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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** |  |  |  |  |  |
| Part 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 (Discipline centric) | 3 | 5 | 25 | 75 | 100 |
| 23PBTHE14-1 | Genetics |  |  |  |  |  |
| 23PBTHE14-2 | Virology |  |  |  |  |  |
| 23PBTHE14-3 | Basic Analytical Methods |  |  |  |  |  |
|  | Elective-II (Generic centric) | 3 | 5 | 25 | 75 | 100 |
| 23PBTHE15-1 | Mushroom Cultivation and Apiculture |  |  |  |  |  |
| 23PBTHE15-2 | Vermiculture Technology |  |  |  |  |  |
| 23PBTHE15-3 | Validation of Medicinal Plants |  |  |  |  |  |
|  |  | **Total** | **20** | **30** |  |  | **500** |
|  |  | **SEMESTER – II** |  |  |  |  |  |
| Part 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 (Discipline centric) | 3 | 4 | 25 | 75 | 100 |
| 23PBTHE24-1 | Enzyme Technology |  |  |  |  |  |
| 23PBTHE24-2 | Diary Technology |  |  |  |  |  |
| 23PBTHE24-3 | Pharmaceutical Biotechnology |  |  |  |  |  |
|  | Elective – IV (Generic centric) | 3 | 4 | 25 | 75 | 100 |
| 23PBTHE25-1 | Medical Laboratory Technology |  |  |  |  |  |
| 23PBTHE25-2 | Food and Nutrition |  |  |  |  |  |
| 23PBTHE25-3 | Biodiversity |  |  |  |  |  |
| Part B | 23PBTHS26 | Skill Enhancement Course (SEC-I):  Tissue engineering | 2 | 4 | 25 | 75 | 100 |
|  |  | **Total** | **22** | **30** |  |  | **600** |

|  |  |  |  |
| --- | --- | --- | --- |
| **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** | **Discipline Centric 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 Generic Centric**  **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 Generic Centric**  **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 COURSE - 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**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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** | **Discipline Centric 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** | **Discipline Centric 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** | **Discipline Centric 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** | **Generic Centric 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** | **Generic Centric 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