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| M.sc.,  Environmental Biotechnology |
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| **SYLLABUS** |
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| **FROM THE ACADEMIC YEAR**  **2023 - 2024** |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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| **TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION** | |
| **Programme** | **M.Sc. ENVIRONMENTAL BIOTECHNOLOGY** |
| **Programme Code** |  |
| **Duration** | **2 years for PG** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**  Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.  **PO2: Decision Making Skill**  Foster analytical and critical thinking abilities for data-based decision-making.  **PO3: Ethical Value**  Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.  **PO4: Communication Skill**  Ability to develop communication, managerial and interpersonal skills.  **PO5: Individual and Team Leadership Skill**  Capability to lead themselves and the team to achieve organizational goals.  **PO6: Employability Skill**  Inculcate contemporary business practices to enhance employability skills in the competitive environment.  **PO7: Entrepreneurial Skill**  Equip with skills and competencies to become an entrepreneur.  **PO8: Contribution to Society**  Succeed in career endeavors and contribute significantly to society.  **PO 9 Multicultural competence**  Possess knowledge of the values and beliefs of multiple cultures and  a global perspective.  **PO 10: Moral and ethical awareness/reasoning**  Ability to embrace moral/ethical values in conducting one’s life. |
| **Programme Specific Outcomes**  **(PSOs)** | **PSO1 – Placement**  To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.  **PSO 2 - Entrepreneur**  To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.  **PSO3 – Research and Development**  Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.  **PSO4 – Contribution to Business World**  To produce employable, ethical and innovative professionals to sustain in the dynamic business world.  **PSO 5 – Contribution to the Society**  To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**Template for P.G., Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester–I** | **Credit** | **Hours** | **Semester-II** | **Credit** | **Hours** | **Semester-III** | **Credit** | **Hours** | **Semester–IV** | **Credit** | **Hours** |
| 1.1. Core-I | 5 | 7 | 2.1. Core-IV | 5 | 6 | 3.1. Core-VII | 5 | 6 | 4.1. Core-XI | 5 | 6 |
| 1.2 Core-II | 5 | 7 | 2.2 Core-V | 5 | 6 | 3.2 Core-VII | 5 | 6 | 4.2 Core-XII | 5 | 6 |
| 1.3 Core – III | 4 | 6 | 2.3 Core – VI | 4 | 6 | 3.3 Core – IX | 5 | 6 | 4.3 Project with viva voce | 7 | 10 |
| 1.4 Discipline Centric  Elective -I | 3 | 5 | 2.4 Discipline Centric  Elective – III | 3 | 4 | 3.4 Core – X | 4 | 6 | 4.4Elective - VI (Industry / Entrepreneurship)  20% Theory  80% Practical | 3 | 4 |
| 1.5 Generic Elective-II: | 3 | 5 | 2.5 Generic Elective -IV: | 3 | 4 | 3.5 Discipline Centric Elective - V | 3 | 3 | 4.5 Skill Enhancement course / Professional Competency Skill | 2 | 4 |
|  |  |  | 2.6 NME I | 2 | 4 | 3.6 NME II | 2 | 3 | 4.6 Extension Activity | 1 |  |
|  |  |  |  |  |  | 3.7 Internship/ Industrial Activity | 2 | - |  |  |  |
|  | **20** | **30** |  | **22** | **30** |  | **26** | **30** |  | **23** | **30** |
| **Total Credit Points -91** | | | | | | | | | | | |

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System**

**for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – I | 5 | 7 |
| Core – II | 5 | 7 |
| Core – III | 4 | 6 |
| Elective – I | 3 | 5 |
| Elective – II | 3 | 5 |
|  |  | **20** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – IV | 5 | 6 |
| Core – V | 5 | 6 |
| Core – VI | 4 | 6 |
| Elective – III | 3 | 4 |
| Elective – IV | 3 | 4 |
| Skill Enhancement Course [SEC] - I | 2 | 4 |
|  |  | **22** | **30** |

**Second Year – Semester – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – VII | 5 | 6 |
| Core – VIII | 5 | 6 |
| Core – IX | 5 | 6 |
| Core (Industry Module) – X | 4 | 6 |
| Elective – V | 3 | 3 |
| Skill Enhancement Course - II | 2 | 3 |
|  | Internship / Industrial Activity | 2 | - |
|  |  | **26** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credits** | **No. of Hours** |
|  | Core – XI | 5 | 6 |
| Core – XII | 5 | 6 |
| Project with VIVA VOCE | 7 | 10 |
| Elective – VI (Industry Entrepreneurship) | 3 | 4 |
| Skill Enhancement Course – III / Professional Competency Skill | 2 | 4 |
| Extension Activity | 1 | - |
|  |  | **23** | **30** |

**Total 91 Credits for PG Courses**

|  |  |
| --- | --- |
| **LEARNING OUTCOMES – BASED CURRICULUM FRAME WORK GUIDELINES**  **BASED REGULATIONS FOR POST GRADUATE PROGRAMME** | |
| **Programme: M.Sc. Environmental Biotechnology** | |
| **Programme Code** | |
| **Duration 2 years [PG]** | |
| **Program Outcomes (PO)** | |
| On successful completion of the **M.Sc.,Environmental Biotechnology**program, the students are expected to | |
| PO1 | Broad based knowledge in Environmental Biotechnology |
| PO2 | Transforming meaningful applications for better healthcare, industries, and economic development |
| PO3 | Constant updation of knowledge |
| PO4 | Empowering skills |
| PO5 | Sole responsibility of contributing the public to lead better life through extension activities |
| PO6 | Development of critical thinking and problem-solving skills |
| PO7 | The provision of an inspiring, exciting and collaborative scientific environment |
| PO8 | To inculcate the values of professionalism and dedication |
| PO9 | Develop intelligent strategies and biochemical approaches in problem solving methods |
| PO10 | To compete globally with confidence in all the sectors of life science |

|  |  |
| --- | --- |
| **Program Specific Outcomes (PSO)** | |
| On successful completion of the **M.Sc.,Environmental Biotechnology**program, the students are expected to | |
| PSO1 | Ability to understand the technical aspects of existing technologies that help in  addressing the biological and Environmental challenges faced by humankind. |
| PSO2 | Abilitytocontribute effectively in the development of the ethicalpractices,  societal contributions, and leading to responsible and competent professionals |
| PSO3 | Acquiring the ability of leadership skills to manage projects in multidisciplinary  environments |
| PSO4 | Nurture problem solving skills, thinking, creativity through assignments, field work, seminarpresentations and project work. |
| PSO5 | Assist students in preparing (personal guidance, research papers, and books) for competitive exams e.g.,NET-JRF, SLET, etc. |

**M.Sc. ENVIRONMENTAL BIOTECHNOLOGY**

# Thecourseof studyandschemeof examination

1. Nameofthecourse:**M.Sc. Environmental Biotechnology**

# ChoiceBasedCreditSystem(CBCS)

Choicebasedcreditsystemisaflexiblesystemoflearning.

„Credit‟definesthequantumofcontents/syllabus prescribedforacourseanddeterminethenumberofhoursofinstructionrequired.

The CBCS has unique features such as enhanced learning opportunities, ability to matchstudentsscholasticneedandaspirations,interinstitutiontransferabilityofstudents,partcompletion of an academic program in the institution of enrollment and part completion inspecializedandrecognizedinstitution,improvementineducationalqualityandexcellence,flexibilityforworkingstudentstocompleteProgrammeoveranextendedtimeandstandardizationandcomparabilityofeducationalprogramsacrossthecountry.

# Thepreambleofthesyllabus

Master of Science (M.Sc.) in Environmental Biotechnology, the curricula, andcoursecontentweredesigned to meet the standards of UGC-CSIR (NET) and(SLET) examinations. The choice-based credit system of learning develops a strong base in the core subject and specializes in thedisciplines of his / her liking and abilities and develops an in-depth understanding of variousaspects of Biotechnology. The students develop experimental skills, design, and implementationof novel synthetic methods, and develop the aptitude for academic and professional skills, byacquiringbasicconceptsforstructuralelucidationwithhyphenatedtechniques,andunderstanding the fundamental biological process and rationale of the computer. The project tintroduced in the curriculum will motivate the students to pursue research and entrepreneurialskilldevelopment**.**

# Methods of Evaluation

|  |  |  |  |
| --- | --- | --- | --- |
|  | **External**  **marks** | **Internals**  **marks** | **Totalmarks** |
| **Theory** | 75 | 25 | 100 |
| **Practical** | 75 | 25 | 100 |

**SEMESTER - I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Course Title | Credits | Hours | Course |  |  |  |
|  | Core 1 | 5 | 7 | Environmental Toxicology | 25 | 75 | 100 |
|  | Core 2 | 5 | 7 | Environmental Biology | 25 | 75 | 100 |
|  | Core 3 | 4 | 6 | Analytical Techniques | 25 | 75 | 100 |
|  | Elective–I | 3 | 5 | 1. Solid Waste Management 2. Environmental Pollution 3. Genetics | 25 | 75 | 100 |
|  | Elective - II  Practical-I | 3 | 5 | A.Labin Biochemistry & Cell And Molecular Biology & Labin Microbiology | 25 | 75 | 100 |
|  |  | **20** | **30** |  |  |  |  |

**SEMESTER - II**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Core 4 | 5 | 6 | Natural Resources | 25 | 75 | 100 |
|  | Core 5 | 5 | 6 | Environmental Microbiology | 25 | 75 | 100 |
|  | Core 6 | 4 | 6 | Environmental Chemistry | 25 | 75 | 100 |
|  | Elective 3 | 3 | 4 | Biostastics and Modelling | 25 | 75 | 100 |
|  | Elective 4 | 3 | 4 | 1. Enzyme Technology 2. Dairy Technology 3. Pharmaceutical Technology | 25 | 75 | 100 |
|  |  |  |  | A.Labin Immunology & Labin Genetic Engineering and Bioinformatics (Practical) |  |  |  |
|  |  | 2 | 4 | Skill Enhancement Course [SEC] - I |  |  |  |
|  | Total | **22** | **30** |  |  |  |  |

**SEMESTER-III**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Core 7 | 5 | 6 | Immunology | 25 | 75 | 100 |
|  | Core 8 | 5 | 6 | Celland MolecularBiology | 25 | 75 | 100 |
|  | Core 9 | 5 | 6 | Biotechnology | 25 | 75 | 100 |
|  | Core 10 | 4 | 6 | MicrobialandIndustrialApplications | 25 | 75 | 100 |
|  | Elective - 5 | 3 | 3 | 1. Waterandwastewatertreatmenttechnology   B.Genomic and Proteomics  C.HerbalBiotechnology | 25 | 75 | 100 |
|  |  | **2** | **3** | Skill Enhancement Course - II |  |  |  |
|  |  | **2** | **-** | Internship / Industrial Activity |  |  |  |
|  | Total | **26** | **30** |  |  |  |  |

**Semester IV**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Core 11 | 5 | 6 | Genetic Engineering | 25 | 75 | 100 |
|  | Core 12 | 5 | 6 |  |  |  |  |
|  | Elective 6 | 3 | 3 | A.Bioremediation  B. IPR and Biosafety  C. Biochemistry | 25 | 75 | 100 |
|  | **Project** | **7** | 10 | Project with *vivavoce* |  | |  |
|  |  | **2** | 4 | Skill Enhancement Course – III / Professional Competency Skill |  | |  |
|  |  | **1** | - | Extension Activity |  | |  |
|  | **Total** | **23** | **30** |  |  |  |  |

**SEMESTER I**

**PAPER1:Environmental Toxicology**

Papercode:Subject:**Environmental Toxicology**

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the basic concepts ofToxic chemicals andalsotolearnthevariousmode of entry of toxic substance in environment.

**CourseObjectives**

1. Tolearnthebasic concept of toxic substance in environment.
2. Tolearn the mode of entry of toxic substance.
3. TodevelopknowledgeonInsecticides
4. Tolearn the possible effect of imbalance of some trace elements
5. Todevelopapieceofknowledgeinbiogeochemical factor in environmental health.

# CourseOutComes

1. Aftercompletingunit1,thestudentswillbeabletoidentifythetoxic chemicals and their biochemical aspects in environment
2. Afterstudyingunit2,thestudentswillbeabletodescribe the mode of entry of toxic substance and carcinogenicity in environment.
3. Afterstudyingunit3,thestudentswillbeabletodescribe the Concept of major trace elements and its effects.
4. Afterstudyingunit4,thestudentswillbeabletoexplainbiogeochemical factor in environmental health.
5. Afterstudyingunit5,thestudentswillbeabletoexplainabout pollution

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide. | **18hours** |
| **Unit-II** | Mode of entry of toxic substance, biotransformation of xenobiotics detoxification, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing. | **18hours** |
| **Unit-III** | Insecticides,MICeffects,Conceptofmajor,traceandRareEarthElement(REE)-possible effects of imbalance of some trace elements | **18hours** |
| **Unit-IV** | Biogeochemical factors inenvironmentalhealth. Epidemiological issues goiter, fluorosis, arsenic poisoning. | **18hours** |
| **Unit-V** | Introductiontopollution,air,noise,water,soil,thermal,marineandradioactivePollution, Concept of Waste management, Solid andhazardous waste management, Electrical energy generation, e-waste,flyash,plasticwaste,Environmentalmanagementsystem  standards, IPCC, UNEP,IGBP,Global environmental issues-Biodiversityloss,climate change,Ozonedepletion,sealevel rise | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. Environmentalchemistry-Sodhi
2. Principals ofEnvironmentalchemistry- Manhan
3. Environmentalhazards&humanhealthR.B.Philip
4. Toxicology-principles&applications-Niesink &Jondevries
5. Parasitology-Chatterjee
6. Preventive&Socialmedicines–Perk

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER IPAPER2:Environmental Biology**

Papercode: Subject:**Environmental Biology**

# Hours/Week:5 Credits:4

# Aim: To enable the students to understand the basic concepts of Ecosystem andalsotolearnthepopulation ecology and earths major ecosystem.

**CourseObjectives**

1.Tolearnthebasic concept of ecology and ecosystem.

2.Tolearn the Ecosystem structure and function.

3.Todevelopknowledgeon Population ecology and Ecological Model.

4.Tolearn the earths major ecosystem and also about the man made reservoir.

5.Todevelopapieceofknowledgeinsoil micro organism.

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoidentifytheorigin of life and and evolution.

7.Aftercompletingunit2,thestudentswillbeabletounderstand the ecosystem structure and ecological pyramids.

8.Aftercompletingunit3,thestudentswillbeable to explain the growth curve and models.

9.Aftercompletingunit4,thestudentswillbeabletoexplain the earths major ecosystem.

1. Aftercompletingunit5,thestudentswillbeabletoexplain the water conservation

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Definition,principlesandscopeofecology,humanecologyandhumansettlements, evolution, origin of lifeand specification, Ecosystem stability-cybernatics and ecosystem regulation, evolution of biosphere. | **18hours** |
| **Unit-II** | Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes. | **18hours** |
| **Unit-III** | Population ecology- density, natality, mortality, survivorship curves, age distribution, growth curves and models, r & k selection, population interactions- Mutualism, Parasitism, Predator- Prey relations, System Theory and Ecological Model. | **18hours** |
| **Unit-IV** | Earths major ecosystem - terrestial and aquatic ecosystem, soil microorganism and their functions, coastal management, criteria employed for disposal of pollutants in marine ecosystem, coastal water system and man-made reservoirs, biology and ecology of reservoirs. | **18 hours** |
| **Unit-V** | Waterconservation,Rainwaterharvesting&watershedmanagement,andenvironmentalethics.Climatechange,globalwarming,acid,rain,ozone  layerdepletion.Environmentalprotectionact,populationexplosion.Disastermanagement | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. Basicecology-E.P. Odum
2. Ecologyandfieldbiology-R.L.Smith
3. Ecology-P.D.Sharma
4. Fundamentalsofecology-E.P. Odum
5. Principlesofecology–Rickleff

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER I**

**PAPER3:Analytical Techniques**

# Papercode:Subject:M.sc Environmental Biotechnology

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the concept of techniques .

**CourseObjectives**

1.TolearnthePrinciple and applications of Microscopes.

2.Tolearn the basic concept of chromatographic techniques.

3.Todevelopknowledgeon Chromatography

4.Tolearn the methods for protein interaction .

5.TodevelopapieceofknowledgeinMolecular markers..

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletounderstand the principle and application of Spectrophotometer and Microscope.

7.Aftercompletingunit2,thestudentswill able to understand the Chromatographic techniques.

8.Afterstudyingunit3,thestudentswillbeable to explain the Gas liquid chromatography and High pressure liquid chromatography.

9.Afterstudyingunit4,thestudentswillbeabletoexplain the methods for measuring nucleic acid and protein interaction.

10.Afterstudyingunit5,thestudentswillbeabletoexplain about the Electrophoresis .

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and flourscence microscopes, Scanning and Transmission electron microscopes | **18hours** |
| **Unit-II** | Chromatographic techniques (Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography), Atomic absorption spectrophotometry, cytophotometryand flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Principle of biophysical method used for analysis of biopolymer structure, Hydrodynamics methods, Plasma emission spectorocopy. | **18hours** |
| **Unit-III** | Electrophoresis, solid and liquidscintillation, X-rayflorescence, X-raydiffraction. Flame photomtery, Gas-liquid chromatography, High pressure liquid chromatography - auto radiography, Ultracentrifugation. | **18 hours** |
| **Unit-IV** | Methods for measuring nucleic acid and protein interactions, DNA finger printing Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction | **18hours** |
| **Unit-V** | General principles. Factors affecting the migration rate – sample, electric field,buffer,andsupportingmedium.Tiseliusmovingboundaryelectrophoresis.PAGE.SDS–PAGE.Pulse-fieldgelelectrophoresis.Celluloseacetatemembraneelectrophoresis.Agarosegelelectrophoresis | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. Principles ofBiophysicalchemistry- Uppadahay-Uppadahay -and Nath.

2.AnalyticalTechniques-S.K. Sahani

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER I**

**ELECTIVE PAPER1:Solid Waste Management**

# Papercode:Subject:M.sc Environmental Biotechnology

**Hours/Week:5 Credits:3**

# Aim: To enable the students to understand the concept of Solid waste Management methods and also to understand the Control and Treatment of Hazardous Waste Management.

**CourseObjectives**

1.TolearntheSource, generation , classification & Composition of solid waste management.

2.Tolearn the basic concept of Solid Waste Management Plan

3.TodevelopknowledgeonHospitalWasteManagement

4.Tolearn the methods for Disaster Management

5.TodevelopapieceofknowledgeinHazardousWasteManagement

&Handlingrules,1989& 2000 (amendments)

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the energy recovery from organic waste.

7.Aftercompletingunit2,thestudentswill able to understand the

HazardousWaste Control & Treatment.

8.Aftercompletingunit3,thestudentswillbeable to explain the HospitalWasteManagement

9.Aftercompleting unit4,thestudentswillbeabletoexplain the Primary, secondary&tertiary&

advance treatment of various effluents.

10.Aftercompleting unit5,thestudentswillbeabletoexplain the process of urban waste .

11..Aftercompletingunit6,thestudentswillbeabletoexplain about the applied use of solid waste .

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Sources, generation, classfication & composition of solid wastes. Solid waste management methods-Sanitarylandfilling,Recycling,Composting,Vermicomposting, Incineration, energy recovery from organic waste. | **18hours** |
| **Unit-II** | Solid Waste Management Plan, Waste minimization technologies, Hazardous Waste Management,Sources&Classification,physicochemicalproperties,HazardousWaste Control & Treatment. | **18hours** |
| **Unit-III** | HospitalWasteManagement,HazardousWasteManagement &Handlingrules,1989& 2000 (amendments) | **18 hours** |
| **Unit-IV** | Disaster Management, Flyashgeneration&utilization, Primary, secondary&tertiary& advance treatment of various effluents. | **18hours** |
| **Unit-V** | **Processing of Urban Waste** :  Methods of collection, storage, transportation.  Material Seperation  Processing on site and off site for source reduction, product recovery and recycling  Methods of disposal – Dumping, Sanitary Landfill, Incineration, Pyrolysis, Composting, Ocean Dumping.  Leachate Management for MSW landfills | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. SolidWasteManagementCPCB.NewDelhi.
2. Ecotechnologyforpollutioncontrol&environmentalmanage ment - By R.K. Trivedi & Arvind Kr.BasicEnvironmentalTechnology-J.A. Nathanson
3. WaterAnalysis:MeasurementofTotalSolids,Total–dissolvedsolids,Total-suspendedsolids,dissolvedoxygen,totalhardness,chloride,turbidity,nitrite,nitrate,fluoride andtotalnitrogen.
4. EstimationofCOD, BODofindustrialeffluents.
5. Potabilitytestofwater(MPNtechnique).
6. Degradationofphenols. Colorimetricassay
7. EstimationofMICandHeavymetaltoleranceofchromiumresistantbacteria
8. ScreeningofBiosurfactantactivity-OilDisplacement test-Dropcollapsetest
9. IsolationofThiobacillusferrooxxidansandThiobacillusthiooxidansfrommetalsulphides,rockandacidminewater.
10. Microbialdegradation,decolourzsationandadsorptionoforganicdyesbyfree andimmobilizedcells
11. Studiesonhalophilesfrom seawater(pigmentationandsalttolerance

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER I**

**ELECTIVE PAPER2: Environmental Pollution**

Papercode:Subject:**Environmental Pollution**

**Hours/Week:5 Credits:3**

# Aim: To enable the students to understand the concept of air, water ,soil and noise pollution and also to understand the methods of monitoring and control of air pollution and also to understand the water quality and standards.

**CourseObjectives**

1.Tolearnthenatural and anthropogenic sources of pollution

2.Tolearn thetypes sources and consequences of water pollution

3.Todevelopknowledgeonchemical and bacteriological sampling as analysis of soil quality

4.Tolearn the methods for sources of noise pollution

5.TodevelopapieceofknowledgeinEffects ofpollutantson human beings

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletounderstand the behaviour of pollutants in the atmosphere

7.Aftercompletingunit2,thestudentswill able to under stand the physico-chemical and

bacteriological sampling

8. Aftercompletingunit3,thestudentswillbeable to explain the heavy metals and

their intreactions with soil components.

9.After completing unit4,thestudentswillbeabletoexplain the sourcesofmarine pollution and its control

10.Aftercompleting unit5,thestudentswillbeabletoexplain the Biodegradation .

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Air pollution- natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffiusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, Methods of monitoring and control of air pollution, SO2, NOx, CO, SPM. | **18hours** |
| **Unit-II** | Water pollution - types sources and consequences of water pollution, physico-chemical and bacteriological sampling, Analysis of water quality, standards, sewage and wastewater treatment and recycling, water quality and standards. | **18hours** |
| **Unit-III** | Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollution control, industrial waste effluents and heavy metals and their intreactions with soil components. | **18hours** |
| **Unit-IV** | Noise pollution - sources of noise pollution, measurement and indices. Marine pollution, sourcesofmarine pollution and its control. Effects ofpollutantson human beings, plants, animals and climate. Air quality standards and air pollution. | **18hours** |
| **Unit-V** | Biodegradation: Biodegradation of organic pollutants: Mechanisms and factorsaffectingbiodegradation.Pollutionproblemsandbiodegradationofsimplealiphatic,aromatic,polycyclicaromatichydrocarbons,halogenatedhydrocarbons,azodyes,ligninandpesticides.Bioenergy. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. Airpollutionandcontrol-K.V.S.G.Murlikrishan
2. Industrialnoisecontrol-Bell&Bell
3. Environmentalengineering-Peary
4. Introductiontoenvironmentalengineeringandscience -GilbertMasters

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| CO5 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER I**

**ELECTIVE PAPER3 Genetics**

Papercode:Subject:**Genetics**

**Hours/Week:5 Credits:3**

**Aim: To enable us to explore many different components of living systems and the advent ofproteomics will made it possible to identify a broad spectrum of proteins in living systems. Thiselectivesubjectwillhelp tounderstandbasicprinciplesandapplications ingenomics andproteomics.**

# Courseobjectives:

1. Toprovidethebasicknowledgeofgeneticsinhighereukaryoticdomainsandover allconceptsofMendeliangenetics.
2. Tounderstandaboutgeneticinheritanceandlinkages
3. Toprovidethebasicconceptsexdetermination
4. Tounderstandaboutgeneticcode,mutationand regulations
5. ToEnrichthestudents’knowledgewithrespecttogeneticengineering,transgenesisandethics

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeable toknowaboutMendelianlaws.
2. Afterstudyingunit-2,thestudentwillbeable tounderstandhowgeneinherited
3. Afterstudyingunit-3,thestudentwillbeable tounderstandabout sexdetermination.
4. Afterstudyingunit-4,the studentwillbeable togeneregulations.
5. Afterstudyingunit-5,the studentwillbeable toknowaboutethicsandtransgenesis.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | HistoryofGenetics:DefinitionandscopeofGenetics-Pre-mendelian geneticconcepts. Basis of Mendelian Inheritance andMendelian genetics. Chromosometheory of linkage, crossing over,recombinationsandmappingofgenesonchromosomes | 18hours |
| UNIT-II | BloodGroupsandtheirInheritanceinHuman–LinkageandCrossing Over:- Drosophila – Morgans‟ Experiments – CompleteandIncompleteLinkage,LinkageGroups,CrossingOvertypes,Mechanisms – Cytological Evidence for Crossing Over, Mapping ofChromosomes–InterferenceandCoincidence. | 18hours |
| UNIT–III | SexLinkageinDrosophilaandMan,SexinfluencedandSexLimitedGenes–Non-DisjunctionandGynandromorphs–CytoplasmicInheritance–MeternalEffectonLimnaea(ShellCoiling),MaleSterlity(Rode‟s Experiment) | 18 hours |
| UNIT–IV | Nature and Function of Genetic Material – Genetic code – Why thegenetic code is comma less, non ambiguous, degenerate triplet code.Fine Structure of the Gene .Gene Regulation – Operon Concept –LacOperon–PositiveandNegativeRegulation.Mutation–MolecularBasisofMutation,TypesofMutation,Mutagens,MutableandMutatorGenes.ChromosomalAberrations–  NumericalandStructural Examplesfrom Human. | 18hours |
| UNIT-V | eneticengineering–Objectives,tools,genecloning,andgeneisolation.Transgenicplantsandanimals,AnimalBreeding–Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour.PopulationGenetics-HardyWeinbergLaw–GeneFrequency,FactorsAffectingGeneFrequency,Eugenics,Euphenicsand  Ethenics,Bioethics. | 18hours |
|  | TotalLecturehours65hours | 90hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# TextBooks

1. Gardneretal(1991).PrinciplesofGenetics.JohnWiley.
2. Hartl.D.L.Aprimerofpopulationgenetics.IIIedition,Sinauerassociatesinc.Sunderland,2000
3. Humangenetics,A.Gardner,R.T.HowellandT.Davies,PublishedbyVinodVasishthaforVivaBooksprivatelimited,2008.
4. ThescienceofGeneticsbyAlanG.Atherly,Jack.R,Girton,Jhon.F,McDonald.Sounderscollegepublishers.

# ReferenceBook

StrachanandRead(2003).HumanMolecularGenetics.Wiley.

1. Pasternak(2005).An IntroductiontoMolecularHumanGenetics.Fritzgarald.
2. Prichard&Korf(2004).MedicalGeneticsataGlance. Blackwell.
3. Manu LLothari,LopaAMehta,sadhanaSRoyChoudhury(2009).EssentialofHumanGenetics(UniversitiesPressIndialtd) Publishing.

# Web Sources

* 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)

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# Practical1:LabInBiochemistryAndCell&MolecularBiologyLabinbiochemistry and

# Microbiology ( 10 credit)

* + - 1. DeterminationofChl.a,Chl.b&totalChl.ByArnonmethod.
      2. EstimationofCarbohydrates
      3. Estimationofsalivaryamylaseactivityinrelationto,substrate/pH/Temperature
      4. Estimationofbloodglucose&urea
      5. EstimationofLDH.
      6. Estimationoftotalserumproteins
      7. Estimationofcreatinineinurine.
      8. Paper/thinlayerchromatography
      9. IsolationofGenomicDNAfromE.coli
      10. IsolationofplasmidDNAfromE.coli

11.Elution&quantificationofDNAfromagarose gel.

1. Preparationofcompetent cellsand transformation
2. PCR
3. IsolationofTotalRNAfrombacteria
4. SynthesisofcDNAbyReversetranscriptionpolymerase chainreaction.

16.Sterilizationtechniques

17.Preparationofculturemedia(SelectiveandEnrichedmedia)

18.Stainingtechniques-Simple,Differential,NegativestainingandMotilitystudies

19.DeterminationofBacterialgrowthcurve

20.Enumerationofbacteriafromenvironmentalsamples-soil,water,airandmilk.

21.Pureculturetechniques-Streak,pourplateandspreadplate.

22.Biochemicaltestsforidentificationofbacteria(IMViC,TSI,Catalase,Oxidase)

23.Antimicrobialassay,phenolcoefficient,agarplatesensitivitymethod.

24.Waterqualityanalysis–MPNmethod.

25.Milk qualityanalysis–MBRTmethod

# Reference

1. IntroductiontoPracticalBiochemistry,E.FPlummerMu,PlummerTataMcGraw-HillEducation,1998.
2. Molecularcloning:alaboratorymanual,4thed.J.Sambrook,FritschandT.Maniatis.coldspringharborlaboratorypress,NewYork,2012
3. Essential cell biology : a practical approach volume 1: cellstructure.JohnDavey,J.Michaellord.Oxforduniversitypress,USA,2003

4.Microbiology-A LaboratorymanualP. Gunasekaran.Newagepublications,Newdelhi,1995.

5.Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T.Maniatis, 2ndEdition.ColdspringHarborLaboratorypress,NewYork,1989.

6.Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5th Edition, theMcGraw-Hillcompanies,2002.

7.Microbiology: ALaboratoryManual,J.G.CappuccinoandN.Sherman, Addison-Wesley,2002.

8.LaboratoryManualofExperimentalMicrobiology,R.M.Atlas,A.E.Brown andL.C.Parks,1995.Mosby,St.Louis,2002.

9.LaboratorymanualinGeneralMicrobiology,N.Kannan,Panimapublishers.

10.Bergey‟sManualofDeterminativeBacteriology.NinthEditionJ.G.Holt,N.R.Krieg.,LippincottWilliams,Wilkinpublishers,2000.

# VALUEADDEDCOURSES

* + 1. **MUSHROOMCULTIVATIONANDAPICULTURE**

**Paper code: Name ofthePaper:**MushroomCultivationandApiculture

**TotalHours perWeek:2 Credits:**2

**Aim: To exploit possibilities and assist in building up a mushroom cultivation and apiculture industry that will makeasignificantcontributiontothegeneraleconomy**.

1. Tomakethestudents toknowaboutmushroomand their types.
2. Toenable thestudentstolearnthemushroomspawnproductionconditions.
3. Tomakethestudents learnaboutmushroomcultivationandmaintenance.
4. Tomakethestudentstoknowaboutapiculturescopeandbeekeepingandtypes.
5. Toenable thestudentstounderstandtheimportanceofhoneyandapplications.

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Thestudentwillbeabletodifferentiatetheedibleandpoisonousmushrooms.
2. Thestudentwillbeabletodevelopmushroomscultureconditions.
3. Thestudentwillbeabletopracticethemushroomcultivationandproduction.
4. Thestudentwillbeabletopracticethebee keepingandculturemaintenance.
5. Thestudentwill beabletoproduceandanalyze theapplications ofhoneyin differentFields.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNITI | History of Mushroom, cultivations and its practice, Introduction tomushroom cultivation, Classification of Mushrooms and differenttypes,EdibleMushrooms,itstypesandtheirorigin,PoisonousMushrooms,itstypesandtheirorigin. | 18 hours |
| UNIT-II | Introduction to mushroom cultivation, sources of beds and types,Spawn, Sources, spawn run, cultivation set up, Culture ventilationandhumiditymanagement,temperature,lighting,moisture,pH,CO2,Culturechamberspreparation,sterilization,Instructions,precautions,handlingandsensors. | 18 hours |
| UNIT –III | Mushroomcultivationmaintenance,conditions,andduration,Spawncollection,preparation,storage,Spawningtechniques,Environmentalconditions,temperature,moist,Fruiting initiation,monitoring,maintenanceandharvest. | 18 hours |
| UNIT–IV | Introductiontoapiculture,definitions,history,scope,importanceofapiculture,BeeKeepingmethodspracticedinworldandinIndia,  TraditionalBeekeepingtechniques,ModernBeekeepingmethods,UrbanBeekeepingmethods. | 18 hours |
| UNIT-V | Introduction to nutritional product of honey and its constituents,Honeypropertiesbiologicalactivities,medicinalvalues,ApplicationsofHoneyinvariousfields,Honeytypesandvalue  addedhoneyproducts. | 18 hours |
|  | Total Lecturehours65hours | 90 hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Textbook:

1. PaulStamets,J.S.andChilton,J.S.2004.MushroomcultivationApracticalguidetogrowingmushroomsathome,AgarikonPress.
2. TewanandPankajKapoorS.C.1993.Mushroomcultivation.MittalPublication.Delhi.
3. Marimuthetal.,1991.OysterMushrooms.Dept.ofPlant pathology,TNAU,Coimbatore.
4. NitaBahl.1988.HandbookofMushrooms,2ndEdition,VolI&II.
5. ShuFingChang,PhilipG.MilesandChang,S.T.2004.MushroomsCultivation,nutritionalvalue,medicinaleffectandenvironmentalimpact.2nded.,CRCpress.
6. Prost,P.J.(1962).Apiculture.OxfordandIBH,NewDelhi.
7. BishtD.S.,Apiculture, ICARPublication.
8. SinghS.,BeekeepinginIndia,IndiancouncilofAgriculturalResearch,NewDelhi

# ReferenceBook:

1. Laidlaw,H.H., 1997.Contemporaryqueenrearing. PublishedbyDadantandSons.R. A.Morse, Rearingqueen honeybees.Wicwas press, NYAlisonBenjamin,By(author)BrianMcCallum,2008. KeepingBeesandMakingHoney.David&Charles,NewtonAbbot.
2. KimPezza,2013.BackyardFarming: KeepingHoneyBees:FromHiveManagementtoHoneyHarvestingandMore.HatherleighPress, U.S.
3. KimFlottum,2014.TheBackyardBeekeeper:AnAbsolute Beginner'sGuide toKeepingBeesinYourYardandGarden.QuarryBooks.
4. Kannaiyan,S.Ramasamy, K.(1980). A hand bookofediblemushroom,Today&TomorrowsPrinters&Publishers,NewDelhi.
5. Pandey B P 1996. A textbook of fungi.Chand and Company N 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

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# VALUEADDEDCOURSES

* + 1. **VERMICULTURETECHNOLOGY**

**Paper code: NameofthePaper:**VermicultureTechnology

**Credits:**2 **TotalHours perWeek:**2

**Aim:ToexploitpossibilitiesandassistinbuildingupaVermiculturetechnologyinsignificantcontributiontothegeneraleconomy.**

# CourseObjectives

1. ToenablethestudentslearnaboutVermiculturecompositing.
2. Toenable thestudentstoknowthehumuscycle,soiltransformation
3. Toenablethestudentsanalyzethenutritionalcompositionofvermicompost.
4. ToenablethestudentstolearnVermiculturetechnology.
5. Toenable thestudentstolearntheharvestofvermicompost.

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Thestudentwill beabletounderstandtheVermicultureand4R’sofrecycling.
2. Thestudent willbeabletoidentifythedecomposingorganicmatterandhumusformation.
3. Thestudentwillbeabletodifferentiatenutritionalvalueofvermicompostandfertilizer.
4. ThestudentwillbeabletopracticetheVermiculturecompostingandmaintainconditions.
5. ThestudentwillbeabletoproduceVermiculturecompost,harvest thecompost andapplication.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNITI | IntroductiontoVermiculturetechnology,definition,meaningandhistory, Economic importance of Vermiculture, their value in soiltexture, Concept of recycling, Concept of four r’ s reduce, reuse,recycleandrestore. | 18 hours |
| UNIT-II | Introductiontomatter,typesofmatter,IntroductiontoHumus,Humus cycle, Sources, quality of products for Humus formation,Groundpopulation,andtransformationprocessin organicmatter. | 18 hours |
| UNIT –III | Introductionofplantfertilizers,nutritionalvalueandtheirimportance, Vermicompost composition and its nutritional value,Importanceofvermicompostasfertilizerforplants,Comparisonof  vermicompostwithotherfertilizers. | 18 hours |
| UNIT–IV | Introduction to vermibeds, sources,types, Preparation of vermibeds,  measurements, Maintenance of vermicompost, Compositingconditions,moist,temperature,aeration. | 18 hours |
| UNIT-V | Vermicompostidentification,conditions,andseparation,compostpacking, sources and methods, Compost storage, conditions anddurations,Vermicomposthandlingandtransport. | 18 hours |
|  | Total Lecturehours65hours | 90 hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Textbook:

1. Kevin,AandK.E.Lee (1989)“EarthwormforGardenersandFisherman”(CSIRO,Australia,DivisionofSoils)
2. RahudakarV.B.(2004).GandulkhatashivayNaisargeekParyay, AtulBookAgency,Pune.
3. Satchel,J.E.(1983)“EarthwormEcology”ChapmanHall, London.
4. Wallwork,J.A.(1983)“EarthwormBiology”EdwardArnold(Publishers)Ltd.London.
5. SultanAhmedIsmail, 2005.TheEarthwormBook,SecondRevisedEdition.OtherIndiaPress,Goa,India.2.Bhatnagar&Patla,2007.
6. Earthwormvermicultureandvermin-composting,KalyaniPublishers,NewDelhi

# ReferenceBook:

1. Bhatt J.V. & S.R. Khambata (1959) “Role of Earthworms in Agriculture” Indian Council of Agricultural Research,NewDelhi2.
2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) “ Verms and Vermicomposting” Proceedings of the National Seminaron Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, SambalpurUniversity,JyotiVihar, Orissa.
3. Edwards,C.A.andJ.R.Lofty(1977)“BiologyofEarthworms” Chapman andHallLtd.,London.
4. Lee, K.E. (1985) “Earthworms: Their ecology and Relationship with Soils and Land Use” Academic Press, Sydney. 5.Kevin,AandK.E.Lee (1989) “EarthwormforGardenersandFisherman” (CSIRO,Australia, DivisionofSoils)
5. MaryVioletChristy,2008.Vermitechnology,MJPPublishers,Chennai.
6. AravindKumar,2005.Verms&Vermitechnology,A.P.H.PublishingCorporation,NewDelhi.

# CourseMaterial:websitelinks,e-Booksande-journals

* 1. VermicultureTechnology,Earthworms,OrganicWastes,andEnvironmentalManagementEditedByClive

A.Edwards,NormanQ. Arancon,RhondaL.Sherman,

* 1. https://[www.scirp.org/journal/paperinformation.aspx?paperid=2490,](http://www.scirp.org/journal/paperinformation.aspx?paperid=2490)**DOI:**10.4236/ti.2010.13019

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# VALUEADDEDCOURSE(VAC-C)

**C)VALIDATIONOFMEDICINAL PLANTS**

**Paper code: NameofthePaper:**ValidationofMedicinal plants

**Credits:**2 **TotalHours perWeek:**2

**Aim: The course aims to introduce the students to the identification and validation of medicinalplantand to understand the cultivation and propagation techniques. To understand the importance ofmedicinalplantsinhumanhealthcare.**

# CourseObjectives

1. Toenable thestudentstounderstandtheimportanceofmedicinalplants.
2. Toenable thestudentstoidentifythemedicinalplants.
3. Toenable thestudentstolearnthetechniquesof validationofmedicinalplants.
4. Toenablethestudentstolearnthecultivationmethodsandmaintenanceofmedicinalplants.
5. Toenable thestudentstounderstandtheimportanceofmedicinalplantinhumanhealth.

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Thestudentwill beabletogain knowledgeaboutimportanceofmedicinalplantparts anditsmedicinalvalue.
2. ThestudentwillbeabletoclassifythemedicinalplantsonBenthamandHookerandPracticeherbariumtechniques.
3. ThestudentwillbeabletoidentifythemedicinalvaluesofplantsusingdifferentvalidationTechniques.
4. Thestudentwill beabletocultivate andpropagatethemedicinalplants
5. ThestudentwillbeabletopracticetheusageofmedicinalplantsintreatmentofhumanDiseases.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNITI | Introduction to Medicinal plants, meaning, definition and types,Medicinal properties of plants and their importance, Medicinalvalues in plant parts, fruits, stem, leaves and roots, Leaf, fruit,rootandstemmodifications,aerialandunderground. | 18 hours |
| UNIT-II | IntroductiontoMedicinalplantidentification,Elementaryknowledgeofbinomialnomenclature,BenthamandHookerclassification,Herbarium,preparationandpreservation. | 18 hours |
| UNIT –III | Introductiontovalidationofmedicinalplants,Macroscopiccharacteristics of medicinal plants, Microscopic characteristics ofmedicinal plants, Chemical compounds and tests of medicinalplants, Chromatographic techniques for validation TLC, HPLC,HPTLC& gas,Chromatography. | 18 hours |
| UNIT–IV | Introductiontomedicinalplantcultivation,Cultivationtechniques, and factors affecting cultivation of medicinal plants,Propagationofmedicinalplantsanddifferentmethodsofpropagation,Managementand Maintenance ofmedicinalplants. | 18 hours |
| UNIT-V | Importance of medicinal value in plants, Medicinal properties ofplantsinhumanhealthanditsrole,advantages,Roleofmedicinal plants in prevention and treatment of human diseases,TraditionalknowledgeandutilityofIndianmedicinalplants. | 18 hours |
|  |  | 90hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Textbook:

1. Indian MedicinalPlants byP.C.Trivedi(2009).
2. MedicinalPlantsofIndianHimalayabyS.S.SamantandU.Dhar.
3. IndianMedicinalPlants(Vol1-4)byK.R.KirtikarandB.D. Basu(2006).
4. IndigenousMedicinalPlantsSocialForestry&TribalsbyM.P.Singhetal.(2003).
5. AyurvedicDrugs andtheirPlantSourcesbyV.V.Sivarajan& I. Balachandran,Oxford &IBH(1994).
6. TheHandbookof AyurvedaShanthabyGodagama,BishenSinghMahendrpalSingh,Dehradun(2004).
7. Direct usesofmedicinalplantsandtheiridentificationbyVardhana,SarupandSons,AnsariRoad,DariyagaNewDelhi(2008).
8. Medicinalplants,appliedbiologyofdomesticationandexportbyK.Singh,S.K.Tyagi,BishenSinghMahendrapalSinghDehradun.
9. QualityControlMethodsforMedicinalPlantsMaterials,W.H.O.(1998).
10. EvaluationofherbalmedicinalproductsbyHoughton

# ReferenceBook:

1. AClassBookofBotany.A.C.Dutta.OxfordUniversityPress.
2. Cultivation ofMedicinalPlants byC.K. Atal &B.M. Kapoor.
3. Hartmann,H.T&Kester,D.E (1989).Plant Propagation–PrinciplesandPractices. PrenticeHall ofIndia.
4. AwadeshN,GhoeamiAand Sharma R,Indigenous HealthCare andEthnomedicine, Sarupand Sons.
5. MedicinalPlantsCultivation:AScientificApproachbyS.S.Purohit,(2004).
6. BrunetonJean,CarolineK.Hatton,Pharmacognosy,Phytochemistry,Medicinalplants.Lavoisier,1999.ISBN1898298637.
7. NikolausJ.Sucher,MariaC.Carles,Genome-Based Approachesto theAuthenticationofMedicinalPlants.PlantaMed.,74:603–623;2008.
8. WHOguidelinesongoodagriculturalandcollectionpractices(GACP)formedicinalplants,WorldHealthOrganization,Geneva,2003.
9. IqbalAhmad,FarrukhAqil,andMohammadOwais,ModernPhytomedicine:TurningMedicinalPlantsintoDrugs.WILEY-VCHVerlagGmbH&Co.KGaA,Weinheim,2006.ISBN-10:3-527-31530-6.
10. VedD.K.&Goraya,G.S.Demand&supplyofmedicinalplantsinIndia,NMPB,NewDelhi&FRLHT,Bangalore,India,2008.

# CourseMaterial:websitelinks,e-Booksande-journals

1. PlantaMedica,Issue13·Volume79·August2013.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)

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER II**

**PAPER1 : Natural Resource**

Papercode:Subject:**Natural Resource**

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the concept of classification, composition, physico- chemical characteristics .

**CourseObjectives**

1.Tolearnthesolar radiations and its spectral characteristics

2.Tolearn the Principles of generation

3.TodevelopknowledgeonNuclear energy

4.Tolearn the Mineral resources and reserves

5.Todevelopapieceofknowledgeinneed areas for exploitation of Mineral resources.

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand source of energy

7.Aftercompletingunit2,thestudentswill able to underdstand

the Principles of generation of hydroelectric power

8. Afterstudyingunit3,thestudentswillbeable to explain Impacts of large scale

exploitation of solar, wind, hydro and ocean energy.

9.Afterstudyingunit4,thestudentswillbeabletoexplain the recycling of resources

10. Afterstudyingunit5,thestudentswillbeabletoexplain the recycling of resources

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | .  Sun as a source of energy, solar radiations and its spectral characteristics, fossil fuels- classification, composition, physico- chemical characteristics and energycontent ofcoal, petroleum and Natural gas. | **18 hours** |
| **Unit-II** | Principles of generation of hydroelectric power, tidal power, thermal energy conversion, wind, geo thermal energy, solar collectors, photovoltaic, solar ponds, oceans. | **18 hours** |
| **Unit-III** | Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas, anaerobic digestion, energy use patterns in different parts of the world. Impacts of large scale exploitation of solar, wind, hydro and ocean energy. | **18 hours** |
| **Unit-IV** | Mineral resources and reserves, ocean ore and recycling of resources, Environmental impact of exploitation, processing and smelting of Mineral, oceans as need areas for exploitation of Mineral resources. | **18 hours** |
| **Unit-V** | Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. Livingintheenvironmental-T.J.Miller.
2. Naturalresourceconservation-Owen&Chiras.
3. EncyclopediaEnergy-I& II.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER II**

**PAPER2 .: Environmental microbiology**

Papercode:Subject:**Environmental microbiology**

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the concept of organisms in nature&their importance and also the uses in Environmental management recycling &up gradationtechnologies

**CourseObjectives**

1.Tolearnthemicrobes in service of nature

2.Tolearn the Microbial Reactors

3.Todevelopknowledgeonmicrobiology of anaerobic fermentation

4.Tolearn the Environmental problems

5.Todevelopapieceofknowledgeinmicrobes as pathological agent in plant, animal and man.

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand organisms in nature&their importance

7.Aftercompletingunit2,thestudentswill able to understand up gradationtechnologies and

Productionofproducts

8.Aftercompletingunit3,thestudentswillbeable to explain microbiology

of anaerobic fermentation.

1. Afterstudyingunit4,thestudentswillbeabletoexplain the Environmental problems &

Environmentalmonitoringthroughmicroorganism.

1. Afterstudyingunit5,thestudentswillbeabletoexplain the Microbial diversity.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | .  Microbiology- organisms in nature&their importance, sampling, culture&cultivationof microorganisms, microbes in service of nature & mankind, batch culture & continuous culture of microbes for commercial use. | **18hours** |
| **Unit-II** | Microbial Reactors, genetically modified microbes & their uses in Environmental management recycling &up gradationtechnologies, Productionofproducts,energyform waste. | **18hours** |
| **Unit-III** | Biogas technology, plant design, construction, operation, biogas form organic wastes, water weeds, land fills, microbiology of anaerobic fermentation. | **18hours** |
| **Unit-IV** | Biotransformation, bioconversion, bioremediation, phytoremediation technology, fermentation technology, development of stress tolerant plants, Environmental problems &Environmentalmonitoringthroughmicroorganism, microbiologyofwater,airandsoil, microbes as pathological agent in plant, animal and man. | **18hours** |
| **Unit-V** | Microbialdiversity-methodstoassessmicrobialdiversity,Culturedependent,andculture-independentmethods.Molecularanalysisofbacterialcommunity;DenaturatingGradient Gel Electrophoresis (DGGE), Terminal RestrictionFragmentLength(TRFL)Polymorphism(T-RFLP),AmplifiedRibosomalDNAandRestrictionAnalysis(ARDRA). | **18 hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1 . Principles of microbiology - Pelzar 2.Microbialbiotechnology-A.N.Glazer 3. Microbial ecology - R.M. Atlas 4.Molecular biology - H.D. Kumar

1. Environmentalbio Technology- Sayler&Fox

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER II**

**PAPER3.: Environmental Chemistry**

# Papercode:Subject:Environmental Chemistry

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the conceptStochiometry, Gibb’s energy and also the Classification of elements and also the thermodynamics

**CourseObjectives**

1.TolearntheChemical potential and solubility of gases in water

2.Tolearn the Chemical processes for formation of inorganic and organic particulate matter

3.Todevelopknowledgeonlaw of thermodynamics

4.Tolearn the Chemistry of air pollutants

5.Todevelopapieceofknowledgeinnitrogen pathways.

# Course Outcomes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Chemical potential and equilibria reactions.

7.Aftercompletingunit2,thestudentswill able to understand the Chemical process and

Thermochemical and photochemical reactions in atmosphere.

8. Aftercompletingunit3,thestudentswillbeable to explain Laws of thermodynamics .

9.Aftercompleting unit4,thestudentswillbeabletoexplain Treatment off Water and ozone chemistry.

10. Aftercompleting unit5,thestudentswillbeabletoexplain about the Bio corrosionandmicrobialmediatedrecovery.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | .Stochiometry, Gibb’s energy, Chemical potential, Chemical equilibria, acid-base, reactions. Solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, Radio nuclides. | **18hours** |
| **Unit-II** | Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. | **18hours** |
| **Unit-III** | Firstlawofthermodynamics,enthalphy,adiabatictransformations,secondlawof thermodynamics, Carnot’s cycle, entropy, Gibb’s free energy, chemical potential, phase equilibria, Gibb’s Donnan equilibrium, third law of thermodynamics, enzymes catalysis, Michaelis/ Menten equation | **18hours** |
| **Unit-IV** | Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical Smog, Chemistry of water, concept of D.O., B.O.D., and C.O.D, water treatment : Sedimentation, Coagulation, Filtration, tertiary and advanced treatment, redox potential, Inorganic and organic components of soil, nitrogen pathways and NPK in soils | **18hours** |
| **Unit-V** | Biocorrosionandmicrobialmediatedrecovery:Microbialcorrosionanditscontrol(petroleumindustryandcoolingtowersystem).Biometallurgy-Bioleaching-application,biotechnologyapproachesforheavymetaleliminationfromeffluents.Bio-mediatedrecoveryofmetals(goldandplatinum).Recoveryofpetroleum-MEOR-Biosurfactant. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. .EnvironmentalChemistry-G.S.Sodhi
2. EnvironmentalChemistry-Mannhan
3. Fundamantalsofsoilscience -HenryD. Futh
4. Textbookoflimnology-G.A.Cole
5. EnvironmentalChemistry-Sharma andKaur

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER II**

**PAPER4. Environmental modeling and Biostatistics.**

Papercode:Subject:**Environmental modeling and Biostatistics.**

**Hours/Week:5 Credits:4**

# Aim: To enable the students to understand the concept of Measurement of central tendency and also the random variable and also the modelling in environmental sciences and also the population growth and interactions.

**CourseObjectives**

1.TolearntheMeasurement of central tendency and Correlationand linearregression

2.Tolearn theBasic concepts of binomial and normal distributions and hypothesis and significance.

3.TodevelopknowledgeonModel classification ,Methods for formulation of dynamic

balance equations mass balance procedures.

4.Tolearn the Models of population growth and interactions.

5.Todevelopapieceofknowledgeinstages involved in model building.

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Basic laws and concepts

7.Aftercompletingunit2,thestudentswill able to understand the tests of hypothesis and significance

8. Afterstudyingunit3,thestudentswillbeable to explain Role of modelling in environmental sciences

9.Afterstudyingunit4,thestudentswillbeabletoexplain.Models of population growth and interactions

10. Afterstudyingunit5,thestudentswillbeabletoexplain about simple growth kinetics.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis, Correlationand linearregressionofone independent variable,Basic laws and conceptsof probability | **18hours** |
| **Unit-II** | Definition of random variable, density function, Basic concepts of binomial and normal distributions,Samplingmeasurementanddistributionofattributes,Moments,matricsand simultaneous linear equations, tests of hypothesis and significance. | **18hours** |
| **Unit-III** | Role of modelling in environmental sciences, Model classification deterministic models, stochastic models, steady state models, dynamic models, Different stages involved in model building. | **18 hours** |
| **Unit-IV** | Models of population growth and interactions Lotka Volterramodel, Leslies matrix model, Point source streampollution, Box model, Gaussian plume model, Linear, simple and multiple regression models, validation and forecasting. | **18 hours** |
| **Unit-V** | Simple microbial growth kinetics monod equation, Methods for formulation of dynamic balance equations mass balance procedures. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. DynamicsofEnvironmentalBioprocesses-Modellingandsimulation-SnapeandDunn.
2. EnvironmentalModeling- Jorgense

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER II**

**ELECTIVE PAPER5 : Enzyme Technology**

# Papercode:Subject:Enzyme Technology

**Hours/Week:5 Credits:2**

**Aim:Toprovideknowledgeofvariousenzymesandenzymetechnologyappliedintheindustries.**

# Courseobjectives:

* 1. To Learn abouttheclassificationandstructurepropertiesofenzymes
  2. ToUnderstandthekinetics,catalysisandinhibitionsactivitiesofenzymes
  3. Tounderstandphysicalproperties,downstreamprocessandpurificationofenzymes.
  4. ToExpeditehowenzymesareusedasco-factors.
  5. ToEnrichthestudents’knowledgewithrespecttodifferent applicationsofEnzymes

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

* 1. Afterstudyingunit-1,thestudentwillbeable toknowaboutbasicknowledgeofenzymes
  2. Afterstudyingunit-2,thestudentwillbeabletounderstandmechanismofenzymeactivities
  3. Afterstudyingunit-3,thestudentwillbeable tounderstandphysicalpropertiesofenzyme.
  4. Afterstudyingunit-4,the studentwillbeable tofunctionofenzymeindifferentprocesses.
  5. Afterstudyingunit-5,the studentwillbeabletoknowvariousapplicationofenzymetechnologies.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | Introductiontoenzymes:Historyofenzymes,nomenclatureandclassificationofenzymes.StructuralfeaturesofEnzymes:Chemicalnature of Enzymes: amino acids, protein structure: Primary, secondary,tertiaryandquartenerystructure.SpecificityofEnzymes:Typesofspecificity, thekoshland“induced fit”hypothesis, strain or transition-state  stabilizationhypothesis. | 18 hours |
| UNIT-II | Enzyme Catalysis and Kinetics: Factors affecting the rate of chemicalreactions, kinetics of un catalyzed chemical reactions, kinetics of enzymescatalyzedreaction,methodsforinvestigatingthekineticsofenzyme-  catalyzedreaction,natureofenzymecatalysis,inhibitionofenzymeactivity. | 18hours |
| UNIT–III | Extraction and purification of microbial enzymes : Importance of enzymepurification, different sources of enzymes. Extracellular an intracellularenzymes. Physical and Chemical methods used for cell disintegration.Enzymefractionationby precipitation(using Temperature,salt,solventpH,etc.),liquid-liquidextraction,ionicexchange,gelchromatography,affinity chromatography and other special purification methods, Enzymecrystallizationtechniques.Criteriaofpurityofenzymes.Pitfallsin  workingwithpureenzymes. | 18hours |
| UNIT –IV | Enzymes inhibition and Co-factors: Irreversible, reversible, competitive,non-competitive and un-competitive inhibition with suitable examples andtheirkineticstudies.Allostericinhibition,typesofallostericinhibitionandtheirsignificanceinmetabolicregulation&theirkineticstudyVitaminsandtheirco-enzymes:Structureandfunctionswithsuitable  examples ,Metallo enzymes and Metal ions as co-factors and enzymesactivators. | 18hours |
| UNIT-V | Immobilization of microbial enzymes and Enzyme Engineering: Methodsviz. adsorption, covalent bonding ,entrapment& membrane confinementand their analytical, therapeutic & industrial applications. Applications ofmicrobial enzymes: Microbial enzymes in textile ,leather, wood industriesanddetergents.Enzymesinclinicaldiagnostics.Enzymesensorsforclinicalprocessesandenvironmentalanalyses.Enzymesastherapeutic  agents. | 18hours |
|  | Total Lecturehours | 90hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# TextBook(s)

1. IntroductiontoproteinsStructurebyBrandenandTooze(1998):GarlandPublishingGroup.
2. Biotechnology.Volume7A-EnzymesinBiotechnology.1983EditedbyH.J.RehmandG.Reed.VerlagChemie.
3. MethodsofEnzymaticanalysisbyHans Ulrich, Bergmeyer,AcademicPress.
4. MethodsinEnzymologybyW.A.Wood,AcdemicPress.
5. TopicsinEnzymeand FermentationBiotechnologybyL.N.Wiseman,JohnWileyand sons

# ReferencesBooks

1. Enzymesbypalmer(2001):Horwoodpublishingseries.
2. Fundamentals ofEnzymologybypriceandStevens(2002):OxfordUniversityPress.
3. EnzymeTechnologybyHelmutUling(1998):JohnWiley.
4. MethodsinEnzymology. Volume22-Enzymepurificationandrelatedtechniques.EditedbyWilliamB.Jakoby.Academicpress,NewYork.
5. AllostericEnzymes-KineticBehaviour.1982.ByB.I.Kurganov,JohnWileyandSons. Inc.,NewYork.
6. EnzymesasDrugsEditedbyJohnS.HolcenbergandJosephRoberts,JohnWiley&sonsNewYork.
7. Advancesin EnzmologybyAltonMeister,IntersciencePublishers.

# MappingwithProgrammeOutcomes

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# ELECTIVEII:(B)DAIRYTECHNOLOGY

**Paper code: NameofthePaper:**DairyTechnology

**TotalHours perWeek:**3 **Credits:2**

**Aim:Toimpartcurrentknowledgeofbasicandappliedmicrobiologicalaspectsoffluidmilksanddairyproductsforimprovedqualityandfoodsafety.**

# Courseobjective:

1. Toteachthemicrobialknowledge inmilk
2. Tolearntheprocessingof milkmicrobiologicalmethods
3. Tounderstandhowthemilkproductsarein qualitymake through dairyindustry
4. Tomade knowledge indifferentiatethetraditionalandindustrialmake dairyproductsanditsprocessing
5. Toaware thestudentsaboutmilkborne diseases

**Courseoutcome**

* 1. Afterstudyingunit-1,thestudentwillbeable toknowaboutbasicknowledgeofmilkmicrobesanditschangesinmaintainingthestorageofmilk.
  2. Afterstudyingunit-2,thestudentwillbeable tounderstandmechanismofprocessingofmilkthroughmicrobiologicalmethods
  3. Afterstudyingunit-3,thestudentwillbeable tounderstanddairyproductsqualityanditschangesthroughmicrbes
  4. Afterstudyingunit-4,thestudentwillbeabletodifferentiatedairyproductsinindustryandhomemade.
  5. Afterstudyingunit-5,thestudentwillbeabletoknowvariousapplicationofmilkandmilkbornemicrobialdiseases.

**MatchingTable(PutYes/Nointheappropriatebox)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | Commonmicrobesinmilkandtheirsignificance.sourcesofmicrobial contamination of raw milk in influencing quality of milkduringproduction,collection,transformationandstorage.Cleanmilk production and antimicrobial systems in raw milk. Microbialchangesinrawmilkduringlongstorage.Microbiological gradingof  rawmilk. | 18hours |
| UNIT-II | Microbiologicalprocessingtechniques:bactofugation,thermization  ,pasteurization, sterilization ,boiling ,UHT, non thermal processesand membrane filtration of milk role of psychrophilic mesophilic,thermophilic and thermoduric bacteria in spoilage of processedmilksandpreventionmicrobiologicalstandards(BIS/PFA)ofheattreatedfluidmilks. | 18hours |
| UNIT–III | Microbiologicalqualityofdairyproducts;fatrich(creamandbutter),frozen (ice cream),concentrated (evaporated and condensedmilk),driedmilks(roller andspraydried),infantdairy foodsandlegal standards. Factors affecting microbial quality of these productsduringprocessing,storageanddistribution.Probioticsandprebiotics(GRAS),cloning-sanitation,controlofmicroorganismsin  dairyprocessing | 18hours |
| UNIT–IV | Microbiology quality of traditional dairy products; heat desiccated(khoa,burfi,peda,kheer),acidcoagulated(paneer,chhana,rasgulla), fermented (lassi, srikhand)and frozen (kulfi).sources ofmicrobial contaminants and their role in spoilage. Importance ofpersonnelandenvironmentalhygieneonqualityoftraditionalmilk  products.microbiologicalstandardsforindigenousdairyfoods. | 18hours |
| UNIT-V | Milk-bornediseases–viralandbacterial,zoonoticinfections  ,pathogens associated with fluids milks, dairy products and theirpublic health significance. sources of pathogens and theirprevention .importance of bio flims, their role in transmission ofpathogensindairyproductsandpreventivestrategies.regulatorycontrol of dairy products, testing of milk and milk products,treatmentofdairywastes. | 18 hours |
|  | TotalLecturehours65hours | 90 hours |

# InternalAssessmentMethods:(25 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

**TextBooks:**

* + 1. AdamsMRandMossMO.(1995).foodmicrobiology,theroyalsocietyofchemistry,Cambridge.
    2. AndrewsAT,VarleyJ(1994)biochemistryofmilkproducts.Royalsocietyofchemistry.
    3. BanwartGJ(1989),basicfoodmicrobiology,Chapman&hall,newYork.
    4. FrazierWCandWesthoffDC.(1988)foodmicrobiology,TATAMcGraw hillpublishingcompanyLtd.NewDelhi.

**References**

1. HobbsBCandRobertsD.(1993)foodpoisoningandfoodhygiene,EdwardArnold(adivisionofHodderandStoughton),London.
2. MayJM.(1987)modernfoodmicrobiology,CBS publishersanddistributors,NewDelhi.
3. RobinsonRK.1990.themicrobiologyofmilk.ElsevierappliedScience.London
4. EdwardHarth,J.T.Steele.Applieddairymicrobiology.1998.MarcelDeekerInc.
5. Modi,HA(2009)dairymicrobiologypointerpublishers,India.Marth,E.Handsteel

J.L(2001)appliedDairymicrobiology,2ndEdition,MarcelDekker,Inc.270MadisonAvenue,newYork,NewYork10016.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# ELECTIVEII:(C)PHARMACEUTICALTECHNOLOGY

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

# Courseobjectives

1Tolearn drugsanditsinvolveddetoxificationthroughphase1&2reactions2Toteachdrugmechanismlikepassiveandactivephases

1. Tolearn thedrugsmanufacturebiotechnological pharmaceutical industry
2. Tounderstandtheimportanceofdrugsintreatingvariousmetabolicdisorders5Toteachvariousapplicationsofdrugsinvariousfields.

CourseoutComes(fiveoutcomesforeachunitsshouldbementioned)

* 1. Afterstudyingunit-1,thestudentwillbeable toknowaboutbasicknowledgeofdrugsofphaseI&II
  2. Afterstudyingunit-2,thestudentwillbeable tounderstanddrugmechanismanditsadverseeffects.
  3. Afterstudyingunit-3,thestudentwillbeable tounderstandbiotechnologyindrugdevelopment,especiallyforAIDS
  4. Afterstudyingunit-4,thestudentwillbeable toknowdrugsand itsimportancevarioustreatment likediabetes,cancer,lipidemiaandinfertility
  5. Afterstudyingunit-5,the studentwillbeabletoknowvariousapplicationof drugdependenceandabuse-management

**MatchingTable(PutYes/Nointheappropriatebox)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | Drug- structural feature and pharmacology activity, pro drugconcept.Absorption–first–passeffect.distributor,metabolism- phase I, II reactions, action of cyto chrome p450 &elimination of drug receptor- localization, type and subtypes,modelsandtheirdrug-receptorinteraction,against&  antagonist . | 18 hours |
| UNIT-II | Adverseresponsetodrugs,drugtolerance,drugintolerance,  Idio SYNERACY (pharmacogenesis), drug allergy.Tachyphylaxis,drugabuse,vaccinationagainstinfection | 18 hours |
| UNIT–III | Biotechnology and pharmacy:genetically engineeredproteinandpeptideagents.noveldrugdeliverysystems–nonconventionalroutesofadministration.AntiAIDSdrugdevelopment,oncogenestargetfordrugs,multi-drugs  resistance. | 18 hours |
| UNIT–IV | Mechanism of action of drugs used in therapy of :respiratorysystem-cough,bronchial-asthma,pulmonarytuberculosis.GIT  –digestents,appetitesuppressants.hypolipidemiaagents,,vomiting, constipation and peptic ulcer. antimicrobial drugs-sulfonamides,trimethoprim,cotrimoxazole,penicillinandmacrolides.aminoglycosides,cephalosporinandbacterialresistance .Insulin and oral diabetic drugs, antifertility andovulationinducingdrugs. | 18 hours |
| UNIT-V | Drugs of plant origin: drug dependence and abuse- managementofselfpoisoningcancer.Chemotherapy-cytotoxicdrug.immunosuppressivedrugtherapy.Newbiologicaltargetsfor  drugdevelopment.Noveldrugscreeningstrategies. | 18 hours |
|  | Total Lecturehours | **90 hours** |

# InternalAssessmentMethods:(25 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

**TextBook:**

* + 1. ThepharmacologyVolIandVolII–GoodmanandGillman,McGrawHillprofessional;12ed(2010)
    2. Basicpharmacology–Foxtercoxbulterworth‟s1980.

Pharmacology and pharmaco therapeutics –R.S.Satoskar.S.D.Bhandhhakar&S.S.AnilapurepopulPrakasharBombay.

**Reference**

* + - 1. Principlesofmedicalchemistry–WilliamO.Foge.B.I.WaverksPvt Ltd, NewDelhi.
      2. Oxfordtextbooksofclinicalpharmacologyanddrugtherapy.D.G.Burger‟sMedicalchemistry&drugdiscovery.
      3. Principlesandpractice–Manfred.E.WolfJohnWileyandsons.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**PRACTICALIII**:**LABINIMMUNOLOGY AND**

**LABINGENETICENGINEERINGANDBIOINFORMATICS**

# (10 credit)

1. Bloodgrouping
2. Lymphocytesubsetidentificationandenumeration.
3. Radialimmuno-diffusiontest.
4. Ouchterlonydoublediffusion
5. Immunoelectrophoresis
6. RocketImmunoelectrophoresis
7. LatexAgglutination
8. QuantitativePrecipitinassay
9. Complementfixationtest
10. ELISA
11. WesternBlotting
12. Antigen-antibodyreaction(precipitationandagglutinationreactiontests)

# GENETICENGINEERING

1. IsolationofgenomicDNAfrom thegivensample anditsmolecularweightdetermination
2. IsolationofRNAfromthegivensampleanditsmolecularweightdetermination
3. IsolationofplasmidDNAfrom thegivensample
4. RestrictiondigestionofLambdaphageDNA
5. LigationofDNAandanalysisbyelectrophoresis
6. DNAamplificationbyPCRandRAPD
7. Preparationofcompetent cellsandtransformationbyCaCl2methodand SelectionoftransformedcolonybyX-Galmethod
8. DeterminationofmolecularweightofproteinsbySDSPAGE

# BIOINFORMATICS

* 1. Restrictionmapping
  2. PCRPrimerDesigning
  3. ORFfinding
  4. Homologysearch
  5. Multiplesequencealignment

# References:

1. PracticalImmunology.FranckC.Hay,OlwynM.R.Westwood.Wiley-Blackwellpublications,2010.
2. immunoassays:APracticalApproach.JamesP.Gosling(editor).Oxforduniversitypress,USA,2010.
3. Labmanualin biochemistry,immunologyandbiotechnology.ArtiNigamArchanaayyagari.McGraw-Hilleducation,2008.
4. Practicalimmunology.RabindraNarain,dom& wisdompublications,2012

**SEMESTER III**

**PAPER1 .: Immunology**

Papercode: Subject:**Immunology**

**Hours/Week:5 Credits:4**

**Aim: To enable the students to understand the concept of anatomy of the immune system and also BandTlymphocytes and also the Antigen-antibodyinteractions and also about Vaccinology and also about the Immuno haematology.**

**CourseObjectives**

1.Tolearnthestrategies forComponentsofimmunity

2.Tolearn the Immunoglobulins

3.Todevelopknowledgeonimmunological techniques

4.Tolearn the Vaccine technology

5.Todevelopapieceofknowledgein Antibody genes and antibody engineering

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Fundamental concept of Immunology and Lymphatic system.

7.Aftercompletingunit2,thestudentswill able to understand the Immune response and

Principle of cell signaling

8. Afterstudyingunit3,thestudentswillbeable to explain. Immunoglobulin techniques

1. Afterstudyingunit4,thestudentswillbeabletoexplainVaccine technology .
2. Afterstudyingunit5,thestudentswillbeabletoexplainHypersensitivity.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Componentsofinnateandacquiredimmunity;Phagocytosis;Complementand Inflammatoryresponses;Haematopoesis;Organsandcellsoftheimmunesystem- primaryandsecondarylymphoidorgans;Lymphaticsystem;Lymphocytecirculation; Lymphocyte homing;MucosalandCutaneous associatedLymphoid tissue. (MALT&CALT);MucosalImmunity; Antigens-immunogens, haptens; Major HistocompatibilityComplex-MHCgenes,MHCandimmuneresponsivenessand disease susceptibility, HLA typing. | **18hours** |
| **Unit-II** | .Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Principles of cell signaling; Immunological basis of self – non-selfdiscrimination; Kinetics of immune response, memory; B-cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell- mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system. | **18 hours** |
| **Unit-III** | Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasma resonance, Biosenor assaysfor assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptotosis, Microarrays, Transgenic mice, Gene knock outs. | **18hours** |
| **Unit-IV** | Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries. | **18hours** |
| **Unit-V** | Hypersensitivity – types and mechanisms, Autoimmunity, Tumor and Transplantation immunology. Immune regulation mechanisms – brief account on immuno-induction, immunosuppression, immuno-tolerance, immuno-potentiation. Role of cytokines, lymphokines and chemokines | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

* 1. WilliamE.Paul,FundamentalImmunology,WoltersKluwer/LippincottWilliams & Wilkins.
  2. StephenKWikel,TheImmunology Host-Ectoparasiticarthropodrelationships. Cabinternational.
  3. HermanN.Eisen,MD,GeneralImmunology.J.B.LippincottCompany.F.M. Burnet, Immonology. W.H. Freeman and company
  4. Jack G. Chirikjian, Plant Biotechnology, Animal cell culture Immunobiotechnology. Jones and Bartlett Publishers.
  5. Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003. 9. Noel R. Rose, Herman Friedman, John L. Fahey. Manual of Clinical Laboratory Immunology. ASM. 3rd ed., 1986.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER III**

**PAPER2 : Cell and Molecular Biology**

# Papercode: Subject:Cell and Molecular Biology

**Hours/Week:5 Credits:4**

**Aim: To enable the students to understand the concept of Genome organization and also the DNA structure , Replication , Repair and Recombination and also the Prokaryotic and Eukaryotic Transcription and also the post Transcriptional Modification and microscopic techniques .**

**CourseObjectives**

1.TolearntheOrganization of bacterialgenome

2.Tolearn the Structure of DNA and Gene targeting

3.TodevelopknowledgeonProkaryotic & Eukaryotic Transcription

4.Tolearn the PostTranscriptionalModifications

## 5.Todevelopapieceofknowledgein Translation&Transport

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Genome Organisation.

7.Aftercompletingunit2,thestudentswill able to understand the DNA structure ; Replication.

8. Aftercompleting unit3,thestudentswillbeable to understand the Prokaryotic and Eukaryotic Transcription.

9.Aftercompleting unit4,thestudentswillbeabletounderstand the concept of post transcriptional

modification.

10.Aftercompleting unit5,thestudentswillbeabletoexplainthe concept of Translation machinery

and transport of proteins.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Organization of bacterialgenome; Structure of eucaryotic chromosomes; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin; DNA reassociation kinetics(Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting and buoyant density; Nucleosome phasing; DNase I hypersensitive regions; DNA methylation & Imprinting | **18hours** |
| **Unit-II** | .Structure of DNA - A-,B-, Z- and triplex DNA; Measurement of properties- Spectrophotometric, CD, AFM and Electron microscope analysis of DNA structure; Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation;Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous; Site specific recombination; Chi sequences in prokaryotes; Gene targeting; Gene disruption; FLP/FRT and Cre/Lox recombination. | **18 hours** |
| **Unit-III** | Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatoryelements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac,trp,ara,his,andgaloperons;Transcriptionalcontrolinlambdaphage;  Transcript processing; Processing of tRNA and rRNA Eucaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and post-transcriptional gene silencing | **18hours** |
| **Unit-IV** | Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA. | **18hours** |
| **Unit-V** | Translation&Transport Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications; Genetic code in mitochondria; Transport of proteins and molecular chaperones; Protein stability; Protein turnover anddegradation | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. DavidFreifelder,EssentialsofMolecularBiology,NarosaPublishingHouse.
2. George M. Malacinski, Essentials of Molecular Biology, Jones and Bartlett Publishers.
3. CornelMulhard,MolecularBiologyandGenomicsAcademicPressisanimprintof Elsevier.
4. Harvey Lodish,Arnold Berk, PaulMatsudaira,Chris-A.Kaiser,MontyKrieger,Mathew
5. P.Scott,S.LawrenceZipursky,JamesDarnell,MolecularCellBiology (Fifth adition), W.H.Freeman and company

New York.

1. Reimer, L. and Kohl, H. (2008) Transmission electron microscopy. Springer.
2. Sharma, V. K. (1991) Techniques in microscopy and cell biology. Tata McGraw Hill

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER III**

**PAPER3 .: Biotechnology**

Papercode: Subject:**Biotechnology**

**Hours/Week:5 Credits:4**

**Aim: To enable the students to understand the concept of Scope of environmental biotechnology and also the basic techniques in genetic engineering and also the Genetically modified organism .**

**CourseObjectives**

1.Tolearnthescope of environmental biotechnology

2.Tolearn the Basic techniques in genetic engineering

3.Todevelopknowledgeonconcept of genetic engineering of plants and its application

## 4.Tolearn the Liquid waste treatment, solid waste management

## 5.Todevelopapieceofknowledgein Biotechnological approaches for Fermentor and industrial

## process of beveage

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the scope of environmental biotechnology and also the fermentation technology.

7.Aftercompletingunit2,thestudentswill able to understand the techniques in genetic engineering.

8 Aftercompleting unit3,thestudentswillbeable to understand the concept of genetic

engineering in plants and its applications

9.Aftercompleting unit4,thestudentswillbeabletoexplainphytotechnology and biotechnological approaches.

10.Aftercompleting unit5,thestudentswillbeabletoexplain about the bio reactor and fermentor .

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradationofgenobiotics; Vermicomposting. Heavy metalpollution;Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants. Microorganisms and organic pollutants; Extremophiles. Fermentation technology (Bioreactors). | **18hours** |
| **Unit-II** | .Basic techniques in genetic engineering: Genetic manipulation, Restriction endonucleases, Introduction of cloned genes into new hosts using plasmid and phage vector systems. RFLP, Polymerase chain reaction, Environmental genomics/metagenomics-a general account, Microbes and environmental management. | **18 hours** |
| **Unit-III** | Basic concept of genetic engineering of plants and its applications- herbicide and stress tolerant plant.Biotechnology strategies in forestry and wasteland management. Biotechnology in biodiversity conservation: gene banks, germplasm conservation and DNA Banks.Genetically modified organisms and Biosafety- a general account. | **18 hours** |
| **Unit-IV** | Bioenergy, ethanol fermentation.Liquid waste treatment; Biofilters, activated sludge systems; membrane bioreactors. Biotechnological approaches for solid waste management, Phytotechnology-terrestrial phytosystems, metal phytoremediation, Phytotechnology-aquaticphytosystems,nutrient filmtechniques,algaltreatment systems. | **18 hours** |
| **Unit-V** | Bioreactors / Fermentor: Types, features, operation: sterilization (Batch and Continuous), inoculation and sampling. Control of bioprocess parameters. Microbial growth and media formulation. Microbial culture - batch, fed batch, semi-continuous, continuous. Growth kinetics of microorganisms. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

* 1. Manahan,S.E.1997.EnvironmentalScienceandTechnology.Lewis,NewYork.
  2. MetcalfandEddy(Eds).2003,WastewaterEngineering:TreatmentandReuse, Tata McGraw-Hill, New Delhi.
  3. Nelson,G.C.2001.GeneticallyModifiedOrganismsinAgriculture:Economics and Politics. Academic Press.
  4. Evans,G.M.andFurlongJ.C.2003.EnvironmentalBiotechnology:Theoryand Application. John Wiley and Sons.
  5. Thomas,J.A.andFuchs,R.2002.BiotechnologyandSafetyAssessment. Academic Press.
  6. Wang L.K. Hung Y.T. nad Shammas N.K.(Eds). 2006. Advanced PhysicochemicalTreatmentProcesses.Springer-VerlagNewYork,LLC
  7. Industrial Microbiology, Reed C., Prescott and Dann’s, 1982. Macmillan publishers.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER III**

**PAPER4.: Microbial and Industrial application**

# Papercode:Subject:Microbial and Industrial application

**Hours/Week:5 Credits:4**

**Aim: To enable the students to understand the concept of microbial diversity and**

**also the microbial growth and also the microbial Interaction and also the Industrial applications.**

**CourseObjectives**

1.TolearntheClassical and modern methods and concepts of microorganisms

2.Tolearn theMicrobial Growth & Physiology

3.TodevelopknowledgeonMicrobial Interactions and Infection

4.Tolearn the Microbes and Environment

## 5.Todevelopapieceofknowledgein Industrial Applications

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Kingdom concepts in classification of microorganisms;Molecular methods.

7.Aftercompletingunit2,thestudentswill able to understand the Microbial growth

8. Aftercompletingunit3,thestudentswillbeable to understand the Microbial

Interactions and Infection

9.After completing unit4,thestudentswillbeabletounderstand the concept of Microbes and environment.

10.Aftercompleting unit5,thestudentswillbeabletounderstand the concept of basic principles of bio process.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | **Microbial Diversity & Systematics**Classical and modern methods and concepts; Domain and Kingdom concepts in classification of microorganisms; Criteria for classification; Classification of Bacteria according to Bergey’s manual; Molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE), Temperature Gradient Gel Electrophoresis (TGGE), Amplified rDNA Restriction Analysis and Terminal Restriction Fragment Length Polymorphism (T-RFLP) in assessing microbial diversity;16S rDNA sequencing and Ribosomal Database Project. | **18hours** |
| **Unit-II** | .**Microbial Growth & Physiology** Ultrastructure of Archaea (Methanococcus); Eubacteria (*E.coli*);Unicellular Eukaryotes (Yeast) and viruses (Bacterial, Plant, Animal and Tumor viruses); Microbial growth: Batch, fed-batch, continuous kinetics, synchronous growth, yield constants, methods of growth estimation, stringent response, death of a bacterial cell. Microbial physiology: Physiological adoption and life style of Prokaryotes; Unicellular Eukaryotes and the Extremophiles (with classical example from each group). | **18 hours** |
| **Unit-III** | **Microbial Interactions and Infection** Host–Pathogen interactions; Microbes infecting humans, veterinary animals and plants; Pathogenicity islands and their role in bacterial virulence | **18hours** |
| **Unit-IV** | **Microbes and Environment** Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics; Vaccines | **18 hours** |
| **Unit-V** | **Industrial Applications**Basic principles in bioprocess technology; Media Formulation; Sterilization;Thermaldeathkinetics; Batchandcontinuoussterilizationsystems;Primary and secondary metabolites; Extracellular enzymes; Biotechnologically important intracellular products;exopolymers; Bioprocess controland monitoring variables such as temperature, agitation, pressure, pH Microbial processes-production, optimization, screening, strain improvement, factors affecting down stream processing and recovery; Representative examples of ethanol, organic acids, antibiotics etc | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. MichaelJ.Pelczar,Microbiology,TataMcGraw-Hill

2. L.ECasida,JR,IndustrialMicrobiology,NewAgeInternational,PJLimited, Publisher.

3. Prescott andDunn,IndustrialMicrobiology,CBSPublisherandDistributor

4. GerandJ.Tortora,BerbellR.Funke,ChristineL.Case,Microbiology,Pearson

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER III**

**ELECTIVE PAPER1.: Water and Waste water Technology**

Papercode: Subject:**Water and Waste water Technology**

**Hours/Week:5 Credits:3**

**Aim: To enable the students to understand the concept Water microbiology and analytical tools in assessment of water pollution.and also the water pollution monitoring and also the effluent treatment system and also the removal of specific pollution**.

**CourseObjectives**

1.Tolearnthestandards of water in relation to public health

2.Tolearn the Principal forms of Water Pollutants

## 3.TodevelopknowledgeonWaterPollutionMonitoring

4.Tolearn the Development and optimization of membrane bioreactor process

## 5.TodevelopapieceofknowledgeEffluenttreatmentsystems

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Methods of water sampling for pollution analysis and Biosensors and also Biological treatment

7.Aftercompletingunit2,thestudentswill able to understand the Biological methods,

## Chemical methods for MonitoringWaterPollution

8.Afterstudyingunit3,thestudentswillbeable to understand the Sewage and

waste water treatments systems

9.Afterstudyingunit4,thestudentswillbeabletoexplain.biotechnological application of

hazardous waste management of water

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | Overview of standards of water in relation to public health - Detection and control of micro-organisms inenvironmentalfresh water, insource and drinking water; Potable and nonpotable water; Methods of water sampling for pollution analysis; Biosensors - types and applications in environmental pollution detection and monitoring; Biological treatment: stabilization pond, aerated lagoon, activated sludge process, trickling filter anaerobic treatment. WaterPollution Principal forms of Water Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Water pollution monitoring and water quality standards; Ocean pollution – oil pollution; Ground water pollution and its control;Water pollution prevention. | **18hours** |
| **Unit-II** | .Methods of monitoring;Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Other emerging techniques such as enzyme detection, hybridization, PCR,Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors of pollution | **18 hours** |
| **Unit-III** | Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments;Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Biofilm development and biofilm Kinetics; Aerobic Biofilms; Bioreactors for waste water treatments; Reactors types and design; Reactors in series; Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment. | **18hours** |
| **Unit-IV** | Physicochemical characteristics and treatment strategies for effluent generated by Distillary and fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes and dye intermediate producing industries and textile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermalpower plants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinated minerals and inorganic chemical industries and petrochemicals; Biotechnological application of hazardous waste management of water; Use of microbial systems; Phytoremediation: Waste water treatment using aquatic plants; Root zone treatment; Development of new biocatalysts to be applied in waste water biotechnology. | **18hours** |
| **Unit-V** | Water Quality and Preliminary treatment.  Water Quality-physical- chemical and biological parameters of water- water quality requirement - potable water standards -wastewater effluent standards -water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes- primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification - sedimentation; Types; aeration and gas transfer – coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, clariflocculation. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

* 1. NicolasPCherewsinott,HandbookofwaterandwastewaterTreatmentTechnology, Boston Oxford Auckland Johannesburg Melbourne ,N Delhi
  2. FrederickWPontinus,WaterQualityandTreatment.Americanwaterworks Association, MC Graw Hill Inc.
  3. SKAgarwal,WaterPollution,APHPublishingCorporation.
  4. Ronald LDooste,Theoryand Practicalofwater andwastewaterTreatment.
  5. BillT.Ray,EnvironmentalEngineering,PWSPublishingcompany.
  6. W. Wesley Eckenfelder, Jr., “IndustrialWater Pollution Control”, 2ndEdn.,McGraw Hill Inc., 1989

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# COREELECTIVEIII(B):GENOMICS&PROTEOMICS

Papercode: Papername:Genomics&ProteomicsHoursofteaching:3 Credits:3

**Aim**:**To enable ustoexploremanydifferentcomponentsoflivingsystemsandtheadventofproteomicswillmadeitpossible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basicprinciplesandapplicationsingenomicsandproteomics.**

# Courseobjectives:

* 1. Toprovidethebasicknowledgeofgenecharacteristicfeatureandmappingconcepts
  2. Tounderstandabout thesequencingtechnologies
  3. Toprovidethebasicconcept forproteinanalysis
  4. Tounderstandabout proteinsequencing
  5. ToEnrichthestudents’knowledgewithrespecttometagenomicandapplications

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeabletoknowaboutgenesfunctionalproperties.
2. Afterstudyingunit-2,thestudentwillbeable tounderstandhowgenesequencingaredone
3. Afterstudyingunit-3,thestudentwillbeable tounderstandProteinanalysis.
4. Afterstudyingunit-4,thestudentwillbeable toproteinsequencingmethods.
5. Afterstudyingunit-5,thestudentwillbeable toknowaboutmetagenomicsand itsapplication.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | Organization of genes across living systems, interrupted genes,overlapping genes, alternative genes , (RNA editing and RNASplicing ) etc. identification and characterization of insert DNAfragments,genecontentand Cvalueparadox –geneclusterandgenefamilies  .restriction mapping, chromosome walking and chromosomallocalizationofgenes.RFLPandotherusesofclonedsequences,cloningofmicrobialgenes. | 18 hours |
| UNIT-II | Methods of preparing genomic DNA, DNA sequence analysismethods, Sanger Di deoxy method, next generation sequencing,SNP – single nucleotide polymorphism, expressed sequencedTags(ESTs),Genediseaseassociation,sitedirectedmutagenesisandmolecular chimeras , gungal genome and genomics.PCR basedAnalysis,DNAFingerprinting. | 18 hours |
| UNIT–III | Scope of proteomics, protein separation techniques – ion exchangechromatography, size – exclusion and affinity chromatographytechniques,size–exclusionandaffinitychromatographytechniques  ,proteinanalysis(includesmeasurement ofconcentration,aminoacid composition, N-terminal sequencing ); SDS-PAGE , twodimensionalgelelectrophoresisandimageanalysis. | 18 hours |
| UNIT–IV | Introduction to mass spectrometry; strategies for proteinidentification ; protein sequencing ; protein modifications andproteomics ; applications of proteome analysis to drug; protein –proteininteraction(Twohybrid interactionscreening),analysisandsequencing individual spots by mass spectrometry (Maldi toff) andproteinmicroarrays. | 18 hours |
| UNIT-V | etagenomics–construction,vectordesignandscreeningo fmetagenomic libraries- biotechnological applications of metagenomics. | 18 hours |
|  | Total Lecturehours | **90 hours** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# TextBooks

1. Introducingproteomics(2011)Josiplovric.JohnWileyPublication
2. Principlesofproteomics(2013). R.MTwyman.Taylorand Francispublish

# ReferenceBooks

1. ExpressionGenetics:accelerated andHighThroughputMethods(1999). EditedbyM.McClelland and

A.Pardee,EatonPublishing,MA.

1. MicrobialFunctionalGenomics(2004).J.Zhou,D.K.Thomson,Y.XuandJ.M.Tiedje,WileyLiss.
2. ReviewsandarticlesfromJournalssuchasNature,Science,PNAS(USA),NucleicAcidsResearch, Trends andCurrentOpinionSeries.
3. PrinciplesofGeneManipulationandGenomics(2013)SandyB.Primrose,RichardTwyman–BlackwellPublishing.
4. An IntroductiontoGeneticEngineering3rdEditionDesmondS.T.NichollCambridgeUniversityPress
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition Bernard R. Glick, Jack J.Pasternak,CherylL.PattenASMPress
6. Post-translationalmodificationsinhostcellsduringbacterialinfection,D.Ribert,P.Cossart,FEBSletters,2010.
7. Proteomicsinpractice:alaboratorymanualofproteomeanalysis(2002).Westermeier,R.,&Naven,T.JohnWiley&Sons,Inc.
8. Proteomicsforbiologicaldiscovery.Veenstra,(2006).TimothyD.andJohnR.YatesJohnWiley& Sons,
9. Plantproteomics:methodsandprotocols.(2007).Thiellement,H., Zivy,M.,Damerval,C. andMéchin,V.eds.Totowa(NJ):HumanaPress.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# COREELECTIVEIII(C):HerbalBiotechnology

**Papercode: Subject:Herbal Biotechnology**

# Hours/Week:3 Credit:3

**Aim:Togivethedetails of plant-derivedvalue-addedcompoundsandtheirfunctions.Toprovideknowledgeonbiotech-basedproductionofHerbalmedicines**

# CourseObjectives

1. Toenablethestudentstolearnaboutthe biochemicalparametersusedintheidentificationandutilizationof medicalplants
2. Toenablethestudentstolearnabouttheextractionofphytochemicalsandprocedures
3. Toexploitandexplorethemedicinalvaluesofplants
4. knowtheevaluationtechniquesfortheherbaldrugs
5. Toprovideknowledge onbiotech-basedproductionofHerbalmedicines

# CourseOutcomes (fiveoutcomesforeachunitshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeableto–knowtheStudyofonhistoryandscopeofherbals
2. Afterstudyingunit-2,thestudentwillbeableto–understandtheImportantmedicinalherbsintreatingdiseases
3. Afterstudyingunit-3,thestudentwillbeableto–learntheBiotechnologicalmethodsofplantpropagation
4. Afterstudyingunit-4,thestudentwillbeableto–exploremethodsInvolvedinsecondarymetaboliteproduction
5. Afterstudyingunit-5,thestudentwillbeableto–knowaboutpharmaceuticalapplicationsandIntellectualPropertyRights

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 | CourseContents | Teaching  hours |
| UnitI | Studyofonhistoryandscopeofherbals-IntroductiontotheIndiansystemofmedicine–Herbaldrugsandimportance-HerbalCosmeticandCosmeceuticals  -FormulationDevelopmentofherbalpreparations-HerbalDrugdiscoveryandNoveldrugdeliverysystems. | 18 hours |
| Unit-II | Important medicinal herbs in treating diseases- Phytochemistry of medicinalplants-alkaloids-flavones-flavonoidsandxanthones-furocoumarins-glycosides-naphthoquinones-phenolsandacylphloroglucinols-resins,  oleoresins and gum resins. Saponins - sterols and steroid-like compounds -tanninsandterpenes. | 18 hours |
| Unit-III | Biotechnological methods of plant propagation. - Micropropagation – SomaticEmbryogenesis and somoclonal variation. Herbal gardening and maintenance-Standardization of cultivation protocols of selected medicinal plants; *in vitro*productionofsecondarymetabolites.PolyhouseTechnology-Important  diseasesofmedicinalplantsandtheirmanagement. | 18 hours |
| Unit-IV | MethodsInvolvedinsecondarymetaboliteproduction-Organculture,Cellculture,Biotransformation(MicrobialandPlantcells)-Scaleup- Enhancement  of product formation by elicitation-Immunodiagnostics and moleculardiagnosticsinselectionofelite plantspecies. | 18 hours |
| Unit-V | Introduction to analysis and quality controls of herbal products (TLC, HPLC,IR, NMR, and mass spectroscopy). Pharmaceutical application of alkaloids,terpenoids, glycosides, volatile oils, tannins and resins. - Intellectual PropertyRights-RegulatoryAffairherbalpharmaceuticals-Entrepreneurship  Management. | 18 hours |
|  | TotalTeachinghours | **90 hours** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Reference&TextBooks:

1. Harborne,J.B.,1998.Phytochemicalmethodstomoderntechniquesofplantanalysis.Chapman &Hall, London.
2. Trease G.E,M.C.Evans,1979.TextbookofPharmacognosy12thed. Balliere-Tindal, London.
3. IrfanA.KhanandAtityaKhanum(Eds.).2004. RoleofBiotechnologyin medicinalandAromaticplants,Vols. I-X.UkaazPublications,Hyderabad.AnalyticaltechniquesinDNA sequencingeditedbyBrianK.Nunnally.
4. AgrawalS.S.andM.Paridhavi,HerbalDrugTechnology,Universitypress2007.
5. Henry,R.J.1997.PracticalApplicationsofPlantMolecularBiology.Chapman&Hall,London,UK.
6. Bidlack,W.R.,Omaye,S.T.,Meskin,M.S.andTopham,D.K.W.,”Phytochemicals as

BioactiveAgents”,1St Edition,CRCPress,2000.

1. SharolTilgner,N.D.1999.Herbalmedicine-Fromtheheartoftheearth.Edn.1,PrintedintheUSA byMalloyLithographingInc.
2. Balasubramanian,Bryce,Dharmalingam,GreenandJayaraman(ed),Concepts inBiotechnology,University,Press,1996.
3. Anderson,F.JIllustratedHistoryoftheHerbals.NewYork:ColumbiaUniversitypress.2009.
4. Callow,J.A.,Ford-Lloyed, B.V. andNewbury, H.J.1997.BiotechnologyandPlantGeneticResources:ConservationandUse,CAB International,OxonUK.
5. Gokhale,S.S,C.K.KokateandA.P.Purohit(1994).Pharmacognosy.Niraliprakashan,Pune.
6. Faroogi,A.A.andB.S.Sreeramu(2004),CultivationofMedicinalandAromaticcrops.UniversityPress(India)P.Ltd.,Hyderabad.
7. Pal.D.CandS.K.Jain(1998),Tribalmedicine,Naya Prakash,206,BidhanSarani,Calcutta.
8. Thirugnanam, Akbarsha and Krishnamurthy (2010), Indian Medicinal plants and Home Remedies,SelviPathipagam,Trichy.

# CourseMaterial:

1. Rasheeduzzafar(2006),Medicinalplantsof India,CBSpublication.
2. InternationalJournalofHerbalMedicine
3. JournalofHerbalmedicineElsevier

en.wikipedia.org/wiki/Herbalmedicine

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# OPENELECTIVEII (A):ENVIRONMENTALSCIENCES

**Paper code: Name ofthePaper:**EnvironmentalSciences

**TotalHours perWeek:**2 **Credits:2**

# CourseObjectives

1. TointroducestudentstothebasicsofEnvironment.
2. Toenablethestudents learnbasicstructureand functionsofecosystem.
3. Tomakestudentsunderstandthedistributionoflifeandlifeformsonearth.
4. Tomakestudentsawareofthedifferentformsofenergyinenvironment.
5. Tomakethestudentsunderstandthedifferent pollutantsandpollutionandtheirManagement.

# CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Thestudentwillbeabletounderstandtheprinciplesandscopeofenvironment.
2. ThestudentwillbeabletounderstandthedistributionandcyclingofenergyandmatterinEnvironment.
3. Thestudentwillbeabletoidentifyandcharacterizetheearthsciences.
4. Thestudentwillbeableexplorate thesourcesofenergyfromenvironment.
5. Thestudentswillbeabletoapplymethodstocontrolandmanagetheenvironmentpollution.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNITI | Definitions,principlesandscopeofenvironmentalscience.Structure and composition of atmosphere, hydrosphere, lithosphere,biosphere. Meteorological parameters. Environmental education andawareness.EnvironmentalEthics. | 18 hours |
| UNIT-II | Introductiontooriginoflifeandspeciation,Ecosystemstructureandfunctions,foodchainsandwebs,Basisofecosystem  classification, Biotransformation, water and air borne microbes,Bioremediation,Bioindicators,Biofertilizers,Biofuels,Biosensors. | 18 hours |
| UNIT –III | Introduction to origin of earth, components of earth, zones of earth,Climates of India, weather reactions, erosion, transport, depositionofsediments,Soilformingmineralsandprocess,identificationand  characterizationofclayminerals,Groundwaterquality,pollutionofgroundwaterandmitigationofitsimpacts. | 18 hours |
| UNIT–IV | Sources of energy, Sun as source of energy, Solar radiation and itsspectralcharacteristics,Characteristicsandenergycontent ofcoal,petroleum,andnatural gases,Energyusagepatterninworldand  India,Pollutants,emissionsofCO2 andGlobalwarming. | 18 hours |
| UNIT-V | Introductiontopollution,air,noise,water,soil,thermal,marineandradioactivePollution, Concept of Waste management, Solid andhazardous waste management, Electrical energy generation, e-waste,flyash,plasticwaste,Environmentalmanagementsystem  standards, IPCC, UNEP,IGBP,Global environmental issues-Biodiversityloss,climate change,Ozonedepletion,sealevel rise. | 18 hours |
|  | TotalLecturehours | 90 hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Textbook:

1. Hardy,J.T.2003.ClimateChange:Causes,EffectsandSolutions.JohnWiley&Sons.
2. Harvey, D.2000.ClimateandGlobalClimateChange.PrenticeHall.
3. Minkoff,E.C.1983.EvolutionaryBiology. AddisonWesley.PublishingCompany.
4. Nei,M.&Kumar,S.2000.MolecularEvolutionandPhylogenetics.OxfordUniversityPress.
5. Pepper,I.L.,Gerba,C.P.&Brusseau,M.L.2006.EnvironmentalandPollutionScience.ElsevierAcademicPress.
6. Purohit, S.S.&Ranjan,R.2007.Ecology,Environment&Pollution.AgrobiosPublications.
7. Owen,O.S,Chiras,D.D,&Reganold,J.P.1998.NaturalResourceConservation–ManagementforSustainable Future(7thedition).PrenticeHall.
8. Elliott,D.1997.SustainableTechnology.Energy, SocietyandEnvironment(Chapter3).

NewYork,RoutledgePress.

1. Bagchi,A.2004. DesignofLandfillsand IntegratedSolidWasteManagement.JohnWiley&Sons.
2. Odum,E.P.1971.Fundamentals ofEcology.W.B.Sounders.
3. Barry,R.G.2003.Atmosphere,WeatherandClimate.RoutledgePress,UK.
4. Mitra,A.P.,Sharma,S.,Bhattacharya,S.,Garg,A.,Devotta,S.&Sen, K.2004.ClimateChangeandIndia.UniversitiesPress,India.

# ReferenceBook:

1. Botkin,DanielB.(2011).EnvironmentalScience:EarthasalivingPlanet,JohnWileyandSons,NewDelhi.
2. Chapman.J.L.andReiss,M.J.(2005).Ecology,PrinciplesadApplictions,CambridgeUniversityPress,London.
3. Dash,M.C.(1994).FundamentalsofEcology, TataMcGrawHill,NewDelhi.
4. Gunther,O.(1998)EnvironmentalInformation Systems.Berlin,NewYork,Springer.
5. MillerG.TaylorandScotSpoolman.(2011).EssentialsofEcology,Books/ColeLearning,sU.S.A.
6. Odum,E.P.(1971).FundamentalsofEcology, W.B.SaunderCompany, Philadelphia
7. SharmaP.D.(1996).EnvironmentalBiology, RastogiPublications,Meerut.
8. VermaP.S.andV.K.Agarwal.(1985).PrinciplesofEcology.S.ChandandCompany(Pub.),NewDelhi.
9. Strahler,A.V.andStrahler,A.A(1973).EnvironmentalGeoscience,WileyInternational.
10. PrimackR.B.2014.EssentialsofConservationBiology, OxfordUniversityPress,USA.

# CourseMaterial:websitelinks,e-Booksande-journals

1. **https://**[**www.hzu.edu.in/bed/E%20V%20S.pdf.**](http://www.hzu.edu.in/bed/E%20V%20S.pdf)
2. **https://**[**www.intechopen.com/books/1882.**](http://www.intechopen.com/books/1882)

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# OPENELECTIVEII(B):MEDICALMICROBIOLOGY

**Paper code: NameofthePaper:MedicalMicrobiology**

**TotalHours perWeek:**2 **Credits:2**

# Aim:Toenablethe studentstounderstandthebasicsofMedicalMicrobiology

**CourseObjectives**

1. Tointroducestudentstothebasicsofcollectionandtransportofmicrobialsource
2. Toteachstudentsabouthostparasiterelationship.
3. Tomakestudents understandthatbacterialpathogens anditsrelateddiseasesofphase I.
4. Tomakestudents understandthatbacterialpathogensanditsrelateddiseasesofphase II.
5. TomakethestudentsunderstandthatNosocomialandZoonoticdiseases

# CourseoutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeableto–knowthebasicsofcollectionandtransportofmicrobialsource
2. Afterstudyingunit-2,thestudentwillbeableto–understandthehostparasiterelationship
3. Afterstudyingunit-3,thestudentwillbeableto–learnbacterialpathogensanditsrelateddiseasesofphaseI
4. Afterstudyingunit-4,thestudentwillbeabletobacterialpathogensanditsrelateddiseasesofphaseII
5. Afterstudyingunit-5,thestudentwillbeableto–knowaboutNosocomialandZoonoticdiseases

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | Collectionsandtransportofspecimens:Collectionsandtransportofspecimens.PrimaryMediaforisolationandtheirqualitycontrol.  Antibioticsensitivitytestingprocedure. | 18hours |
| UNIT-II | HostParasiteRelationship:Normalmicrobialfloraofhumanbody,Virulence factors of bacteria causing infection, Microbial  Infections,HostParasiteRelationships. | 18hours |
| UNIT–III | Bacterial pathogens and associated diseases part I, Classification,Morphology, cultural &Biochemical characteristics, pathogenicity,Lab diagnosis&Prophylaxis and treatmentof disease caused byStaphylococci,Streptococcai,Neisseriae,Mycobacteria,  Corynebacteria,Bacillus,Clostridium. | 18hours |
| UNIT–IV | Bacterialpathogensand associateddiseasespartII  E,coli,Samonella,Shigella,Vibrio,pseudomonas,Spirochaetes,Rickettisiae.GramNegativeanaerobes. | 18 hours |
| UNIT-V | NosocomialandZoonoticdiseases,Hospitalacquiredinfection–infectioncontrolcommittee,Zoonoticdiseases-Anthrax,Plague. | 18 hours |
|  | TotalLecturehours | 90hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# TextBooks&References

1. DavidGreenwood,RichardC.B,Slack,JohnForestpeuthere“MedicalMicrobiology”14thEdn.ELBS withChurchillLivingstone.
2. AnanthanarayananRand JayaramPanicker,C.K.Textbookofmicrobiology-OrientLongman
3. ColleJC,DuguidJP, FraserAC,Marimon(Bp)1996.Mackie andMcCartneyPracticalMedicalMicrobiology14thEdn.ChurchillLivingstone.
4. Baron L.J, Peterson L.RandFinegodS.M(1994)BaileyandScottDiagnosticMicrobiology,9thEdn.MosbyPublications.
5. Cowan andSteel (1995)ManualforidentificatioinofMedicalBacteria.4thEDN,CambridgeUniversityPressLondon.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**OPENELECTIVEII(C):AGRICULTURALBIOTECHNOLOGY**

**Papercode:** DDOBT13C **NameofthePaper:**AgriculturalBiotechnology

**TotalHours/Week:**2 **Credits:** 2

**Aim:** To make the students learn the fundamental principles of biotechnology, various developmentsand theirapplicationsandscopeinagriculturalBiotechnology.Toprovideknowledgeinbiotechnologicalinnovationspertainingtoissuesinagriculture.

# CourseObjectives

1. Toprovidethestudentstheknowledge inbiotechnologicalinnovationspertainingtoissuesinagriculture
2. Toenablethestudents learnbasicsof geneticsintheplantevolution.
3. Toenablethestudentstounderstand theconcepts ofmolecularbiology.
4. Tomakethestudentsawareofadvancedmoleculartechniquesin plantbiotechnology.
5. Tomakethestudentsunderstandthedifferent waysof genetransfermethodsandIdentificationoftransgenicgenes.

# CourseOutComes

1. Thestudentwill beabletoappreciatetheimportanceof agricultureandneedforBiotechnologyinagriculture.
2. Thestudentwill beabletolearnthebasicsconcepts ofplantsystem andtheirgenetics.
3. Thestudentwill beabletodifferentiatethe genome,plasmidsandvectorsandtheirtranslation.
4. Thestudentwill beabletoselectthedifferentways ofgenetransfermethodsforPlanttransgenesis,variousdevelopmentsandtheirapplications.
5. Thestudentswillbeabletoapplysuitablemethodsofbiotechnologyinagriculture andidentificationofplanthybridization.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |

|  |  |  |
| --- | --- | --- |
| UNIT I | History,scopeandimportanceofbiotechnologyinAgriculture–ApplicationofbiotechnologyinAgriculture | 18 hours |
| UNIT-II | Mendeliangenetics,allosomes,linkageandextrachromosomalinheritance-Introductiontogenetics-Earlierconceptsofinheritance  –cell andcellorganelles-Cell division,Mendel‟slaws | 18hours |
| UNIT–III | Nucleic acid structure and its function-Modes of DNA replication-Genetic code - Central dogma of life – Transcription – Translation-RecombinantDNAtechnology-DNAmodifyingenzymes–CloningVectors–Plasmids-cosmids-phagemids-Shuttlevectors-BAC-YAC-HAC-applications. | 18hours |
| UNIT–IV | Gene transfer methods – *Agrobacterium* - mediated gene transfer,direct gene transfer, gene silencing – Principles of QTL and MarkerAssistedSelection(MAS)–Achievements-Transgenicplants–  Achievements–Current trends. | 18 hours |
| UNIT-V | Geneisolation,synthesisandcloning,genomicandcDNAlibraries,PCRbasedcloning,positionalcloning-Nucleicacidhybridization  andimmunochemicaldetection-DNAsequencing. | 18 hours |
|  | TotalLecturehours | 90hours |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# Textbook:

1. Benjamin Lewin,GeneIX,9thEdition,JonesandBarlettPublishers, 2007.
2. J.D.Watson,N.H.Hopkins,J.WRoberts,J.A.Seitz&A.M.Weiner;MolecularBiologyoftheGene,6thEdition,BenjaminCummingsPublishingCompanyInc,2007.
3. Albertsetal;MolecularBiologyoftheCell,4thedition,Garland,2002.
4. Esau'sPlantAnatomy;Meristems,Cells,andTissuesofthePlantBody: TheirStructure,Function,andDevelopment,3rdEdition,JohnWiley&Sons,2006.
5. MartinJIngrouilleandWilliamEddie,Plants:DiversityandEvolution
6. BingruHuang,Plant-EnvironmentInteractions,3rdEdition,CRCPress,2006.
7. R.H.Smith,PlantTissueCulture:TechniquesandExperiments,AcademicPress,SanDiego.1992.
8. SSBhojwaniandMKRazdan,PlantTissueCulture,ElsevierPubl.
9. S.B.Primrose,R.M.Twyman andR.W.Old;PrinciplesofGeneManipulation.6thEdition,S.B.UniversityPress,2001.
10. J.SambrookandD.W.Russel;MolecularCloning:A LaboratoryManual,Vols1-3,CSHL,2001.

# ReferenceBook:

1. BrownCM,Campbell IandPriestFG.2005.IntroductiontoBiotechnology.PanimaPublications.
2. Bhojwaniand Dantu, 2013.Planttissueculture:Anintroductorytext,Springer,NewDelhi.
3. Singh,B.D., Fundamentalsofgenetics2014,KalyaniPublishers,NewDelhi.
4. Gardner,E.J.&Snustad,D.P.1991.PrinciplesofGenetics.JohnWiley&Sons,USA.
5. Chawla,H.S.2008.IntroductiontoPlantBiotechnology,3rdEd.OxfordIBH,India.69.
6. Dale,J.W.andVonSchantz,M.2002.FromGenestoGenomes: ConceptsandApplicationsofDNATechnology.JohnWiley&Sons,Newyork,USA.
7. Snustad,D.P.&Simmons,M.J.2006.Genetics.4thEd.JohnWiley&Sons,USA.
8. Strickberger,M.W.2005.Genetics(IIIEd).PrenticeHall,NewDelhi,India

# CourseMaterial:websitelinks,e-Booksande-journals

1. **https://**[**www.isaaa.org/resources/publications/agricultural\_biotechnology/download/A**](http://www.isaaa.org/resources/publications/agricultural_biotechnology/download/A) **gricultural\_Biotechnology.pdf.**

# https://[www.researchgate.net/publication/267338355\_Book\_Review\_Agriculture\_Biotechnology\_and\_Develop](http://www.researchgate.net/publication/267338355_Book_Review_Agriculture_Biotechnology_and_Develop) me

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

# PRACTICALV:LABINPLANTBIOTECHNOLOGY &ANIMALBIOTECHNOLOGY AND

# LABINMICROBIALTECHNOLOGY&ENVIRONMENTALBIOTECHNOLOGY

**PlantBiotechnology (10 credit)**

* 1. Introductiontoplanttissueculture-inductionofcallusand suspensioncultures.
  2. Isolationandpurifytheprotoplastsandcheckitsviability.
  3. Inductionofsomaticembryogenesisandanalysisofdifferentstages.
  4. Extractthegenomic DNAfromplantsbyCTAB
  5. Cultureandselectionof AgobacteriumonAgarmedium
  6. Agrobacteriummediatedgenetransformation
  7. UseofAgroinfilterationforTransient ExpressioninPlant
  8. Gusassay
  9. AnalysisofWT/Transgenicplant byPCR
  10. IsolationofTotalRNAfromleaves
  11. Genegunmethodoftransformation
  12. Syntheticseedpreparation

# Lab inAnimalBiotechnology

1. Developmentofprimarycelllines/maintenanceof establishedcelllines.
2. Cellcountingandcellviability.
3. Trypsinizationofmonolayerandsubculturing.
4. Genetransferbytransfection
5. Preparationofmetaphasechromosomesfromculturedcells.
6. Isolationof DNAanddemonstrationofapoptosis ofDNAladdering
7. MTTassayforcellviabilityandgrowth

**MicrobialTechnology**

1. Studyoffermentor-Demonstration.
2. Productionandisolationofantibiotics(Penicillin andStreptomycin)
3. ProductionandanalysisofSinglecell protein(Spirullinaandyeast)
4. Productionof yoghurtandestimationoflacticacid.
5. Estimationofpercentageofalcoholof givensample
6. Productionandassayofα-amylasefromAspergillusnigerbysolidsubstratefermentation.
7. Immobilizationofgivenenzyme/wholecells
8. Estimationofamountofcitricacidinthegivensample.

# References

1. PracticalApplicationsofPlantMolecularBiology.RobertJ.Henry.RoutledgeChapman&Hall,2008.
2. MolecularPlantBiology:Apracticalapproach(Vol.IandII).GilmartinandBowler.OxfordUniversitypress,UK,2002.
3. PlantCellCulture:EssentialMethods.MichaelR.Davey,PaulAnthony.Wiley,2010.
4. PlantTissueCulture,ThirdEdition:Techniquesand Experiments.RobertaH.Smith.AcademicPress,2012.
5. PlantcellcultureProtocols(MethodsinMolecularBiology,3rdEd).VictorM.Loyola-Vargas,NeftaliOchoa-Alejo.HumanaPress,2012.
6. PlantCell,TissueandOrganCulture:FudamentalMethods(SpringerLabManuals).OlufL.Gamborg(Editor),GregoryPhillips(Editor),Springer,2013
7. WaterAnalysis:MeasurementofTotalSolids,Total–dissolvedsolids,Total-suspendedsolids,dissolvedoxygen,totalhardness,chloride,turbidity,nitrite,nitrate,fluoride andtotalnitrogen.
8. EstimationofCOD, BODofindustrialeffluents.
9. Potabilitytestofwater(MPNtechnique).

10.Degradationofphenols. Colorimetricassay

11.EstimationofMICandHeavymetaltoleranceofchromiumresistantbacteria

12. ScreeningofBiosurfactantactivity-OilDisplacement test-Dropcollapsetest

13. IsolationofThiobacillusferrooxxidansandThiobacillusthiooxidansfrommetalsulphides,rockandacidminewater.

14. Microbialdegradation,decolourzsationandadsorptionoforganicdyesbyfree andimmobilizedcells

15. Studiesonhalophilesfrom seawater(pigmentationandsalttolerance)

**MOOC-MASSIVEOPENONLINECOURSES**

**USRR(UNIVERSITYSOCIALRESPONSIBILITYREPORT)**

TheaimoftheFieldStudyistohelpstudentsconnectwiththesocietyintherespectivediscipline.FollowingaretheimportantfeaturesoftheFieldStudyandtheUSRR:

* 1. **Aim:** The Field Study must aim at relating the subject of study with the society in so far as theapplicationandtheusefulnessofthestudyareconcerned
  2. **Topic selection:** The topic for the Field Study must be chosen by the student in the second semester inthe month of February; the process for the same shall begin on 1st February and shall end on the lastworking day of the month of February. Students are free to select the topic for the Field Study inconsultation with the Experts and Faculty Members of their choice, both from within and outside theUniversity
  3. **Period and duration:** The Field Study shall be undertaken for a duration of 15 days in the summervacation that falls immediately at the end of the second semester of the program and the same should beaccountedfortheThirdSemesteroftheprogram
  4. **USRR:** The USSR (University Social Responsibility Report) must be prepared by every student of theprogramwrittenin50to75pages.Thereportshallbewrittenbasedonthestandardresearchmethodology.

# Reviewandevaluationschedule:

* + 1. ***ReviewingtheFieldwork:***FirstweekofJuly
    2. ***ReportReview:*** SecondweekofAugust
    3. ***Reportsubmission:***FirstweekofSeptember
    4. ***ReportEvaluation:*** ThirdweekofSeptember
  1. **Faculty Composition:** The following members may be nominated for confirming the topic and forevaluatingtheUSRR:
     1. ProfessorandHeadoftheconcernedDepartment
     2. OneFacultymemberwithrelatedfieldofspecializationfrom theconcernedDepartment
     3. OneseniorfacultymemberfromtheDepartmentofSociologyfromotherInstitution

**SEMESTER IV**

**PAPER1: Genetic Engineering**

Papercode: Subject:**Genetic Engineering**

**Hours/Week:5 Credits:4**

Aim: To enable the students to understand the basic concept and also the cloning vector and also the cloning methodology and also the sequencing methods.

**CourseObjectives**

1.TolearntheDNA Structure and properties

2.Tolearn the CloningVectors and plasmid based vector

3.TodevelopknowledgeonCloningMethodologies and PCR and Its Applications

4.Tolearn about the swquencing method and gene silencing

## 5.Todevelopapieceofknowledgeabout gene expression .

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletounderstand the Basic concept and DNA structure and properties .

7.Aftercompletingunit2,thestudentswill able to understand the cloning vector and

methodologies to reduce formation of inclusion bodies.

8.Aftercompleting unit3,thestudentswillbeable to understand Cloning methodologies

and PCR and its applications.

9.Aftercompleting unit4,thestudentswillbeabletoexplainabout the PCR and its application .

10.Aftercompleting unit5,thestudentswillbeabletoexplainabout the sequencing method.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay; DNaseI footprinting; Methyl interference assay | **18hours** |
| **Unit-II** | Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies;Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors | **18 hours** |
| **Unit-III** | Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Far- western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression | **18 hours** |
| **Unit-IV** | **PCR and Its Applications** Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; Proof reading enzymes;PCR ingene recombination;Deletion;addition;Overlapextension;and SOEing; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test). | **18 hours** |
| **Unit-V** | Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNAvectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

* 1. DavidP.Clark,NanetteJPazdernik,BiotechnologyApplyingtheGenetic Revolution, Elsevier.
  2. JackG.Chirikjian,GeneticEngineeringMutagenesisSeparationTechnology, Jones and Bartlett Publishers.
  3. U.Satyanarayana,Biotechnology,BooksandALLIED(p)Limited.
  4. Michael P. Tombs, Biotechnology and Genetic Engineering Reviews volume 10. Intercept.
  5. DannielL.Hart,ElizabethW.Jones,essentialGenetic(SecondEdition)Jones and Batlett Publishers.
  6. EJohansenNange,ArthurPNange,BasicHumanGenetics(SecondEdition) Sinauer Association, Ins Publisher Sunderland, Massachusetts.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER IV**

**ELECTIVE PAPER1.: Bioremediation**

# Papercode:Subject:Bioremediation

**Hours/Week:5 Credits:3**

Aim: To enable the students to understand the basic concept of bio remediation I and II and also the Hazardous waste management and also the concept of phyto remediation.

**CourseObjectives**

1.TolearntheIntroduction , Bioremediation and Bioaugumentation .

2.Tolearn the Solid phase bio remediation and Biosparging.

3.Todevelopknowledgeon Hazardous waste management

4.Tolearn the Concept of bioremediation and also Conceptsofphytoremediation

## 5. TodevelopapieceofknowledgeBioremediation of toxic metal ions- biosorption

## and bioaccumulationprinciples. And also about the microbial remediation and ecological restoration

## and bio remediation .

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of bio remediation and bio augmentation.

7.Aftercompletingunit2,thestudentswill able to understand the solid phase bio remediation.

8.Aftercompletingunit3,thestudentswillbeable to understand the hazardous

waste management.

9.Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of bio remediation and also the use of micro organism in augmentation..

10.Aftercompletingunit5,thestudentswillbeabletoexplainthe concept of microbial remediation

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | **Bioremediation- I** Introduction, constraints and priorities of Bioremediation, BiostimulationofNaturallyoccurring microbialactivities, Bioaugmentation, insitu, ex situ, intrinsic & engineered bioremediation | **18 hours** |
| **Unit-II** | **Bioremediation** –**II**Solid phase bioremediation- land farming, preparedbeds, soilpiles, Phytoremediation.Composting,Bioventing&Biosparging;Liquidphasebioremediation  -suspendedbioreactors,fixedbiofilmreactors. | **18 hours** |
| **Unit-III** | **Hazardous Waste Management** biotechnology application to hazardous waste management - examples of biotechnological applications to hazardous wastemanagement–cyanidedetoxification- detoxificationofoxalate, urea etc.-toxic organics  -phenols. | **18 hours** |
| **Unit-IV** | Concept of bioremediation (in-situ & ex-situ), Bioremediation of toxic metal ions- biosorptionand bioaccumulationprinciples. Conceptsofphytoremediation. Microbial leaching of ore-direct and indirect mechanisms. Mining and metal. Use of microorganisms in augmentation of petroleum recovery. Biotechnology-with special reference to Copper and Iron. | **18 hours** |
| **Unit-V** | Microbial remediation of phenolics-sewage nutrients(phosphate and nittare). Impact of bioremediation in the petroleum industry,paperindustry,marineoilpollutantsandchemicalindustry.Phytoremediationadvantagesandapplications(agriculture) | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. EnvironmentalBiotechnologybyS.K. Agarwal
2. Biodegradation&Bioremediation(1999), MartinAlexander,Academicpress.
3. StanierR.Y.,IngramJ.L.,WheelisM.L.,PainterR.R.,GeneralMicrobiology, McMillan Publications, 1989.
4. FosterC.F.,JohnWareD.A.,EnvironmentalBiotechnology,EllisHorwoodLtd., 1987.
5. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, AdvancesinAppliedBiotechnologySeries,Vol.4,GulfPublicationsCo.London, 1989.
6. Bioremediationengineering;designandapplication1995John.T.cookson, Jr. Mc Graw Hill, Inc.
7. EnvironmentalBiotechnologybyA.K.Chatterjee
8. EnvironmentalBiotechnologybyS.N.JogdandHimalayaPublishing

.**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER IV**

**ELECTIVE PAPER2: IPR and Biosafety**

Papercode: Subject:**IPR and Biosafety**

**Hours/Week:5 Credits:3**

Aim: To enable the students to understand the basic concept of Introduction of intellectual property and also the basic patterns and concepts of prior art and also patent filing procedure and biosafety.

**CourseObjectives**

1.TolearntheIntroduction to intellectual property and types of IP .

2.Tolearn the basic patent and concept of Prior art and International Databases.

3.Todevelopknowledge about the patent filling procedure and infringement .

4.Tolearn the Concept of bio safety levels and bio safety guidelines .

## 5. Todevelopapieceofknowledgeabout the biological safety cabinets and risk analysis.

# CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of Intellevtual property and agreement and treaties .

7.Aftercompletingunit2,thestudentswill able to understand the concept of patents .

8. Aftercompletingunit3,thestudentswillbeable to understand the patent filing procedure

and patent licensing

1. Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of biosafety levels .
2. Aftercompletingunit5,thestudentswillbeabletoexplainthe concept of biosafety guidelines.

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | **Introduction to Intellectual Property**Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies  **Agreements and Treaties**History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments | **18hours** |
| **Unit-II** | **Basics of Patents and Concept of Prior Art**Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTScope(WIPO), IPO, etc.) | **18hours** |
| **Unit-III** | **Patentfilingprocedures**  National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies | **18hours** |
| **Unit-IV** | **Biosafety**  Introduction; Historical Backround; Introduction toBiological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; | **18hours** |
| **Unit-V** | **Biosafety guidelines** - Government of India; Definition of GMOs & LMOs; RolesofInstitutional BiosafetyCommittee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1. P.Narayanan,IntellectualPropertyLaws,EasternLawHouse.
2. MeenuPaul,IntellectualPropertyLaws,AllahabadLawAgency.
3. IntellectualPropertyLawcontainingActsandRules,UniversalLawPublication Company.

.**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 3 | 2 | 2 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | 3 |
| **Weightage** | 15 | 15 | 10 | 10 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 3 | 2 | 2 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**SEMESTER IV**

**ELECTIVE PAPER3: Biochemistry**

Papercode:Subject:**Biochemistry**

**Hours/Week:5 Credits:3**

Aim: To enable the students to understand the basic concept of bio molecules and also the classification of lipids and also about the amino acids and also the IUB classification and nomenclature .

**CourseObjectives**

1.Tolearntheconcept and organisation of biomolecules and Carbohydrates.

2.Tolearn the concept of classification of lipids.

3.Todevelopknowledge about the classification of amino acids

4.Tolearn the Concept of IUB classification and nomenclature of enzymes and nucleic acids .

## 5. Tounderstand the structure of proteins and also the structue of purine and prymidine bases.

# CourseOutComes

6. Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of bio molecules and carbohydrates structure and classification..

7..Aftercompletingunit2,thestudentswill able to understand the concept of classification of lipids and properties of fatty acids.

8. Aftercompletingunit3,thestudentswillbeable to understand the concept of classification and structure of amino acids.

9.Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of IUB classification and nomenclature of enzymes .

10.Aftercompletingunit5,thestudentswillbeabletoexplainthe basic concept of nucleic acid

# Matching Table (Put Yes/Nointheappropriatebox)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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** | **CourseContents** | **Teaching hours** |
| **UnitI** | **Organisation of Biomolecules**, Buffers, Principleand biological application of diffusion osmosis, viscosity and Donnan membrane equilibrium. Carbohydrates : structure and classification of carbohydrates, metabolism of carbohydrates : glycoysis, TCA ycle HMP pathways. | **18 hours** |
| **Unit-II** | **Lipids** : Classification, structure and nomenclature of lipids, Biological significance of lipids, physico- chemical properties of fattyacids and triacyl glycerol. | **18hours** |
| **Unit-III** | **Aminoacids** : classification, structure and nomenclature of aminoacids, physico-chemical properties of aminoacids. proteins: confirmation of proteins and polypeptides secondary, tertiary and quartenaryand domainstructureofproteins, denaturationofproteins andRamchandranplots | **18hours** |
| **Unit-IV** | **IUB Classification and nomenclature of enzymes**, general properties of enzymes, enzyme kinetics- Michaelis Menten equations, Coenzymes - structure and biological fucntion of coenzymes A, TPP, FMN, FAD, NAD and lipoic acid, structure of purine and pyrimidine bases, nucleosides and nucleotides. Primary structure of nucleic acid, Three dimensional structure of t- RNA. | **18hours** |
| **Unit-V** | **Nucleic acids**  Nature of genetic material, structure of purine and pyrimidine nucleotides. Composition of DNA and RNA-Watson crick model of DNA. Types of nucleic acid (DNA and RNA).Properties of nucleic acids-Tm, denaturation and renaturation, hypo and hyper chromicity. | **18hours** |
| **TotalTeachinghours** | | **90** |

**InternalAssessmentMethods:(25 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distributionfor  internals | Test(CIAI+CIA  II+CIAIII) | Seminars | Assignment | Totalmarks |
| Marks | 15 | 05 | 05 | 25 |

# ReferenceBook:

1.PrinciplesofBiochemistryLehninger.

**MappingwithProgrammeOutcomes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

**PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1**

# MappingwithProgramme SpecificOutcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
| **CO1** | 3 | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 |
| **CO4** | 3 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 2 | 3 | 3 | 3 |
| **Weightage** | 15 | 10 | 15 | 15 | 15 |
| **Weighted percentage (rounded of) Course Contribution to POs** | 3 | 2 | 3 | 3 | 3 |

**Strong - 3, Medium – 2, Low - 1**

**PROJECT. (8 CREDIT)**

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