical Laboratory Technology-6th edition, L.Mukherjee. vol. I, II, III. 2010. Tata Mcgraw-Hill publishing company limited.
2. Hand book medical laboratory technology 2nd edition-V.H.Talib CBS publishers & 2008.
3. Clinical laboratory practices in CMC procedure, CMC, Vellore
4. Text book of Medical lab technology, 1st Edition-Ranmniksood.jaypee, 2006.
5. Laboratory manual in biochemistry-Jayaraman New Age International Pvt Ltd publishers. 2011.

**Reference Book:**

1. Kanai L. Mukherjee and Anuradha Chakravarthy, Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests, Vols. I, II and III. Tata McGraw Hill Publishing Company Ltd., 2017.
2. Ramnik Sood, Concise Book of Medical Laboratory Technology Methods and Interpretations. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi, 2015.
3. N. Pattabiraman. Laboratory Manual in Biochemistry, 4th Edition. All India Publishers & Distributors, 2015.
4. Namita Jaggi. Microbiology Theory for MLT. 2nd Edition. Jaypee Brothers Medical Publishers (P) Ltd., 2013.
5. Alan H. Lowenclock. Varley’s Practical Clinical Biochemistry, 6th Edition. CBS Publishers and Distributors, 1988.

**Course Material:**

1. Website links: https://library.fvtc.edu/MLT/Links,  
   <https://libguides.gvsu.edu/MLS/websites>,
2. E-Books: https://[www.pdfdrive.com/medical-laboratory-technician-e23958474.html,](http://www.pdfdrive.com/medical-laboratory-technician-e23958474.html)
3. E-journals:https://onlinelibrary.wiley.com/journal/10982825, <https://academicjournals.org/journal/JMLD>.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Generic Centric Elective – IV**  **23PBTHE25-2: FOOD & NUTRITION** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

**Course objectives**

1. To enable the students to learn the basic concepts of nutrition and different categories of foods.
2. To enable the students to gain knowledge of different nutrient contents and their importance.
3. To make them learn the basics of nutritive and calorific value.
4. To enable the students to know food adulterants and food poisoning, disadvantages & health problems.
5. To enable the students learn the food spoilage and preservation methods.

**Course Outcomes**

1. The student will be able to differentiate the foods types and their nutritive value.
2. The student will be able to develop competence to carry out investigation in nutrition
3. The student will be able to measure and calculate calorific value of different types of foods
4. The student will be able to identify the food adulterants and food poisoning
5. The student will be able to practice food sterilization, preservation and processing.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | Definition and basis of food and nutrition, Different Food groups and classification, Nutritional significance and physiological role of food groups, Protein Energy Malnutrition (PEM), definition and types, Treatment and preventive measures of PEM. | **5 hours** |
| **Unit-II** | Introduction to Vitamins., Fat soluble vitamins, Water soluble vitamins | **5 hours** |
| **Unit – III** | Introduction to calorific value and nutritive value, Bomb calorimeter, Measurement of calorific value and nutritive of foods, RQ value, BMR and SDA of food stuffs, their measurements and influencing factors, Nutritive value of proteins and amino acids, Balanced diet, composition of balanced diet for pregnant woman, infants, old age. | **5 hours** |
| **Unit – IV** | Definitions of food adulterations and food poisoning, Sources of foods and types of adulterants, advantages and disadvantages of adulteration, Constituents of foods, carbohydrates, proteins, fats, oils, Flavours, colours and natural toxicants, Sources causes and remedies for acidity, gastritis, indigestion and constipation. | **5 hours** |
| **Unit-V** | Introduction to food spoilage, food preservation and food processing, Causes and types of food spoilage, types of food preservation and food processing, Food sterilization and pasteurization. | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lectures** | **05 hours** |
|  | **Total Teaching hours** | **30** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Albanese, Anthony A Ed, Protein And Amino Acid Nutrition Academic Press New York 1959.
2. Devlin T.M., Biochemistry by Stryer Text book of Biochemistry with clinical correlations.
3. Lehninger, Principles of Biochemistry, by 4th Ed. By Nelson D.L. and Cox. M.M. 6
4. Murray R.K., Grammer, D.K., Mayer P.A., Rodwell V.W., Harpers Biochemistry, a lange medical book 26th Ed. Mc. Graw Hill, Health Professions Division.
5. West. E.S., Todal, W.R., Mason H.S. and Van Brygen J.T., Text Book of Biochemistry.
6. Mayer, J., Human Nutrition, Charles, C. Thomas, spring field.
7. Michael, J. Gibney, Barrie, M. Margetis, John, M. Kearney. Lenore Arab. Public Health Nutrition. Blackwell science, Blackwell Publishing Company (2004).
8. Frazier, We, Food Microbiology, Tata Mc Graw Hill 1978.
9. Meyer, Lilian H. Ed. (1987), Food chemistry. Indian Ed. CBS Publishers and Distributors
10. Barker, D.J. P (1998), Mothers, Babies and Health in later life. Edinburgh, Churchill livingstone.
11. Ward, R.H.T; Smith, S.K. Donnai, D. (Eds.) (1994) Early fetal Growth and Development. London, & COG Press.
12. Wallace, H.M. and Giri, K. (1990), Health care of women and children in developing countries, third party publishing co.Oakland.

**Reference Book:**

1. Seema yadav: - Food Chemistry, anmol publishing (P) Ltd, NewDelhi
2. Car H.Synder: -the extraordinary chemistry for ordinary things, John Wiley & sonsinc, NewYork,1992.
3. B.Sivasankar – food processing and preservation – PHI learni9ng (P) LTD , New Delhi – 11001.

**Course Material:** website links, e-Books and e-journals: https://chico-primo.hosted.exlibrisgroup.com

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Elective – IV**  **23PBTHE25-3: BIODIVERSITY** | **H/W** | **C** |
| **II** | **4** | **3** |

**Aim:** To enable students to gain a deeper understanding about the every living things including plants, bacteria, animals and humans .and enormous variety of life on Earth.

**Course objectives**

1. To learn the basic concepts of ecosystem and ecology
2. To teach various biodiversity across the country and globe face.
3. To understand the History, guiding principles, conservation of ecology and biodiversity as per ICUN.
4. To learn the importance of pollution damages environmental through how it influence biodiversity
5. To teach and understand how water pollution affects environment and its remedies.

**Course outcomes**

1. After studied unit-1, the student will be able to understand the ecosystem and environment.
2. After studied unit-2, the student will be able to understand various types of biodiversity.
3. After studied unit-3, the student will be able to Understand History, guiding principles, conservation challenges and models of conservation biology.
4. After studied unit-4, the student will be able to Gain knowledge of biosafety and risk assessment of Environmental Pollution.
5. After studied unit-5, the student will be able to Understand Water conservation, Rain water harvesting and disaster management of biodiversity.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i.Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit-I** | Ecosystem concept Introduction and overview of ecosystem ecology - History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change,  Trophic dynamics and temporal dynamics, Ecological efficiencies | **5 hours** |
| **Unit-II** | Biodiversity and its origin, Global and local trends , Mega biodiversity countries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity. | **5 hours** |
| **Unit – III** | History, guiding principles, conservation challenges and models of conservation biology. IUCN Red list categories and criteria, habitat management and establishment of wildlife corridors and protected areas, bio-indicators. Biosphere reserves, in situ and ex situ conservations (sanctuaries, national parks, zoological parks, botanical gardens, oceanorium). | **5 hours** |
| **Unit – IV** | Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment Protection Act: Air, water, forest and wild life acts, issues involved in enforcement of environmental legislation. | **5 hours** |
| **Unit-V** | Water conservation, Rain water harvesting & watershed management, and environmental ethics. Climate change, global warming, acid, rain, ozone layer depletion. Environmental protection act, population explosion. Disaster management. | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments, Seminars and Guest lectures** | **5 hours** |
|  | **Total Teaching hours** | **30 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Textbooks**

1. Alcock J. 2013. Animal Behavior: An Evolutionary Approach, 10th edition (Sinauer Associates,Inc.)
2. Bolhuis J J and L Giraldeau (eds) 2005 The behaviour of animals (BlackwellPub.)
3. Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press) 4. Burnse D (ed.) 2001 Animal: the definitive visual guide to worlds‟ wildlife (Cambridge UniversityPress)
4. Collen B, Pettorelli N, Baillie J E M and Durant S M (Eds) 2013 Biodiversity Monitoring and Conservation: Bridging the Gap Between Global Commitment and Local Action(WileyBlackwell)
5. GL. Karia and R.A. Christian, West Water Treatment, Concepts and Design Approach, Prentice Hall of India,2005.
6. Benny Joseph, Environmental Studies, Tata McGrawHill, 2005

**Reference book**

* Introduction to bioethics (2018), 2nd edition by J.A. Bryan

**Related Online Contents** [MOOC, SWAYAM, NPTEL, Websites etc.]

* <https://swayam.gov.in/nd1_noc20_hs18/preview>
* https://nptel.ac.in/courses/109/106/109106092/
* <https://onlinecourses.nptel.ac.in/noc20_hs18/preview>
* https://nptel.ac.in/courses/102/104/102104068/
* https://[www.futurelearn.com/courses/biosecurity](http://www.futurelearn.com/courses/biosecurity)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Skill Enhancement Course (SEC-I):**  **23PBTHS26: TISSUE ENGINEERING** | **H/W** | **C** |
| **II** | **4** | **2** |

**Aim:** The subject imparts knowledge on the fundamentals of tissue and its function. The student will be provided with a basic knowledge and understanding about the functions of tissue and its biomedical applications.

**Course objectives**

1. To learn the basic concepts of Tissue Engineering
2. To teach various knowledge to create tissue culture methods.
3. To understand the medical application of tissue Engineering uses.
4. To learn and examine the benefits of Tissue Engineering & Pharmaceutical Products
5. To teach and understand the essential of tissue engineering and its applications.

**Course Outcomes:**

1. After studied unit-1, the students will able to understand the basics of Basics of Tissue Engineering
2. After studied unit-2, the students will able to apply the knowledge to create tissue culture methods
3. After studied unit-3, the students will able to acquire adequate knowledge in the use of tissue in medical application
4. After studied unit-4, the students will able to evaluate the benefits of Tissue Engineering & Pharmaceutical Products
5. After studied unit-5, the students will able to analyze the importance of applications of tissue engineering

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i.Remembering | ii.Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | No |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching Hours** |
| **Unit-I** | Basic biology of tissue engineering: The basis of growth and differentiation-morphogenesis and tissue engineering | **5 hours** |
| **Unit-II** | In vitro control of tissue development-Growth factors-Tissue engineering bioreactors- In vitro synthesis of Tissue and organs- Organotypic and histotypic engineered tissues. 3D cell culture-Tissue assembly in microgravity | **5 hours** |
| **Unit-III** | Biomaterials in tissue engineering-Scaffolds, extracellular matrix, polymers and nanocomposites. Approaches to transplanting engineered cells | **5 hours** |
| **Unit-IV** | Bioartificialpancrease, Hepatassist liver support system, Artificial Womb, Heamatopoietic system: Red blood cell substitutes, Renal replacement devices | **5 hours** |
| **Unit-V** | Structural tissue engineering-Bone regeneration through cellular engineering, Skin tissue engineering, Brain implants-Neural stem cells, Periodontal applications | **5 hours** |
| **Unit-VI** | **Internal Assessment: Assignments and Seminars** | **5 hours** |
|  | **Total Teaching hours** | **30 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Reference Books:**

1. Sylvia, S. Mader, 2011, Human Biology, Twelfth edition, McGraw Hill, USA.
2. Robert P. Lanaza, Robert Langer and Joseph Vacanti, 2007. Principles of Tissue Engineering. Third edition Academic Press.
3. Micklem.H.S.,LoutitJohn.F., 2004, Tissue grafting and radiation, Academic Press, New York..
4. Penso.G., Balducci.D., 2004.Tissue cultures in biological research,Elsevier, Amsterdam
5. Cecie Starr, 1996, Biology, Third edition , Wordsworth, America.

**Useful Websites:**

* [www.nuigalway.ie/anatomy/tissue\_engineering.html](http://www.nuigalway.ie/anatomy/tissue_engineering.html)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE COURSE - VII**  **23PBTHC31: PLANT BIOTECHNOLOGY** | **H/W** | **C** |
| **6** | **5** |
| **Part A** |

**Aim**: This paper has been designed to give the students comprehensive knowledge about the applications of plant Molecular biotechnology for increasing agricultural production, environment improvement, human, nutrition and health. Help students to get a career in both industry/R & D.

**Course objectives**:

1. To Understand the role of plants nuclear, chloroplast and mitochondrial genomes and Equip students with knowledge on molecular markers and marker-aided breeding
2. To Understanding the mechanism of gene transfer in plant and various methods of gene transfer
3. To understand various Components of plant genetic engineering
4. To Expedite the students to understand the techniques involved in plant tissue culture
5. To Enrich the students’ knowledge with respect to different applications of transgenic technology

**Course Out Comes**

1. After studied unit-1, the student will be able to know about genomic organization in plants and about the Markers
2. After studied unit-2, the student will be able to know methods of gene transfer in plants
3. After studied unit-3, the student will be able to understand the plant genetic engineering aspect
4. After studied unit-4, the student will be able to know plant cell and tissue culture techniques
5. After studied unit-5, the student will be able to understand Applications of plant Biotechnology in various fields.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **UNIT- I** | Genome organization in Plants:  Nucleus, Chloroplast and Mitochondria, Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Strand Conformational Polymorphism), AFLP, QTL, map based cloning, molecular marker assisted  selection. | **12 hours** |
| **UNIT-II** | Methods of gene transfer in plants:  Structure and function of Ti plasmid of Agrobacterium, Mechanism of T-DNA transfer to plants. Ti plasmid vectors for plant transformation. Transient and stable gene transformation. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation and floral dip  method. | **12 hours** |
| **UNIT – III** | Plant Genetic Engineering :  Plant vectors: Co-integrate, binary vectors and viral vectors. Designing gene constructs - Promoters and polyA signals, Protein targeting signals, Plant selectable markers, Reporter genes. Positive selection, Selectable marker elimination, Transgene silencing. Transplastomics: Chloroplast transformation: advantages. Strategies for marker free transformation. Analysis of transgenic  plants. Genome editing technology in Plant- CRISPR/Cas. | **12 hours** |
| **UNIT – IV** | Plant Cell and Tissue Culture: Tissue culture media (composition and preparation), Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis. Embryo culture and embryo rescue. Artificial seeds. Protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants. Cryopreservation  and DNA banking for germplasm conservation. | **12 hours** |
| **UNIT-V** | Application of transgenesis for:  crop improvement: Insect resistance, disease resistance, virus resistance, herbicide resistance, and resistance to biotic & abiotic stress. Transgenesis for male sterility and terminator seed. Transgenesis for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients. Molecular pharming: Exploitation of Biotechnological techniques for plant therapeutic compounds - production of recombinant proteins in plants. Expression of antibodies in plants for immunotherapy. Expression of recombinant antibody fragments in plants. | **12 hours** |
| **UNIT - VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Lecture hours** | **65 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Book(s)**

1. Plant Biotechnology: The genetic manipulation of plants. Second edition.Slater, Scott, and Fowler, 2008, Oxford University Press, UK.
2. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A. Gonzales.1994. Oxford University Press. UK.
3. An Introduction to Plant Tissue Culture, Third Edition, M.K. Razdan, Oxford and IBH Publishing Co., 2003.
4. Introduction ton plant biotechnology, Third edition, H S Chawla, 2009. Cassells, A. C and Peter B. Gahan. (2006).
5. Dictionary of Plant Tissue Culture. Food Products Press, an Imprint of the Haworth Press, Inc., New York-London-Oxford.
6. Adrian Slater, Nigel Scott and Mark Fowler. (2008). Plant Biotechnology – the Genetic Manipulation of Plants. Second Edition. Oxford University Press. Paul Christou and Harry Klee. (2004).
7. Handbook of Plant Biotechnology, 2nd volume set, Wiley publisher.
8. Bhojwani and Dantu, (2013). Plant Tissue Culture: an Introductory Text, Springer, New Delhi.
9. Bhojwani, S.S and Razdan. M.K. (2009). Plant Tissue Culture-Theory and Practice. Elsevier India Pvt. Ltd.

**Reference Books:**

* 1. Slater A, NW Scott, MR Fowler. Plant bio technology, Oxford University Press,2003.
  2. Hans Walter Heldt. Plant Biotechnology & Molecular Biology, Oxford University Press, 1997.
  3. Nigel W. Scott, Mark R. Fowler,Adrian Slater. Plant Biotechnology: The genetic manipulation of plants 2nd Edition 2nd Edition, Oxford University Press,2008.
  4. J. Hammond, P. McGarvey,V. Yusibov. Plant Biotechnology: New Products and Applications 1sted. Springer1999.
  5. Bob Buchanan,Wilhelm Gruissem, Russell Jones. Biochemistry & Molecular Biology of Plants. I.k. International Pvt. Ltd,2007.
  6. Robert J. Henry. Practical Applications of Plant Molecular Biology. Routledge Chapman & Hall,1997.
  7. Introduction to Plant Biotechnology by H.S. Chawla, 2002. Oxford and IBH P Publishing Co.Pvt. Ltd. NewDelhi.
  8. Plant molecular genetics by Monica. A. Hughes.1999. Pearson Education limited, England.
  9. An introduction to genetic engineering in plants, Mantel S.H, Mathews J.A. Mickee R.A.1985. Blackwell Scientific Publishers.London.
  10. Scott and Mark R. Fowler, 2003, Oxford University press, UK. 11. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press,UK.
  11. Gonzales.1994.Oxford University Press. Oxford. 4. Plant Molecular Biology by Donald Grierson and S.V. Convey.1984. Blackie and Son.
  12. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A.

**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites, etc.]**

* https://nptel.ac.in/courses/102/103/102103016/
* https://[www.mooc-list.com/tags/biotechnology](http://www.mooc-list.com/tags/biotechnology)
* https://[www.coursera.org/courses?query=biotechnology](http://www.coursera.org/courses?query=biotechnology)
* https://[www.intechopen.com/books/genetic-transformation](http://www.intechopen.com/books/genetic-transformation)
* https://link.springer.com/book/10.1007% 2F978-3-662-07424-4
* https://link.springer.com/book/10.1007%2F978-81-322-1026-9
* https://[www.ebook777.com/plant-](http://www.ebook777.com/plant-) tissue-c

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S–Strong, M–Medium, L–Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE COURSE - VIII**  **23PBTHC32: ANIMAL BIOTECHNOLOGY** | **H/W** | **C** |
| **6** | **5** |
| **Part A** |

**Aim:** To provide an overview and current developments in different areas of animal Biotechnology and its application

**Course Objectives**

* 1. To provide the basic knowledge on cloning methods, animal tissue culture techniques and applications of genetic engineering to the students.
  2. To obtain the knowledge of research related Various laboratory animals
  3. To know the advanced methods in animal handling according to CPCSEA guidelines
  4. To provide an overview and current developments in different areas of animal Biotechnology and its application.
  5. To obtain knowledge on difference between in vivo & in vitro for uses of animal modelling

**Course Out Comes**

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

* + 1. After studied unit-1, the student will be able to know about the genetic engineering tools, vectors, methods of gene cloning.
    2. After studied unit-2, the student will be able to know techniques and application of animal in rDNA technology
    3. After studied unit-3, the student will be able to understand about the animal tissue culture
    4. After studied unit-4, the student will be able to know how to conduct research in breeding, physiology, production, yield and management of crops and agricultural plants or trees, shrubs, and nursery stock, their growth in soils, and control of pest
    5. After studied unit-5, the student will be able to understand applications of animal biotechnology

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **UNIT-I** | Introduction to animal tissue culture. Mammalian cell culture, Tissues, Continuous cell lines, Suspension cultures, Cryopreservation and transport of Animal germplasm, (Embryo, Semen and ovum). | **12 hours** |
| **UNIT-II** | Cell cultures media and Growth parameters of animal cell culture, Role of serum and essential supplements to medium and their applications. Cell Synchronization, Cell cloning Methods and Micromanipulation. | **12 hours** |
| **UNIT – III** | Gene transfer in animal cells. Animal Germ cell and development, Valuable genes for Animal biotechnology, Transgenic Animals and Hybridization, and gene knockout, Somatic cell cloning Production of transgenic animals – mice, sheep and fish. | **12 hours** |
| **UNIT – IV** | Testing of drugs, testing the toxicity of environmental pollutants in cell culture, Cytotoxicity, Apoptosis, Tissue, Diagnostic antigens | **12 hours** |
| **UNIT-V** | Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry, transgenic insects as bioreactor. Commercial scale production of animal cells, application of animal cell culture for in vitro, cultures technology in production of pharmaceutical proteins, and animal viral vaccines. | **12 hours** |
| **UNIT-VI** | **Internal Assessment: Assignments, Seminars and Guest lecturers** | **5 hours** |
|  | **Total Lecture hours** | **65 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Culture of Animal cells, 2006, 3rd Edition, R. Ian Freshney . A John Wiley &Sons, Inc., publications.
2. Animal Cell Culture – Practical Approach, R.W. Masters, Oxford. AnimalCell Culture Techniques. Ed. Martin Clynes, Springer.
3. Biotechnology by Kashav. T (Wiley EasternLtd).
4. Animal Cell Biotechnology; Methods and protocols, Nigel Jenkins, HumanaPress.
5. Biotechnology of Animal Tissue. P.R. Yadav & Rajiv Tyagi, 2006. Discovery 54 publishing House. New Delhi.
6. From Genes to Clones Introduction to Gene Technology – Winnacker, E.L.1987., Panima Educational Book Agency, New Delhi.
7. Gene VII – Benjamin Lewin, 2000. Oxford University Press, UK.
8. Principles of Gene Manipulation and Genomics – Primrose, S.B. and Twyman, R.M. 2006. 7th Edition. Blackwell PublishingCompany.
9. Recombinant DNA Second Edition – James D. Watson, Micheal Gilman, MarkZoller, 2001. W.H. Freeman and Company, NewYork.
10. Biotechnology, Satyanarayanan .U, (2008), Books and Allied (p)Ltd.

**Reference Book:**

* 1. CPCSEA Guidelines for Laboratory Animal Facility, CPCSEA, 2003.
  2. Kumar, H.D. Modern Concept of Biotechnology. Vikas Publishing House Pvt. Ltd., 2007
  3. Animal Biotechnology: Models in Discovery and Translation, Second Edition (Elsevier)

**Course Material:**

Website links:

<https://www.sciencedirect.com/book/9780128117101/animal-biotechnology#book-description>

E-Books: <https://www.pdfdrive.com/animal-biotechnology-e41305678.html>

E- journals: <https://www.tandfonline.com/toc/labt20/current>

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester - III** | **CORE COURSE - IX**  **23PBTHC33: ENVIRONMENTAL BIOTECHNOLOGY** | **H/W** | **C** |
| **6** | **5** |
| **Part A** |

**Aim:** To acquire a basic comprehension of the environment in its totality and of its problems and to provide an understanding of the environmental and biological challenges facing society through the integration of biology with legal, regulatory and social issues.

**Course Objectives**

1. Introduce the student to the different areas in which biotechnology is developed and the environmental application methods.
2. Emphasize the knowledge of the different types of biotechnological processes that exist in the field of environmental applications.
3. To make known the wide range of professional activities linked to biotechnological knowledge.
4. Know the possibilities of environmental application presented by the biotechnology of higher organisms.
5. To make known the great biodiversity existing in the microbial world and the biogeochemical cycles that govern the terrestrial ecosphere.

**Course Out Comes**

1. After studied unit-1, the student will be able to understand and assimilate the specific concepts and terminology of environmental biotechnology.
2. After studied unit-2, the student will be able to describe the properties of microorganisms with potential application to environmental biotechnology processes.
3. After studied unit-3, the student will be able to Explain technologies, tools and techniques in the field of environmental biotechnology.
4. After studied unit-4, the student will be able to Know the role of microorganisms as biotechnological agents.
5. After studied unit-5, the student will be able to Study biodegradation for environmental application

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analysing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | Yes |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching**  **hours** |
| **Unit-I** | Environmental pollution: Basic concepts and global issues-Global warming & Acid rain. Pollution measurements- air and water. Biosensor in environmental monitoring. Bioremediation of environmental pollutants in soil and water- oils, heavy metals and detergents. Biofouling and Biosensors. | **12 hours** |
| **Unit-II** | Waste treatment: Wastewater treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries. Solid wastes: Types and characteristics. Solid waste disposal- landfilling incineration. Biogas from solid waste. Composting and vermicomposting. Monitoring parameters for composting. | **12 hours** |
| **Unit-III** | Bioremediation: Introduction of Bioremediation advantages and applications; Types of bioremediations. Microbial remediation of phenolics-sewage nutrients (phosphate and nittare). Impact of bioremediation in the petroleum industry, paper industry, marine oil pollutants and chemical industry. Phytoremediation advantages and applications (agriculture). | **12 hours** |
| **Unit-IV** | Biocorrosion and microbial mediated recovery: Microbial corrosion and its control (petroleum industry and cooling tower system). Bio metallurgy- Bioleaching- application, biotechnology approaches for heavy metal elimination from effluents. Bio-mediated recovery of metals (gold and platinum). Recovery of petroleum-MEOR- Biosurfactant. | **12 hours** |
| **Unit-V** | Biodegradation: Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioenergy. | **12 hours** |
| **Unit-VI** | **Internal Assessments, Seminars, and Guest lecture** | **05 hours** |
|  | **Total Teaching hours** | **65** |

Internal Assessment Methods: (25 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Reference & Text Books:**

1. Murugesan AG and Rajakumari C. (2005). Environmental Science and Biotechnology: Theory and Techniques.
2. Sharma PD. (1994). Environmental Biology, Rastogi Publications.
3. Eugenia J.Olguin. (2000). Environmental Biotechnology and cleaner Bioprocesses, Tayloir and Francis.
4. Beech IB and Gaylarde CC (1999). Recent advance in the study of biocorrosion- an overview. *Rev Microbial* 30, 177- 190.
5. Booth GH (1971). Microbiological corrosion, M and B monographs CE11, Mills and Boon, London.
6. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
7. Jogdand SN.(2008).Environmental Biotechnology, 4th Edt Himalaya Publishing House Pvt. Ltd.
8. Fundamentals of Ecology Eugene P. Odum and Gary W (2007). Barrett. Saunders Publishers.
9. Instant Notes in Ecology Aulay MacKenzie, Andy Ball and Sonia Virdee (2001). Taylor & Francis Publishers.
10. Environmental Biotechnology by Alan Scragg (2005). IInd edition. Pearson Education Limited, Eng.
11. Environmental Biotechnology by S.N.Jogdand. (1995). Ist edt. Himalaya Publishing House. Bombay
12. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy (2017). Tata Mc Graw Hill, New Delhi.
13. Environmental chemistry by A.K. De (2007). New Age international Publishers.
14. Introduction to Biodeterioration by D. Allsopp and K.J. Seal, (2004). Cambridge University Press.

**Course Material:**

1. <http://www.fao.org/3/t0551e/t0551e05.htm>
2. <http://www.fao.org/fcit/environment-health/solid-waste/en/>

**Mapping with Program Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE COURSE - X – PRACTICAL III**  **23PBTHP34: PLANT BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY** | **H/W** | **C** |
| **6** | **4** |
| **Part A** |

**PRACTICAL - III**

**LAB IN PLANT BIOTECHNOLOGY, ANIMAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY**

**Lab in Plant Biotechnology**

1. Introduction to plant tissue culture-induction of callus and suspensioncultures.
2. Isolation and purify the protoplasts and check itsviability.
3. Induction of somatic embryogenesis and analysis of differentstages.
4. Extract the genomic DNA from plants by CTAB
5. Culture and selection of Agobacteriumon Agarmedium
6. Agrobacterium mediated genetransformation
7. Use of Agroinfilteration for Transient Expression in Plant
8. Gusassay
9. Analysis of WT/ Transgenic plant byPCR
10. Isolation of Total RNA fromleaves
11. Gene gun method oftransformation
12. Synthetic seedpreparation

**Lab in Animal Biotechnology**

1. Development of primary cell lines/maintenance of established celllines.
2. Cell counting and cellviability.
3. Trypsinization of monolayer and subculturing.
4. Gene transfer bytransfection
5. Preparation of metaphase chromosomes from cultured cells.
6. Isolation of DNA and demonstration of apoptosis of DNAladdering
7. MTT assay for cell viability and growth

**Lab in Environmental Biotechnology**

1. Water Analysis: Measurement of Total Solids, Total – dissolved solids, Total- suspended solids, dissolved oxygen, total hardness, chloride, turbidity, nitrite, nitrate, fluoride and totalnitrogen.
2. Estimation of COD, BOD of industrialeffluents.
3. Potability test of water (MPNtechnique).
4. Degradation of phenols. Colorimetricassay
5. Estimation of MIC and Heavy metal tolerance of chromium resistantbacteria
6. Screening of Biosurfactant activity-Oil Displacement test-Drop collapsetest
7. Isolation of Thiobacillus ferrooxxidans and Thiobacillus thiooxidans from metal sulphides, rock and acid mine water.
8. Microbial degradation, decolourzsation and adsorption of organic dyes by free and immobilizedcells
9. Studies on halophiles from sea water (pigmentation and salt tolerance)

**References**

1. Practical Applications of Plant Molecular Biology. Robert J. Henry .Routledge Chapman & Hall,2008.
2. Molecular Plant Biology: A practical approach (Vol. I and II). Gilmartin andBowler. Oxford University press, UK,2002.
3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony.Wiley, 2010.
4. Plant Tissue Culture, Third Edition:Techniques and Experiments . Roberta H. Smith. Academic Press,2012.
5. Plant cell culture Protocols (Methods in Molecular Biology, 3rd Ed). Victor M. Loyola-Vargas, Neftali Ochoa-Alejo. Humana Press,2012.
6. Plant Cell, Tissue and Organ Culture: Fudamental Methods (Springer Lab Manuals). Oluf L. Gamborg (Editor), Gregory Phillips (Editor), Springer,2013.

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE ELECTIVE – III - 1**  **23PBTHE35-1: GENOMICS & PROTEOMICS** | **H/W** | **C** |
| **3** | **3** |
| **Part A** |

**Aim:** To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications in genomics and proteomics.

**Course objectives:**

* 1. To provide the basic knowledge of gene characteristic feature and mapping concepts
  2. To understand about the sequencing technologies
  3. To provide the basic concept for protein analysis
  4. To understand about protein sequencing
  5. To Enrich the students’ knowledge with respect to metagenomic and applications

**Course Out Comes (five outcomes for each units should be mentioned)**

1. After studied unit-1, the student will be able to know about genes functional properties.
2. After studied unit-2, the student will be able to understand how gene sequencing are done
3. After studied unit-3, the student will be able to understand Protein analysis.
4. After studied unit-4, the student will be able to protein sequencing methods.
5. After studied unit-5, the student will be able to know about metagenomics and its application.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching**  **hours** |
| **UNIT-I** | Organization of genes across living systems, interrupted genes, overlapping genes, alternative genes, (RNA editing and RNA Splicing) etc. identification and characterization of insert DNA fragments, gene content and C value paradox – gene cluster and gene families. restriction mapping, chromosome walking and chromosomal localization of genes. RFLP and other uses of cloned sequences, cloning of microbial genes. | **10 hours** |
| **UNIT-II** | Methods of preparing genomic DNA, DNA sequence analysis methods, Sanger Di deoxy method, next generation sequencing, SNP – single nucleotide polymorphism, expressed sequenced Tags(ESTs),Gene disease association, site directed mutagenesis and molecular chimeras, gungal genome and genomics.PCR based Analysis, DNA Fingerprinting. | **08 hours** |
| **UNIT – III** | Scope of proteomics, protein separation techniques – ion exchange chromatography, size – exclusion and affinity chromatography techniques, size – exclusion and affinity chromatography techniques, protein analysis (includes measurement of concentration , amino acid composition, N-terminal sequencing ); SDS-PAGE , two dimensional gel electrophoresis and image analysis. | **13 hours** |
| **UNIT – IV** | Introduction to mass spectrometry; strategies for protein identification; protein sequencing ; protein modifications and proteomics ; applications of proteome analysis to drug; protein – protein interaction (Two hybrid interaction screening ), analysis and sequencing individual spots by mass spectrometry (Maldi toff) and protein microarrays . | **08 hours** |
| **UNIT-V** | Meta genomics – construction, vector design and screening of meta genomic libraries- biotechnological applications of meta genomics. | **08 hours** |
| **UNIT-VI** | Internal Assessment: Assignments, Seminars and Guest lecturers | **5 hours** |
|  | **Total Lecture hours** | **50 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Books**

1. Introducing proteomics (2011) Josip lovric. John Wiley Publication
2. Principles of proteomics (2013). R. M Twyman. Taylor and Francis publishers.

**Reference Books**

1. Expression Genetics: accelerated and High Throughput Methods (1999). Edited by M. McClelland and A. Pardee, Eaton Publishing, MA.
2. Microbial Functional Genomics (2004). J. Zhou, D.K. Thomson, Y. Xu and J.M. Tiedje, Wiley Liss.
3. Reviews and articles from Journals such as Nature, Science, PNAS (USA), Nucleic Acids Research, Trends and Current Opinion Series.
4. Principles of Gene Manipulation and Genomics (2013) Sandy B. Primrose, Richard Twyman – Blackwell Publishing.
5. An Introduction to Genetic Engineering 3rd Edition DesmondS. T. Nicholl Cambridge University Press
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten ASM Press
7. Post-translational modifications in host cells during bacterial infection, D. Ribert, P. Cossart, FEBS letters, 2010.
8. Proteomics in practice: a laboratory manual of proteome analysis (2002).Westermeier, R., & Naven, T. John Wiley & Sons, Inc.
9. Proteomics for biological discovery. Veenstra, (2006). Timothy D. and John R. Yates John Wiley & Sons,
10. Plant proteomics: methods and protocols. (2007). Thiellement, H., Zivy, M., Damerval, C. and Méchin, V. eds. Totowa (NJ): Humana Press.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE ELECTIVE – III - 2**  **23PBTHE35-2: HERBAL BIOTECHNOLOGY** | **H/W** | **C** |
| **3** | **3** |
| **Part A** |

**Aim:** To give the details of plant-derived value-added compounds and their functions. To provide knowledge on biotech-based production of Herbal medicines.

**Course Objectives**

1. To enable the students to learn about the biochemical parameters used in the identification and utilization of medical plants
2. To enable the students to learn about the extraction of phytochemicals and procedures
3. To exploit and explore the medicinal values of plants
4. know the evaluation techniques for the herbal drugs
5. To provide knowledge on biotech-based production of Herbal medicines

**Course Outcomes (five outcomes for each unit should be mentioned)**

1. After studied unit-1, the student will be able to – know the Study of on history and scope of herbals
2. After studied unit-2, the student will be able to – understand the Important medicinal herbs in treating diseases
3. After studied unit-3, the student will be able to –learn the Biotechnological methods of plant propagation
4. After studied unit-4, the student will be able to –explore methods Involved in secondary metabolite production
5. After studied unit-5, the student will be able to –know about pharmaceutical applications and Intellectual Property Rights

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | No | No | No |
| 2 | Yes | Yes | No | No | No | No |
| 3 | Yes | Yes | No | No | No | No |
| 4 | Yes | Yes | No | No | No | No |
| 5 | Yes | Yes | No | No | No | No |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching**  **hours** |
| **Unit-I** | Study of on history and scope of herbals - Introduction to the Indian system of medicine – Herbal drugs and importance- Herbal Cosmetic and Cosmeceuticals - Formulation Development of herbal preparations - Herbal Drug discovery and Novel drug delivery systems. | **10 hours** |
| **Unit-II** | Important medicinal herbs in treating diseases- Phytochemistry of medicinal plants- alkaloids- flavones- flavonoids and xanthones -furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - sterols and steroid-like compounds - tannins and terpenes. | **08 hours** |
| **Unit-III** | Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation. Herbal gardening and maintenance- Standardization of cultivation protocols of selected medicinal plants; *in vitro* production of secondary metabolites. Polyhouse Technology- Important diseases of medicinal plants and their management. | **13 hours** |
| **Unit-IV** | Methods Involved in secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scale up – Enhancement of product formation by elicitation-Immunodiagnostics and molecular diagnostics in selection of elite plant species. | **08 hours** |
| **Unit-V** | Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy). Pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins. - Intellectual Property Rights - Regulatory Affair herbal pharmaceuticals - Entrepreneurship  Management. | **08 hours** |
| **Unit-VI** | Internal Assessments, Seminars, and Guest lecture | **5 hours** |
|  | **Total Teaching hours** | **50 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Reference & Text Books:**

1. Harborne, J.B., 1998. Phytochemical methods to modern techniques of plant analysis. Chapman & Hall, London.
2. Trease G. E, M. C. Evans, 1979. Textbook of Pharmacognosy12th ed. Balliere-Tindal, London.
3. Irfan A. Khan and AtityaKhanum (Eds.). 2004. Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad. Analytical techniques in DNA sequencing edited by Brian K. Nunnally.
4. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
5. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman &Hall, London, UK.
6. Bidlack, W.R., Omaye, S.T., Meskin, M.S.andTopham, D.K.W.,” Phytochemicals as Bioactive Agents”, 1St Edition, CRC Press, 2000.
7. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth. Edn. 1, Printed in the USA by Malloy Lithographing Inc.
8. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University,Press, 1996.
9. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press. 2009.
10. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
11. Gokhale, S.S,C.K.Kokate and A.P.Purohit (1994). Pharmacognosy. Niraliprakashan, Pune.
12. Faroogi, A.A. and B.S.Sreeramu (2004), Cultivation of Medicinal and Aromatic crops. University Press (India) P. Ltd., Hyderabad.
13. Pal. D.C and S.K. Jain (1998), Tribal medicine, Naya Prakash, 206, Bidhan Sarani, Calcutta.
14. Thirugnanam, Akbarsha and Krishnamurthy (2010), Indian Medicinal plants and Home Remedies, SelviPathipagam, Trichy.

**Course Material:**

1. Rasheeduzzafar (2006), Medicinal plants of India, CBS publication.
2. International Journal of Herbal Medicine
3. Journal of Herbal medicine Elsevier
4. en.wikipedia.org/wiki/Herbal medicine

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **CORE ELECTIVE – III - 3**  **23PBTHE35-3: IMMUNOLOGY** | **H/W** | **C** |
| **3** | **3** |
| **Part A** |

**Aim:** To provide the students insights into the various aspects of immunology such as classical immunology, clinical immunology, immunotherapy and diagnostic immunology.

**Course objectives :**

* 1. To Learn the basic components and principles of defense mechanism against infections
  2. To Understand the properties antigens and structure and types of Immunoglobulin
  3. To understand principle behind Antigens- Antibody reactions.
  4. To Expedite how the immune system recognizes foreign antigen and the significance of self/non-self-discrimination
  5. To Enrich the students’ knowledge with respect to different applications of Immunotechnology

**Course Out Comes (five outcomes for each units should be mentioned)**

1. After studied unit-1, the student will be able to know about basics of Immunity and various components of Immune system
2. After studied unit-2, the student will be able to understand about Antigens and structural properties of Immunoglobulin
3. After studied unit-3, the student will be able to understand principle of antigen-antibody reaction and their types
4. After studied unit-4, the student will be able to how immune cells are signaled, processed and destroyed
5. After studied unit-5, the student will be able to know various immunological technologies.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching**  **hours** |
| **UNIT- I** | Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Humoral and cellular- Mediated Immunoresponses. Components of immunity, Innate and Adaptive immunity. Haematopoiesis and differentiation of immune cells. Cells and Tissues of the immune system: Cells involved in the Immune response: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. The lymphoid organs: Thymus, Bone marrow, Spleen, lymph nodes, MALT. | **12 hours** |
| **UNIT-II** | Antigens and Immunogenicity. Nature of Antigens and antibodies. Theories of Antibody formation. Antibody structure, structural basis of Antibody diversity; Immunoglobulin as Anitgen, Properties of immunoglobulin and subtypes. Complement and its role in Immune Responses. | **12 hours** |
| **UNIT – III** | Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA. B-cell generation, activation and differentiation. Antibody production, Regulation and Diversity. | **12 hours** |
| **UNIT – IV** | Cytokines: structure of Cytokines; function of Cytokines. Complement fixation. Structure and function of MHC class I and II molecules - antigen recognition and presentation, HLA typing, Cellular Immunity. Hypersensitivity Reactions, Types of Hypersensitivity, Immune tolerance, Autoimmunity and transplantation. | **12 hours** |
| **UNIT-V** | Hybridoma secreting monoclonal antibodies-Recombinant antibody molecules. Catalytic Antibodies. Vaccine technology including DNA vaccines. Immunological techniques for identification of infectious diseases : immune-electrophoresis, western blot, flowcytometry and immune-fluorescence microscopy including *in situ* localization techniques such as FISH and GISH. | **12 hours** |
| **UNIT-VI** | Internal Assessment: Assignments, Seminars and Guest lecturers | **5 hours** |
|  | **Total Lecture hours** | **65 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text Book(s)**

1. Parham, P. (2014). The Immune System (4th edition). W. W. Norton &Company.
2. Murphy, K., Travers, P., Walport, M., &Janeway, C. (2012). Janeway'sImmunobiology. New York: Garland Science.
3. Paul, W. E. (1993). Fundamental Immunology. New York: Raven Press. Goding, J. W. (1986). Monoclonal Antibodies: Principles and Practice
4. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House,Chennai.

**References Books**

1. Immunology (7th ed) J.Kuby ,W.H freeman and company , newYork.2013
2. Basic immunology updates ed: functions and disorders of immune system (3rd ed). abulk.abbas, Andrew H.HLictman ,saunders publishers , newYork,2010
3. Immunology: an introduction (4th ) I.R Tizard, saunders college publishers, newYork.
4. Essential immunology (11th ed).peterdelves,seamusmartin,dennjis burton, Ivan Roitt, Wiley – Blackwell publication, Singapore,2006
5. Immunology (Lippincotts illustrated reviews series) thaodoan, roger melvold, susanviselli, Carl Waltenbaugh, Lippincott Williams & Wilkins publications2012
6. Fundamental immunology (7th ed) William e Paul, Lippincott Williams & Wilkins publications,2012
7. Essentials of clinical immunology (6th ed) Helen chapel ,Manselhaeney, Siraj misbah, Neil snowden, Wiley-Blackwell publications,2014
8. Monoclonal antibodies principles and practice(3rd ed) W.Goodings, academic press,2010
9. Monoclonal antibodies :P methods and protocols (2nd ed) .Vincentossipo, Nicolas fisher, Humana press,2014.
10. Essentials of clinical immunology (6th ed).Helen chapel, Manselhaeney, ,Siraj misbah, Neil Snowden, Wiley- Blackwell publications,2014
11. J.Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork..
12. I.R.Tizard, 1995, Immunology: An Introduction , 4th edition , Saunders College Publishers, NewYork.

**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**

1. https://nptel.ac.in/courses/102/105/102105083/
2. https://[www.coursera.org/specializations/immunolog](http://www.coursera.org/specializations/immunolog)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **Skill Enhancement – II**  **23PBTHS36: GENE MANIPULATION TECHNOLOGY** | **H/W** | **C** |
| **3** | **2** |
| **Part B (i)** |

**Aim:** To study gene regulation and to obtain stable inheritance and expression of new characteristics.

**Course Objectives:**

|  |
| --- |
| 1. Understand the basics of Basics of Gene Manipulation Technology |
| 1. Apply the knowledge to create Constructions of DNA Libraries Constructions of DNA Libraries. |
| 1. Acquire adequate knowledge in the use of Genome Sequencing and Transcriptomics |
| 1. Evaluate the benefits of Protein Engineering & Pharmaceutical Products |
| 1. Analyse the importance of Gene Cloning & Applications of Gene Cloning |

**Course Outcome:**

After studying this course, students will be able to:

* To understand more about the science that underlies the development of genetically modified organisms and in particular how gene transfer is brought about
* To know something of the potential benefits and uncertainties associated with gene transfer and the high levels of technical ingenuity involved
* To understand more the science that underpins the development of Golden Rice and understand why the usefulness of this product has proved so contentious.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | No | No |
| 5 | Yes | Yes | Yes | No | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Content** | **Teaching**  **Hours** |
| **UNIT - I** | Basics of Gene Manipulation Technology-Restriction Enzymes-Cutting and Joining Reactions-Vectors-Selection of Recombinants- Agarose Gel Electrophoresis-Southern Blotting- Hybridization-Autoradiography-PCR- Native Page- SDS-Page-2D Gel Electrophoresis- Western Blotting. | 7 |
| **UNIT - II** | Constructions of DNA Libraries- Vectors Used In the Construction of CDNA and Genomic DNA Libraries- Chromosome Walking- Positive Selection and Subtractive Hybridization- Preparation Of (BAC/YAC Library). | 7 |
| **UNIT - III** | Genome Sequencing and Transcriptomics- Sanger’s Sequencing, Whole Genome Shot gun Sequencing- Comparative Genome Sequencing- Transcriptome Analysis- DNA Microarray- Expression of Recombinant Proteins. | 7 |
| **UNIT - IV** | Protein Engineering & Pharmaceutical Products- Site Directed Mutagenesis- Protein Analysis- Therapeutic Protein- Vaccines. | 7 |
| **UNIT - V** | Applications of Gene Cloning- creating Transgenic Animals and Plants- Reporter Genes- Animal Cloning, Gene expression in plants- Biosafety and Bioethics. | 7 |
| **UNIT-VI** | Internal Assessment: Assignments, Seminars and Guest lecturers | 5 |
|  | **Total Lecture hours** | 40 |

**Text Books / References**

1. Principles of Gene manipulation (1994) 5th Edition, Old R.N. and Primrose S.B.
2. From Genes to Clones (1987) Winnaeker E.L., Wiley VCH publication
3. Recombinant DNA (1992) 2nd edition, Watson J.D., Witreowski J., Gilman M. And Zooller M., W.H. Freeman & co. Ltd.
4. An Introduction to Genetic Engineering (2008) 3rd edition, Nicholl, D.S.T., Cambridge university press,
5. Molecular Biotechnology (1996) 3rd edition, J. J. Pasternak, American society for microbiology.
6. The Biochemistry of Nucleic acid (1992) 11th edition, Adam et al, Springer publication.
7. Genetic Engineering (2005) Janke k. swtlow, Springer publication.

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: III** | **23PBTHI37: SUMMER INTERNSHIP** | **H/W** | **C** |
| **--** | **2** |
| **Part B (ii)** |

Internship in Industries related to Biotechnology Field [Food / clinical trial/ dairy/ aqusciences, pharmaceutical OR CSIR/DBT/DST research laboratories]

**Learning Outcome:**

To gain hands on training and expertise in handling sophisticated instruments and acquire in depth knowledge in their applications.

**Course outcomes**:

The student will learn to

|  |
| --- |
| 1. Understand working principles and the techniques of various processes |
| 1. Apply standard operating procedures followed in industries |
| 1. Prepare to face challenges & gain confidence in the field of study. |
| 1. Critically assess the utilization of sophisticated instruments and expensive consumables |
| 1. Develop work ethics to be followed in a scientific laboratory |

**Refer to the Regulations for Additional Information**

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: IV** | **CORE COURSE – XI**  **23PBTHC41: BIOINFORMATICS** | **H/W** | **C** |
| **6** | **5** |
| **Part A** |

**Course Objectives**

1. To provide information an understanding of the major computational problems in the field of molecular biology and to gain knowledge on molecular databases.
2. To enable to learn alignment of sequence, rapid similarity searching, phylogenies.
3. Comparative genomics, pattern search, classification of sequence and structure,
4. Automated pattern learning, representing and searching protein structure, gene expression profiling, clustering expressed genes, discovering transcription factor bindings sites, discovering common functions of co- expressed genes,
5. To make them translate metabolic pathways, signal transduction pathways and management.

**Course Out Comes**

After successful completion of this course, students will be able to:

1. The student will be able to use various biological databases.
2. The student will be able do alignment and compare the differences of local and global using BLAST and advanced alignment tools.
3. The student will be to understand the techniques used in genomics and proteomics and their applications
4. The student will be able to comprehend basis of protein structure determination, identify domains and motifs in protein, usage of tools to predict the sites in protein, and learn the computational methods and application of bioinformatics techniques
5. The student will be able to interpret the biological metabolic pathways.

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | No | Yes | Yes | No |
| 2 | Yes | Yes | Yes | Yes | Yes | No |
| 3 | Yes | Yes | No | Yes | Yes | No |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Units** | **Content** | **Teaching**  **Hours** |
| **UNIT-I** | Biological data bases: gen bank: sequence data/ types ; - protein data bases – ESTs STSs – GSSs – HTGS; NCBI- PubMed- Entrez – BLAST – OMIM; Types Of Accession Numbers- Locus Link, Unigene, Entrez, EBI, and Expasy, Nucleic Acid Data Bank (NDB) | **12 hours** |
| **UNIT-II** | Sequence alignment: alignment algorithms – global and local – significance ; BLAST search steps –BLAST algorithm –BLAST search strategies ; advanced BLAST-alignment tools. | **12 hours** |
| **UNIT – III** | Gene expression analysis tools: the mRNA-c DNA-libraries; microarrays: experimental design – probe – hybridization – DNA fragment counting assembly and restriction enzyme mapping. image analysis – data analysis- biological confirmation – microarray database. | **12 hours** |
| **UNIT – IV** | Proteomic analysis tools: protein domains and motifs – bio informatic tools for high throughput protein analysis – protein structure – Sequence Similarty Basics: Similarty, Identity, Homology, Homology Modelling and visulaization | **12 hours** |
| **UNIT-V** | Pathway bioinformatics : protein – carbohydrate metabolism – biochemical cycles – interconnection of pathways – metabolic regulation ––KEGG: theory and practice. | **12 hours** |
| **UNIT-VI** | Internal Assessment: Assignments, Seminars and Guest lecturers | **5 hours** |
|  | **Total Lecture hours** | **65 hours** |

**Internal Assessment Methods: (25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distribution for  internals | Test (CIA I + CIA  II + CIA III) | Seminars | Assignment | Total marks |
| Marks | 15 | 05 | 05 | 25 |

**Text book:**

1. Bioinformatics: Sequence and genome analysis by David, W Mount, Cold Spring Harbur Press.
2. Bioinformatics Computing By Bryan Bergeron, Publisher: Prentice Hall PTR.
3. Bioinformatics a practical guide to analysis of genes and protein, Eds A D Baxevanis and B.F.Francis Ouellette, Wiley Interscience.
4. Discovering Genomics, Proteomics, and Bioinformatics, 2 nd Edition, Campbell AM & Heyer LJ, Pearson, 2007.
5. Bioinformatics: Sequence and Genome Analysis, 2 nd Edition, Mount D, CSHL Press, 2004.
6. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Baxevanis AD & Francis BF, Wiley, 2004.
7. School of Biotechnology SYLLABUS of M. Sc. (Biotechnology) ODD SEMESTERS (2017 & 2018 Batches) Page 11 of 25 4. A Bioinformatics Guide for Molecular Biologists,
8. Aerni S & Sirota M, CSHL Press, 2014. 5. Genomes, 2nd Edition, Brown TA, Oxford, Wiley, 2002.

**Reference Book:**

1. Botkin, Daniel B. (2011). Environmental Science: Earth as a living Planet, John Wiley and Sons, New Delhi.
2. Chapman. J. L. and Reiss, M.J. (2005). Ecology, Principles ad Applictions, CambridgeUniversity Press, London.
3. Dash, M.C. (1994).Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.
4. Gunther, O. (1998) Environmental Information Systems. Berlin, New York, Springer.
5. Miller G. Taylor and Scot Spoolman. (2011). Essentials of Ecology, Books/ Cole Learning, sU.S.A.
6. Odum, E.P. (1971). Fundamentals of Ecology, W.B. Saunder Company, Philadelphia
7. Sharma P. D. (1996). Environmental Biology, Rastogi Publications, Meerut.
8. Verma P.S. and V.K. Agarwal. (1985). Principles of Ecology. S. Chand and Company (Pub.), New Delhi.
9. Strahler, A. V. and Strahler, A.A (1973). Environmental Geoscience, Wiley International.
10. PrimackR.B. 2014. Essentials of Conservation Biology, Oxford University Press, USA.

**Course Material: website links, e-Books and e-journals**

https://[www.pdfdrive.com/basics-of-bioinformatics-lecture-notes-](http://www.pdfdrive.com/basics-of-bioinformatics-lecture-notes-) https://[www.elsevier.com/books/bioinformatics/singh/978-0-323-89775-4.](http://www.elsevier.com/books/bioinformatics/singh/978-0-323-89775-4)

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong , M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: IV** | **CORE COURSE – XII**  **23PBTHC42: RESEARCH METHODOLOGY** | **H/W** | **C** |
| **6** | **5** |
| **Part A** |

**Aim:** To enable the students to understand the importance of research, familiarize themselves with writing the project report, and learn about the various applications of statistics in the research.

**Course Objectives**

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define the appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner

**Course Outcomes (five outcomes for each unit should be mentioned)**

1. After studied unit-1, the student will be able to understand research concepts, issues and types and basic knowledge of qualitative research
2. After studied unit-2, the student will be able to know read, comprehend, and explain research articles in their academic discipline.
3. After studied unit-3, the student will be able to develop an understanding of various kinds of research, objectives of doing research, research process, research designs, sampling, principles and research techniques.
4. After studied unit-4, the student will be able to detailed know the Observation and Collection of data and Generalization and Interpretation
5. After studied unit-5, the student will be able to Have adequate knowledge of ethics, plagiarism, citation and acknowledgment

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | Yes |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

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| --- | --- | --- |
| **Units** | **Course Contents** | **Teaching hours** |
| **Unit I** | Objectives and types of research: Motivation and objectives – Research methods *vs* Methodology. Types of research – Descriptive *vs*. Analytical, Applied *vs*. Fundamental, Quantitative *vs*. Qualitative, Conceptual *vs*. Empirical. | **12 hours** |
| **Unit-II** | Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs- patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis. | **12 hours** |
| **Unit-III** | Research design and methods – Research design – Basic Principles- Need of research design –– Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, experimentation. Determining experimental and sample designs. Research techniques- microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR and AAS. | **12 hours** |
| **Unit-IV** | Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation. | **12 hours** |
| **Unit-V** | Reporting and ethics – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports. Environmental impacts - Ethical issues - ethical committees - Commercialization – Copy right   * royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material Plagiarism - Citation and acknowledgement - Reproducibility and accountability. | **12 hours** |
| **Unit-VI** | Internal Assessments, Seminars, and Guest lecture | **05 hours** |
|  | **Total Teaching hours** | **65** |

**Reference & Text Books:**

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2. Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International.418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing.270p.
5. Wadehra, B.L. 2000. *Law relating to patents, trademarks, copyright designs and geographical indications*. Universal LawPublishing.
6. Satarkar, S.V., 2000. *Intellectual property rights and Copy right*. EssEssPublication
7. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS
8. Kothari, C.R.,1985, Research Methodology- Methods and Techniques, New Delhi
9. MS office, Sexena, S. 2001.Vikas Publishing House Pvt. Ltd., New Delhi M
10. Kothari, C.R.,1985, Research Methodology- Methods and Techniques, New Delhi
11. Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, Duncary, P. 2003. Macmillan, pp 256.
12. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS

**Course Material:**

1.https://bbamantra.com/research-methodology/ 2.https://[www.researchgate.net/publication/329736173\_Research\_Methodology\_Msc\_notes\_of\_Dr\_J](http://www.researchgate.net/publication/329736173_Research_Methodology_Msc_notes_of_Dr_J) udu\_illavarasusvyasa\_univ

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

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| --- | --- | --- | --- |
| **Semester: IV** | **23PBTHD43: PROJECT WITH VIVA VOCE** | **H/W** | **C** |
| **10** | **7** |
| **Part A** |

**Refer to the Regulations &**

**Learning Outcome:**

The paper imparts a thorough knowledge on the basics of academic research. The student will get to understand the core concepts of pursuing research.

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| --- | --- | --- | --- |
| **Semester: IV** | **Elective (Industry /Entrepreneurship)**  **23PBTHE44: MEDICAL DIAGNOSTICS** | **H/W** | **C** |
| **4** | **3** |
| **Part A** |

**Course Objectives:**

The paper imparts a thorough knowledge about various types of specimen received in the diagnostic laboratory. The student will able to know the procedures carried out in different laboratories.

**Course outcomes:**

|  |
| --- |
| 1. Describe the basis of clinical and hematological tests |
| 1. Explain various techniques in histopathological laboratory. |
| 1. Outline the process to diagnose common infections. |
| 1. Recite the recent rapid diagnostic tests. |
| 1. Discuss and classify the diagnostic techniques that uses immuno-cytochemistry |

**Matching Table (Put Yes / No in the appropriate box)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit | i. Remembering | ii. Understanding | iii. Applying | iv. Analyzing | v. Evaluating | vi. Creating |
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | Yes | Yes | Yes |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 5 | Yes | Yes | Yes | Yes | Yes | Yes |

|  |  |  |
| --- | --- | --- |
| **Unit** | **Content** | **Hours** |
| **I** | Hematology: Smearing and staining Methods, Osmotic fragility test, Cell counting variations –RBC, WBC, Platelets, Eosinophil & Reticulocyte count, ESR, LE Cell. Haemopoeisis –Erythrocytes, Hemoglobin-Estimation, Packed Cell Volume, indices. Hemato crit and Red cell indices, Anemia, Coagulation Factors, Coagulation disorders–Bleeding & Clotting Time, Bone marrow study. | 6 |
| **II** | Histology and Cytology: Histological Procedures Biopsy, Autopsy, Collection, Preservation & Labeling of Slides, Blocks, Specimens, Techniques, Grossing Methods, Fixatives, Processing of the tissues including Bone, Embedding, Section Cutting, Staining & Mounting, Special Stains Preservation of reports & records. Techniques Equipment & Procedures-FNAC, Imprints smear, Vaginal & Buccal smear, Swabs. Staining procedure and Mounting, Preparation of fluids for Cytological Examination, Immunohistochemistry and Insitu hybridization. | 7 |
| **III** | Diagnostic medical microbiology: Microbial pathogenesis, Collection, culturing, identification procedures: Updated immunologic or molecular diagnostic tests. The diagnostic laboratory tests for identification of Staphylococcus aureus, E.coli, shigella, Salmonella etc., including bacteriologic methods for isolation, serologic methods of diagnosis. Test for bacterial Sensitivity tests against antimicrobial agents and clinical implications, their interpretation. Specific culture and drug sensitivity methods. | 7 |
| **IV** | Recent advances in Medical Microbiology: Torch profile, myco, dot, lgG, lgA, lgM and lgE testing, Australia Ag (Hbs Ag) etc. | 6 |
| **V** | Laboratory Diagnosis of Virus Infection: Viral pathogenesis Specimen collection and submission, Cultivation & assays for virus, Purification & identification of virus, Serological tests and rapid diagnostic tests. | 7 |
| **VI** | Internal Assessments, Seminars, and Guest lecture | 5 |
|  | **Total Teaching hours** | 38 |
| **Reference Books**   * Fischbach, Lippincott (2014) A Manual of Laboratory and Diagnostic Tests, 9th Edition,Williams & Wilkins India. * Connie Mahon, George Manuselis (2014). Text book of Diagnostic Microbiology, 5th Edition, Saunders Co. * Koneman, Allen, Janda, Schrecken berger, Winn Lippincott (2006). Color Atlas and Text book of Diagnostic Microbiology. | | |

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

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| --- | --- | --- | --- |
| **Semester: IV** | **Skill Enhanncement Course / Professional Competency Skill – I**  **23PBTHS45: ANALYTICAL BIOTECHNOLOGY** | **H/W** | **C** |
| **4** | **2** |
| **Part B (i)** |

**Course objectives:**

The paper imparts a thorough knowledge on the Tools and Techniques in Molecular Diagnosis. The student will able to know the principles and applications of microscopy and spectroscopy.

**Course outcomes:**

|  |
| --- |
| 1. Understand the knowledge of applications of microscopy and spectroscopy. |
| 1. Acquires knowledge of the concept of Chromatography techniques and its applications. |
| 1. Gain knowledge of the Electrophoresis techniques. |
| 1. Understand the tools and techniques in Molecular Diagnosis. |
| 1. Understand the radioactive isotopes and its applications |

|  |  |  |
| --- | --- | --- |
| **Unit** | **Content** | **Hours** |
| **I** | Principles and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy. Properties of electromagnetic radiations. Principles, instrumentation and applications of UV visible, infrared, NMR spectroscopy. Spectrofluorimetry and mass spectrometry, X-ray diffraction. Flow cytometry. | 7 |
| **II** | Principles and applications of gel-filtration, ion-exchange and affinity chromatography. TLC, GLC and HPLC. Basic principles of sedimentation. Applications of preparative and analytical ultra centrifuges. Principles and applications of lyophilization. | 7 |
| **III** | General principles of electrophoretic techniques. Poly Acryl amide Gel Electrophoresis. Isoelectric focusing. 2-D Electrophoresis. Capillary electrophoresis. Agarose gel electrophoresis of DNA and RNA. Blotting techniques. DNA fingerprinting. | 7 |
| **IV** | Tools and Techniques in Molecular Diagnosis, ELISA and Western blotting, PCR and Real Time PCR, Flow cytometry, Immunohistochemistry and Hybridization, Sequencing methods. | 7 |
| **V** | Detection and measurement of radioactivity. Applications of radioisotopes in biological sciences. Autoradiography. Non-isotopic tracer techniques. Principles and range of electrochemical techniques. Operation of pH electrodes. Principles and applications of Ion-selective and gas sensing electrodes. Oxygen electrodes. | 7 |

|  |
| --- |
| **Reference Books**   * Wilson, K., & Walker, J. M. (2010). Principles and techniques of biochemistry and molecular Biology. UK, New York: Cambridge University Press. * Katoch, R. (2011). Analytical techniques in biochemistry and molecular biology. New York: Springer. * Silverstein, R. M. (2005). Spectrometric identification of organic compounds. (7th ed.). Hoboken, NJ: John Wiley & Sons. * Harvey, D. (2000). Modern analytical chemistry. Boston: McGraw-Hill. * Chatwal, G.R., & Anand, S. (1984). Instrumental methods of chemical analysis. New Delhi. Himalaya Publishing House. |

**Mapping with Programme Outcomes**

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

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester: IV** | **23PBTHX46 : EXTENSION ACTIVITY** | **H/W** | **C** |
| **-** | **1** |
| **Part B (ii)** |

**-Refer to the Regulations-**