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| B.Sc.,  MICROBIOLOGY |
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| |  | | --- | | **SYLLABUS** | | **from the academic year**  **2023-2024** | |
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| **TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005** |
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| **LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME** | |
| **Programme:** | **B.Sc. MICROBIOLOGY** |
| **Programme Code:** |  |
| **Duration:** | **3 Years (UG)** |
| **Programme Outcomes:** | **PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study  **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.  **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.  **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one’s learning to real life situations.  **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.  **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation  **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team  **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.  **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.  **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.  **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.  **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.  **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one’s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.  **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.  **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling. |
| **Programme Specific Outcomes:** | On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to:  **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory.  **PSO2: Critical Thinking:** Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively  **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.  **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models.  **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.  **PSO6: Self-directed & Lifelong Learning:** Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field. |

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| **PO/PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** |
| **PO1** |  |  |  |  |  |  |
| **PO2** |  |  |  |  |  |  |
| **PO3** |  |  |  |  |  |  |
| **PO4** |  |  |  |  |  |  |
| **PO5** |  |  |  |  |  |  |
| **PO6** |  |  |  |  |  |  |

**2. Highlights of the Revamped Curriculum**:

* Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
* The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
* The General Studies and Statistics based problem solving skills are included as mandatory components in the ‘Training for Competitive Examinations’ course at the final semester, a first of its kind.
* The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
* The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
* The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
* Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
* State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

**ValueadditionsintheRevampedCurriculum:**

|  |  |  |
| --- | --- | --- |
| **Semester** | **NewlyintroducedComponents** | **Outcome/ Benefits** |
| **I** | **FoundationCourse**  To ease the transition of learningfrom higher secondary to highereducation,providinganoverviewofthepedagogyoflearningLiteratureandanalysingtheworldthroughtheliterarylens  givesrisetoanewperspective. | * Instill confidenceamongstudents * Createinterestforthesubject |
| **I,II,III,IV** | **SkillEnhancementpapers**(Discipline centric /Generic/Entrepreneurial) | * Industry readygraduates * Skilledhumanresource * Studentsareequippedwithessentialskillsto   makethememployable |
| * Trainingonlanguageandcommunicationskillsenablethestudents gain   knowledge and  exposureinthecompetitiveworld. |
| * Discipline centric skillwillimprovetheTechnical knowhow ofsolvingreallife   problems. |
| **III,IV,V& VI** | Electivepapers | * Strengthening thedomainknowledge * Introducing thestakeholders to theState-of Arttechniquesfrom the streamsofmulti-disciplinary,crossdisciplinaryandinterdisciplinarynature * Emerging topics inhigher education/industry/communicationnetwork/healthsectoretc.areintroducedwith   hands-on-training. |

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| **IV** | ElectivePapers | | * Exposuretoindustrymouldsstudentsintosolutionproviders * GeneratesIndustryreadygraduates * Employmentopportunitiesenhanced |
| **VSemester** | Electivepapers | | * Self-learning isenhanced * Applicationoftheconcepttorealsituationisconceivedresulting   intangibleoutcome |
| **VISemester** | Electivepapers | | * Enriches the studybeyondthe course. * Developingaresearchframework and   presenting their  independent and  intellectual ideaseffectively. |
| **ExtraCredits:**  **ForAdvancedLearners/Honorsdegree** | | | * Tocatertotheneedsofpeerlearners/research   aspirants |
| **SkillsacquiredfromtheCourses** | | Knowledge, Problem Solving, Analytical  ability,ProfessionalCompetency,ProfessionalCommunicationandTransferrable Skill | |

**Credit Distribution for UG Programmes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sem I** | **Credit** | **H** | **Sem II** | **Credit** | **H** | **Sem III** | **Credit** | **H** | **Sem IV** | **Credit** | **H** | **Sem V** | **Credit** | **H** | **Sem VI** | **Credit** | **H** |
| Part 1. Language – Tamil | 3 | 6 | Part..1. Language – Tamil | 3 | 6 | Part..1. Language – Tamil | 3 | 6 | Part..1. Language – Tamil | 3 | 6 | 5.1 Core Course –\CC IX | 4 | 5 | 6.1 Core Course –  CC XIII | 4 | 6 |
| Part.2 English | 3 | 6 | Part..2 English | 3 | 6 | Part..2 English | 3 | 6 | Part..2 English | 3 | 6 | 5.2 Core Course – CC X | 4 | 5 | 6.2 Core Course –  CC XIV | 4 | 6 |
| 1.3 Core Course – CC I | 5 | 5 | 2..3 Core Course – CC III | 5 | 5 | 3.3 Core Course – CC V | 5 | 5 | 4.3 Core Course – CC VII  Core Industry Module | 5 | 5 | 5. 3.Core Course CC -XI | 4 | 5 | 6.3 Core Course –  CC XV | 4 | 6 |
| 1.4 Core Course – CC II | 5 | 5 | 2.4 Core Course – CC IV | 5 | 5 | 3.4 Core Course – CC VI | 5 | 5 | 4.4 Core Course –  CC VIII | 5 | 5 | 5. 4.Core Course –/ Project with viva- voce  CC -XII | 4 | 5 | 6.4 Elective -VII Generic/ Discipline Specific | 3 | 5 |
| 1.5 Elective I Generic/ Discipline Specific | 3 | 4 | 2.5 Elective II Generic/ Discipline Specific | 3 | 4 | 3.5 Elective III Generic/ Discipline Specific | 3 | 4 | 4.5 Elective IV Generic/ Discipline Specific | 3 | 3 | 5.5 Elective V Generic/ Discipline Specific | 3 | 4 | 6.5 Elective VIII  Generic/ Discipline Specific | 3 | 5 |
| 1.6 Skill Enhancement Course SEC-1 | 2 | 2 | 2.6 Skill Enhancement Course SEC-2 | 2 | 2 | 3.6 Skill Enhancement Course SEC-4,  (Entrepreneurial Skill) | 1 | 1 | 4.6 Skill Enhancement Course SEC-6 | 2 | 2 | 5.6 Elective VI Generic/ Discipline Specific | 3 | 4 | 6.6 Extension Activity | 1 | - |
| 1.7 Skill Enhancement -(Foundation Course) | 2 | 2 | 2.7 Skill Enhancement Course –SEC-3 | 2 | 2 | 3.7 Skill Enhancement Course SEC-5 | 2 | 2 | 4.7 Skill Enhancement Course SEC-7 | 2 | 2 | 5.7 Value Education | 2 | 2 | 6.7 Professional Competency Skill | 2 | 2 |
|  |  |  |  |  |  | 3.8 E.V.S. | - | 1 | 4.8 E.V.S | 2 | 1 | 5.8 Summer Internship /Industrial Training | 2 |  |  |  |  |
|  | **23** | **30** |  | **23** | **30** |  | **22** | **30** |  | **25** | **30** |  | **26** | **30** |  | **21** | **30** |
| **Total – 140 Credits** | | | | | | | | | | | | | | | | | |

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

**for all UG courses including Lab Hours**

**First Year – Semester-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part-1 | Language – Tamil | 3 | 6 |
| Part-2 | English | 3 | 6 |
| Part-3 | Core Courses & Elective Courses [in Total] | 13 | 14 |
| Part-4 | Skill Enhancement Course SEC-1 | 2 | 2 |
| Foundation Course | 2 | 2 |
|  |  | **23** | **30** |

**Semester-II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part-1 | Language – Tamil | 3 | 6 |
| Part-2 | English | 3 | 6 |
| Part-3 | Core Courses & Elective Courses including laboratory [in Total] | 13 | 14 |
| Part-4 | Skill Enhancement Course -SEC-2 | 2 | 2 |
| Skill Enhancement Course -SEC-3 (Discipline / Subject Specific) | 2 | 2 |
|  |  | **23** | **30** |

**Second Year – Semester-III**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part-1 | Language - Tamil | 3 | 6 |
| Part-2 | English | 3 | 6 |
| Part-3 | Core Courses & Elective Courses including laboratory [in Total] | 13 | 14 |
| Part-4 | Skill Enhancement Course -SEC-4 (Entrepreneurial Based) | 1 | 1 |
| Skill Enhancement Course -SEC-5 (Discipline / Subject Specific) | 2 | 2 |
| E.V.S | - | 1 |
|  |  | **22** | **30** |

**Semester-IV**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| Part-1 | Language - Tamil | 3 | 6 |
| Part-2 | English | 3 | 6 |
| Part-3 | Core Courses & Elective Courses including laboratory [in Total] | 13 | 13 |
| Part-4 | Skill Enhancement Course -SEC-6 (Discipline / Subject Specific) | 2 | 2 |
| Skill Enhancement Course -SEC-7 (Discipline / Subject Specific) | 2 | 2 |
| E.V.S | 2 | 1 |
|  |  | **25** | **30** |

**Third Year**

**Semester-V**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| **Part-3** | Core Courses including Project / Elective Based | 22 | 26 |
| **Part-4** | Value Education | 2 | 2 |
| Internship / Industrial Visit / Field Visit | 2 | 2 |
|  |  | **26** | **30** |

**Semester-VI**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **List of Courses** | **Credit** | **No. of Hours** |
| **Part-3** | Core Courses including Project / Elective Based & LAB | 18 | 28 |
| **Part-4** | Extension Activity | 1 | - |
| Professional Competency Skill | 2 | 2 |
|  |  | **21** | **30** |

**Consolidated Semester wise and Component wise Credit distribution**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parts** | **Sem I** | **Sem II** | **Sem III** | **Sem IV** | **Sem V** | **Sem VI** | **Total Credits** |
| **Part I** | 3 | 3 | 3 | 3 | - | - | 12 |
| **Part II** | 3 | 3 | 3 | 3 | - | - | 12 |
| **Part III** | 13 | 13 | 13 | 13 | 22 | 18 | 92 |
| **Part IV** | 4 | 4 | 3 | 6 | 4 | 1 | 22 |
| **Part V** | - | - | - | - | - | 2 | 2 |
| **Total** | 23 | 23 | 22 | 25 | 26 | 21 | **140** |

**\*Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

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| --- | --- | --- |
| **MethodsofEvaluation** | | |
| **InternalEvaluation** | ContinuousInternalAssessmentTest | 25 Marks |
| Assignments |
| Seminars |
| AttendanceandClassParticipation |
| **ExternalEvaluation** | EndSemesterExamination | 75 Marks |
|  | Total | 100 Marks |
| **MethodsofAssessment** | | |
| **Recall(K1)** | Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions | |
| **Understand/Comprehend(K2)** | MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryor  overview | |
| **Application (K3)** | Suggestidea/conceptwithexamples,Suggestformulae, Solveproblems,  Observe,Explain | |
| **Analyze(K4)** | Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate | |
|  | betweenvariousideas,Mapknowledge | |
| **Evaluate(K5)** | Longer essay/Evaluationessay,Critiqueorjustifywithprosandcons | |
| **Create(K6)** | Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor  Presentations | |

FIRST SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.NO | Course  Category |  | Course | Credit distribution | | | | Overall Credits | Total contact  Hours/week | Marks | | |
| L | T | P | S | CIA | ESE | Total |
| 1 | Part –I |  | Language - Tamil | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 2 | Part –II |  | English | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 3 | Part -III |  | CC-1 | L |  |  |  | 4 | 5 | 25 | 75 | 100 |
| 4 | Part -III |  | CC-2 |  |  | P |  | 4 | 5 | 40 | 60 | 100 |
| 5 | Part -III |  | AL-1 | L |  |  |  | 3 | 4 | 25 | 75 | 100 |
| 6 | Part –IV |  | SEC-1 (NME) | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
| 7 | Part –IV |  | FC | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
|  |  |  | Total |  |  |  |  | 23 | 30 |  |  |  |

SECOND SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.NO | Course  Category | Course | Credit distribution | | | | Overall Credits | Total contact  Hours/week | Marks | | |
| L | T | P | S | CIA | ESE | Total |
| 1 | Part –I | Language - Tamil | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 2 | Part –II | English | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 3 | Part -III | CC-3 | L |  |  |  | 4 | 5 | 25 | 75 | 100 |
| 4 | Part -III | CC-4 |  |  | P |  | 4 | 5 | 40 | 60 | 100 |
| 5 | Part -III | AL-2 | L |  |  |  | 4 | 4 | 25 | 75 | 100 |
| 6 | Part –IV | SEC-2 (NME) | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
| 7 | Part –IV | SEC-3 | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
|  |  | Total |  |  |  |  | 24 | 30 |  |  |  |

THIRD SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.NO | Course  Category | Course | Credit distribution | | | | Overall Credits | Total contact  Hours/week | Marks | | |
| L | T | P | S | CIA | ESE | Total |
| 1 | Part –I | Language - Tamil | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 2 | Part –II | English | L |  |  |  | 3 | 6 | 25 | 75 | 100 |
| 3 | Part –III | CC-5 | L |  |  |  | 4 | 5 | 25 | 75 | 100 |
| 4 | Part –III | CC-6 |  |  | P |  | 4 | 5 | 40 | 60 | 100 |
| 5 | Part –III | AL-3 | L |  |  |  | 3 | 3 | 25 | 75 | 100 |
| 6 | Part –IV | SEC-4 | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
| 7 | Part –IV | SEC-5 | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
| 9 | Part –IV | E.V.S | L |  |  |  | - | 1 | 25 | 75 | 100 |
|  | Total |  |  |  |  |  | 23 | 30 |  |  |  |

FOURTH SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.NO | Course  Category | Course  Code | Course | | Credit distribution | | | | | | | | Overall Credits | | Total contact  Hours/week | | Marks | | | | | |
|  | L | | T | | P | | S | | CIA | | ESE | | Total | |
| 1 | Part –I |  | Language - Tamil | | L | |  | |  | |  | | 3 | | 6 | | 25 | | 75 | | 100 | |
| 2 | Part –II |  | English | | L | |  | |  | |  | | 3 | | 6 | | 25 | | 75 | | 100 | |
| 3 | Part –III | 22MBUGCT4 | CC VII | | L | |  | |  | |  | | 4 | | 4 | | 25 | | 75 | | 100 | |
| 4 | Part –III | 22MBUGCP4 | CC VIII | |  | |  | | P | |  | | 4 | | 4 | | 40 | | 60 | | 100 | |
| 5 | Part –III | 22MBUGDE4 | AL IV | | L | |  | |  | |  | | 3 | | 4 | | 25 | | 75 | | 100 | |
| 6 | Part –IV | 22MBUGSEC6 | SEC-6 | | L | |  | |  | |  | | 2 | | 2 | | 25 | | 75 | | 100 | |
| 7 | Part –IV | 22MBUGSEC7 | SEC-7 | | L | |  | |  | |  | | 2 | | 2 | | 25 | | 75 | | 100 | |
| 9 | Part –IV |  | EVS | | L | |  | |  | |  | | 2 | | 2 | | 25 | | 75 | | 100 | |
| Total | | | |  | |  | |  | |  | | 25 | | 30 | |  | |  | |  | |

FIFTH SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sl.  NO | Course  Category | Course | Credit distribution | | | | Overall Credits | Total contact  Hours/week | Marks | | |
| L | T | P | S |  |  | CIA | ESE | Total |
|  | 1 | Part -III | CC- IX | L |  |  |  | 4 | 5 | 25 | 75 | 100 |
|  | 2 | Part –III | CC –X | L |  |  |  | 4 | 5 | 25 | 75 | 100 |
|  | 3 | Part -III | CC- XI |  |  | P |  | 4 | 5 | 40 | 60 | 100 |
|  | 4 | Part -III | Core course/ Project with viva- voce-XII |  |  |  |  | 4 | 5 | 25 | 75 | 100 |
|  | 5 | Part -III | Elective-5 | L |  |  |  | 3 | 4 | 25 | 75 | 100 |
|  | 6 | Part -III | Elective-6 | L |  |  |  | 3 | 4 | 25 | 75 | 100 |
|  | 7 | Part -IV | Value Education |  |  |  |  | 2 | 2 | 25 | 75 | 100 |
|  | 8 | Part -IV | Internship/ Industrial visit/ Field visit |  |  |  |  | 2 | - | 25 | 75 | 100 |
|  |  | Total |  |  |  |  |  |  |  |  |  |  |
|  | | | |  |  |  |  | 26 | 30 |  |  |  |

SIXTH SEMESTER

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Course  Category | Course  Code | Course | Credit distribution | | | | Overall Credits | Total contact  Hours/week | Marks | | |
| L | T | P | S |  |  | CIA | ESE | Total |
| 1 | Part -III |  | CC-XIII | L |  |  |  | 4 | 6 | 25 | 75 | 100 |
| 2 | Part -III |  | CC-XIV | L |  |  |  | 4 | 6 | 25 | 75 | 100 |
| 3 | Part -III |  | CC-XV |  |  | P |  | 4 | 6 | 40 | 60 | 100 |
| 4 | Part -III |  | Elective-7 | L |  |  |  | 3 | 5 | 25 | 75 | 100 |
| 5 | Part -III |  | Elective-8 | L |  |  |  | 3 | 5 | 25 | 75 | 100 |
| 6 | Part -IV |  | Extension activity |  |  |  |  | 1 | - | - | - | - |
| 7 | Part -IV |  | Professional competency skill | L |  |  |  | 2 | 2 | 25 | 75 | 100 |
|  |  | Total |  |  |  |  |  | 21 | 30 |  |  |  |

**Credit Distribution for UG MICROBIOLOGY**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Part** | **Course Details** | **Credit** |
| 1 | **III** | Core(15x4) | 60 |
| 2 | Elective Generic/ Discipline Specific Elective(8x3=24) | 24 |
| 3 | I& II | Language & English  (Lang - 4x3=12  Eng - 4x3=12) | 24 |
| 4 | IV | NME(2x2) | 4 |
| 5 | EVS(1x2) | 2 |
| 6 | Value Education(1x2) | 2 |
| 7 | Extension Activity(1x1) | 1 |
| 8 | * Ability Enhancement [AECC]- Soft Skill(4x2=8) * Skill Enhancement Course [4 Courses x 2 credits =8 credits ] SEC-4 – 1 Credit * Summer internship/ Industrial training (2x1=2 credits) * Foundation course * Professional Competency Skill | 8  9  2  2  2 |
|  |  |  | **141** |

**Remarks: English Soft Skill Two Hours Will be handled by English Teachers**

**(4+2 = 6 hours for English).**

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | | | **Marks** | | | |
| **CIA** | | **External** | **Total** |
| **22MBUGCT1** | **FUNDAMENTALS OF MICROBIOLOGY AND**  **MICROBIAL DIVERSITY** | | **Core Course – 1** | **Y** | **-** | **-** | **-** | **4** | **5** | | | **25** | | **75** | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | |
| CO1 | Learn the fundamental principles about different aspects of Microbiology including recent developments in the area. | | | | | | | | | | | | | | |
| CO2 | Describe the structural organization, morphology and reproduction of microbes. | | | | | | | | | | | | | | |
| CO3 | Explain the methods of cultivation of microbes and measurement of growth. | | | | | | | | | | | | | | |
| CO4 | Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology. | | | | | | | | | | | | | | |
| CO5 | Compare and contrast the different methods of sterilization. | | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | **No.of Hours** | | | **Course Objectives** | | |
| I | History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity. | | | | | | | | | 12 | | | CO1 | | |
| II | General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae. | | | | | | | | | 12 | | | CO2 | | |
| III | Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques. | | | | | | | | | 12 | | | CO3 | | |
| IV | Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods. | | | | | | | | | 12 | | | CO4 | | |
| V | Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents. | | | | | | | | | 12 | | | CO5 | | |
|  | Total | | | | | | | | | 60 | | |  | | |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | | Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms. | | | | | | | | | PO5, PO6, PO10 | | | | |
| CO2 | | Gain Knowledge of detailed structure and functions of prokaryotic cell organelles. | | | | | | | | | PO10 | | | | |
| CO3 | | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | | | | | | | | | PO11 | | | | |
| CO4 | | Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application. | | | | | | | | | PO4, PO11 | | | | |
| CO5 | | Understand the concept of asepsis and modes of sterilization and disinfectants**.** | | | | | | | | | PO4, PO11 | | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1 | | Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition.,McGraw –Hill, New York. | | | | | | | | | | | | | |
| 2 | | Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott’s Microbiology. 10th  Edition., McGraw-Hill International edition. | | | | | | | | | | | | | |
| 3 | | Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson. | | | | | | | | | | | | | |
| 4 | | Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc.New York. | | | | | | | | | | | | | |
| 5 | | Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby CollegePublishing, St Louis. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1 | | Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9thEdition). Jones &Bartlett learning 2010. | | | | | | | | | | | | | |
| 2 | | Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd | | | | | | | | | | | | | |
| 3 | | Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction,  11thEdition., Benjamin Cummings. | | | | | | | | | | | | | |
| 4 | | Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications. | | | | | | | | | | | | | |
| 5 | | Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of  Microorganisms, 13th Edition Benjamin-Cummings Pub Co. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | |
| 1 | | https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-  microbiology/a-brief-history-of-microbiology | | | | | | | | | | | | | |
| 2 | | <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp> | | | | | | | | | | | | | |
| 3 | | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/# | | | | | | | | | | | | | |
| 4 | | <https://bio.libretexts.org/@go/page/9188> | | | | | | | | | | | | | |
| 5 | | https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-  nutrition/ | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  | M | M |  |  |  | M |  |
| CO2 |  |  |  |  |  |  |  |  |  | M | M |
| CO3 |  |  |  |  |  |  |  |  |  |  | S |
| CO4 |  |  |  | M |  |  |  |  |  |  | S |
| CO5 |  |  |  | M |  |  |  |  |  |  | S |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | | |
| **CIA** | | | **External** | | **Total** | |
| **22MBUGCP1** | **PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY** | | **Core Course II- Practical I** | **-** | **-** | **Y** | **-** | **4** | **5** | **40** | | | **60** | | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | | Acquire knowledge on Cleaning of glass wares, GLP and sterilization. | | | | | | | | | | | | | | |
| CO2 | | Gain knowledge on media preparation and cultural characteristics. | | | | | | | | | | | | | | |
| CO3 | | Learn the pure culture technique | | | | | | | | | | | | | | |
| CO4 | | Learn the microscopic techniques and staining methods. | | | | | | | | | | | | | | |
| CO5 | | Acquire knowledge on stain and staining methods | | | | | | | | | | | | | | |
| **UNIT** | | **Details** | | | | | | | | | **No.of Hours** | | | **Course Objectives** | | |
| I | | Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration. | | | | | | | | | 12 | | | CO1 | | |
| II | | Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates. | | | | | | | | | 12 | | | CO2 | | |
| III | | Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media.  Pure culture techniques: streak plate, pour plate, decimal dilution. | | | | | | | | | 12 | | | CO3 | | |
| IV | | Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production.  Microscopy: light microscopy and bright field microscopy. | | | | | | | | | 12 | | | CO4 | | |
| V | | Staining techniques: smear preparation, simple staining, Gram’s staining and endospore staining.  Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop. | | | | | | | | | 12 | | | CO5 | | |
|  | | Total | | | | | | | | | 60 | | |  | | |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | | Practice sterilization methods; learn to prepare media and their quality control. | | | | | | | | | | PO4, PO7, PO8, PO9, PO11 | | | |
| CO2 | | Learn streak plate, pour plate and serial dilution and pigment production of microbes. | | | | | | | | | | PO4, PO7, PO8, PO9 | | | |
| CO3 | | Understand Microscopy methods, different Staining techniques and motility test. | | | | | | | | | | PO4, PO7, PO8, PO9, PO11 | | | |
| CO4 | | Observeculture characteristics of microorganisms. | | | | | | | | | | PO4, PO7, PO8, PO9 | | | |
| CO5 | | Study on Microbial Diversity using Hay Infusion Broth-Wet mount | | | | | | | | | | PO4, PO7, PO8, PO9 | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1 | | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. | | | | | | | | | | | | | |
| 2 | | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. | | | | | | | | | | | | | |
| 3 | | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. | | | | | | | | | | | | | |
| 4 | | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. | | | | | | | | | | | | | |
| 5 | | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1 | | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. | | | | | | | | | | | | | |
| 2 | | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India | | | | | | | | | | | | | |
| 3 | | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS | | | | | | | | | | | | | |
| 4 | | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. | | | | | | | | | | | | | |
| 5 | | Lim D. (1998). Microbiology, 2ndEdition, WCB McGraw Hill Publications. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | |
| 1 | | http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403. | | | | | | | | | | | | | |
| 2 | | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> | | | | | | | | | | | | | |
| 3 | | https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf | | | | | | | | | | | | | |
| 4 | | https://microbiologyinfo.com/top-and-best-microbiology-books/ | | | | | | | | | | | | | |
| 5 | | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | M |  |  | L | M | L |  | M |
| CO2 |  |  |  | S |  |  | L | L | L |  |  |
| CO3 |  |  |  | S |  |  | M | M | L |  | M |
| CO4 |  |  |  | S |  |  | M | L | L |  |  |
| CO5 |  |  |  | S |  |  | M | L | L |  |  |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE1** | **BASIC AND CLINICAL BIOCHEMISTRY** | Elective Generic / Discipline Specific Elective-I | **Y** | **-** | **-** | **-** | **3** | **4** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | |
| CO1 | Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life. | | | | | | | | | | | | |
| CO2 | Explain the biological activity of amino acids and proteins. | | | | | | | | | | | | |
| CO3 | Identify the metabolic errors in enzymes of carbohydrates and lipids. | | | | | | | | | | | | |
| CO4 | Describe the disorders in amino acid metabolism. | | | | | | | | | | | | |
| CO5 | Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life. | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Biomolecules -Carbohydrate – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance. | | | | | | | | | 12 | | CO1 | |
| II | Biomolecules - Amino acids – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance. | | | | | | | | | 12 | | CO2 | |
| III | Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus,ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia,sphingolipidosis. | | | | | | | | | 12 | | CO3 | |
| IV | Disorders of Metabolism: Disorders of amino acid metabolism:alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias. | | | | | | | | | 12 | | CO4 | |
| V | Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions.  Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. | | | | | | | | | 12 | | CO5 | |
|  | Total | | | | | | | | | 60 | |  | |

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| **Course Outcomes** | | |
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Explain the structure, classification , biochemical functions and significance of carbohydrates and lipids | PO1 |
| CO2 | Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation. | PO1 |
| CO3 | Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism. | PO4, PO5, PO6 |
| CO4 | Discuss and evaluate the pathology of aminoacid metabolic disorders. | PO4, PO5, PO6 |
| CO5 | Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis. | PO5, PO6, PO9 |
| **Text Books** | | |
| 1 | Satyanarayana, U. and Chakrapani, U(2014).Biochemistry,4th Edition, Made Simple Publisher. | |
| 2 | Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7th Edition, S Chand Company. | |
| 3 | AmbikaShanmugam’s (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd. | |
| 4 | Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers | |
| 5 | Jeremy M. Berg,LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher. | |
| **References Books** | | |
| 1 | AmitKessel&Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2ndEdition, Chapman and Hall. | |
| 2 | David L. Nelson and Michael M. Cox (2017).Lehninger Principles of Biochemistry, 7thEdition W.H. Freeman and Co., NY. | |
| 3 | LupertStyrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9thEdition ,W.H.Freeman& Co. New York. | |
| 4. | Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley. | |
| 5. | Joy PP, Surya S. and AswathyC (2015). Laboratory Manual of Biochemistry, Edition 1.,Publisher:Kerala agricultural university. | |
| **Web Resources** | | |
| 1 | https://www.abebooks.com › plp | |
| 2 | <https://kau.in/document/laboratory-manual-biochemistry> | |
| 3 | https://metacyc.org | |
| 4 | https://www.medicalnewstoday.com | |
| 5 | https://journals.indexcopernicus.com | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | M |  |  |  |  |  |  |  |  |  |  |
| CO2 | M |  |  |  |  |  |  |  |  |  |  |
| CO3 |  |  |  | S | S | S |  |  |  |  |  |
| CO4 |  |  |  | S | S | S |  |  |  |  |  |
| CO5 |  |  |  |  | S | S |  |  | S |  |  |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGSEC1** | **Social and Preventive medicine** | **Skill enhancement Course**  **SEC - 1 (NME)** | **Y** | **-** | **-** | **-** | **2** | **2** | | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | Describe the concepts of health and disease and their social determinants | | | | | | | | | | | | | |
| CO2 | Summarize the health management system | | | | | | | | | | | | | |
| CO3 | Know about the various health care services | | | | | | | | | | | | | |
| CO4 | Outline the goals of preventive medicine | | | | | | | | | | | | | |
| CO5 | Gain knowledge about alternate medicine | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Introduction to social medicine:  History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies. | | | | | | | | | | 6 | | CO1 | |
| II | Health management:  Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control. | | | | | | | | | | 6 | | CO2 | |
| III | Health care and services:  Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners. | | | | | | | | | | 6 | | CO3 | |
| IV | Preventive medicine:  Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods. | | | | | | | | | | 6 | | CO4 | |
| V | Prevention through alternate medicine:  Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks. | | | | | | | | | | 6 | | CO5 | |
|  | Total | | | | | | | | | | 30 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | Identify the health information system | | | | | | | | PO1,PO5, PO6 | | | | | |
| CO2 | Associate various factors with health management system | | | | | | | | PO1,PO2, PO3,PO5, PO6, PO9 | | | | | |
| CO3 | Choose the appropriate health care services | | | | | | | | PO1,PO5, PO6 | | | | | |
| CO4 | Appraise the role of preventive medicine in community setting | | | | | | | | PO4,PO5, PO6 | | | | | |
| CO5 | Recommend the usage of alternate medicine during outbreaks | | | | | | | | PO1,PO5, PO6 | | | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | Park.K (2021). Textbook of preventive and social medicine, 26th  edition.  BanarsidasBhanot publishers. | | | | | | | | | | | | | |
| 2. | Mahajan& Gupta (2013). Text book of preventive and social medicine, 4thedition. Jaypeebrothers medical publishers. | | | | | | | | | | | | | |
| 3. | Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers. | | | | | | | | | | | | | |
| 4. | Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatics. 12th edition, Jaypee Brothers Medical Publishers. | | | | | | | | | | | | | |
| 5. | Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers. | | | | | | | | | | | | | |
| 2 | GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers. | | | | | | | | | | | | | |
| 3 | Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010).Handbook of Health Psychology and BehavioralMedicine.Guilford Press. | | | | | | | | | | | | | |
| 4 | Marie Eloïse Muller, Marie Muller, MarthieBezuidenhout, KarienJooste (2006).Health Care Service Management. Juta and Company Ltd. | | | | | | | | | | | | | |
| 5 | Geoffrey Rose (2008).Rose's Strategy of Preventive Medicine: The Complete.OUP Oxford. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | <https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php> | | | | | | | | | | | | | |
| 2 | https://www.teacheron.com/online-md\_preventive\_and\_social\_medicine-tutors | | | | | | | | | | | | | |
| 3 | <https://www.futurelearn.com> | | | | | | | | | | | | | |
| 4 | <https://www.healthcare-management-degree.net> | | | | | | | | | | | | | |
| 5 | https://www.conestogac.on.health-care-administration-and-service-management | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S |  |  |  | S | S |  |  |  |  |  |
| CO2 | S | S |  | M | S | S |  |  | M |  |  |
| CO3 |  |  |  | M | S | S |  |  |  |  |  |
| CO4 | S |  |  | S | S | M |  |  |  |  |  |
| CO5 | S |  |  |  | S | S |  |  |  |  |  |

SEMESTER II

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGCT2** | **MICROBIAL PHYSIOLOGY AND METABOLISM** | | **Core Course III** | **Y** | **-** | **-** | **-** | **4** | **5** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | Study the basic principles of microbial growth. | | | | | | | | | | | | | |
| CO2 | Understand the basic concepts of aerobic and anaerobic metabolic pathways. | | | | | | | | | | | | | |
| CO3 | Analyze the role of individual components in overall cell function. | | | | | | | | | | | | | |
| CO4 | Provide information on sources of energy and its utilization by microorganisms. | | | | | | | | | | | | | |
| CO5 | Study the different types of metabolic strategies. | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth. | | | | | | | | | | 12 | | CO1 | |
| II | Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth. | | | | | | | | | | 12 | | CO2 | |
| III | An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation. | | | | | | | | | | 12 | | CO3 | |
| IV | Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle. | | | | | | | | | | 12 | | CO4 | |
| V | Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa. | | | | | | | | | | 12 | | CO5 | |
|  | Total | | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Describe microorganisms based on nutrition. | | | | | | | | | PO6, PO9 | | | |
| CO2 | | Know the concept of microbial growth and identify the factors affecting bacterial growth. | | | | | | | | | PO6, PO7, PO9 | | | |
| CO3 | | Explain the methods of nutrient uptake. | | | | | | | | | PO6, PO9 | | | |
| CO4 | | Describe anaerobic and aerobic energy production. | | | | | | | | | PO6, PO9 | | | |
| CO5 | | Elaborate on the process of bacterial photosynthesis and reproduction. | | | | | | | | | PO6, PO9 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1 | | Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge. | | | | | | | | | | | | |
| 2 | | RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India. | | | | | | | | | | | | |
| 3 | | MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006. | | | | | | | | | | | | |
| 4 | | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. | | | | | | | | | | | | |
| 5 | | S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | | Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49. | | | | | | | | | | | | |
| 2 | | Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge. | | | | | | | | | | | | |
| 3 | | Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA. | | | | | | | | | | | | |
| 4 | | Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications. | | | | | | | | | | | | |
| 5 | | BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | | https://sites.google.com/site/microbial physiologyoddsem/teaching-contents | | | | | | | | | | | | |
| 2 | | https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition | | | | | | | | | | | | |
| 3 | | <https://onlinecourses.swayam2.ac.in/cec20_bt14/preview> | | | | | | | | | | | | |
| 4 | | http://web.iitd.ac.in/~amittal/2007\_Addy\_Enzymes\_Chapter.pdf | | | | | | | | | | | | |
| 5 | | <https://www..frontiersin.org.microbial-physiology-and-metabolism> | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  |  | M |  |  | M |  |  |
| CO2 |  |  |  |  |  | M | L |  | M |  |  |
| CO3 |  |  |  |  |  | M |  |  | M |  |  |
| CO4 |  |  |  |  |  | M |  |  | M |  |  |
| CO5 |  |  |  |  |  | M |  |  | M |  |  |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | | **Marks** | | |
| **CIA** | **External** | **Total** |
| **22MBUGCP2** | **MICROBIAL PHYSIOLOGY AND METABOLISM** | | **CCIV- CORE PRACTICAL II** | **-** | **-** | **Y** | **-** | **4** | **5** | | **40** | **60** | **100** |
| **Course Objectives** | | | | | | | | | | | | | |
| CO1 | | Understand the principles of motility test. | | | | | | | | | | | |
| CO2 | | Understand the basic concepts of staining methods. | | | | | | | | | | | |
| CO3 | | Learn the bacterial count using different methods and anaerobic culture. | | | | | | | | | | | |
| CO4 | | Study the morphological demonstration of microorganisms and identification. | | | | | | | | | | | |
| CO5 | | Study the biochemical identification of the bacteria. | | | | | | | | | | | |
| **UNIT** | | **Details** | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie’s tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining | | | | | | | | 12 | | CO1 | |
| II | | Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate.  Bacterial growth curve. | | | | | | | | 12 | | CO2 | |
| III | | Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains. | | | | | | | | 12 | | CO3 | |
| IV | | Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa. | | | | | | | | 12 | | CO4 | |
| V | | Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H2S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test.Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture. | | | | | | | | 12 | | CO5 | |
|  | | Total | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | |
| CO1 | | Describe hanging drop, wet mount preparation, semi-solid agar, Craigie’s tube method. | | | | | | | | PO6, PO7, PO8, PO9, PO11 | | | |
| CO2 | | Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining. | | | | | | | | PO6, PO7, PO8, PO9, PO11 | | | |
| CO3 | | Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains. | | | | | | | | PO6, PO7, PO8, PO9, PO11 | | | |
| CO4 | | Describe demonstration of the size of yeast, fungal filaments and protozoa. | | | | | | | | PO6, PO7, PO8, PO9, PO11 | | | |
| CO5 | | Elaborate on the bacterial identification- morphological, physiological, and biochemical methods. | | | | | | | | PO6, PO7, PO8, PO9, PO11 | | | |
| **Text Books** | | | | | | | | | | | | | |
| 1 | | James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York . | | | | | | | | | | | |
| 2 | | Kannan. N (1996).Laboratory manual in General Microbiology. Palani Publications. | | | | | | | | | | | |
| 3 | | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. | | | | | | | | | | | |
| 4 | | Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher. | | | | | | | | | | | |
| 5 | | Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher. | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | |
| 1 | | DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York. | | | | | | | | | | | |
| 2 | | Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49. | | | | | | | | | | | |
| 3 | | Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge. | | | | | | | | | | | |
| 4 | | Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications. | | | | | | | | | | | |
| 5 | | Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications. | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | |
| 1 | | https://sites.google.com/site/microbial physiologyoddsem/teaching-contents | | | | | | | | | | | |
| 2 | | <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition> | | | | | | | | | | | |
| 3 | | <https://onlinecourses.swayam2.ac.in/cec20_bt14/preview> | | | | | | | | | | | |
| 4 | | https://www.studocu.com/microbial-physiology-practicals | | | | | | | | | | | |
| 5 | | https://www.agr.hokudai.ac.jp/microbial-physiology | | | | | | | | | | | |

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| **Methods of Evaluation** | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | | 40 Marks |
| Assignments | |
| Seminars | |
| Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | | 60 Marks |
|  | Total | | 100 Marks |
| **Methods of Assessment** | | | |
| **Recall (K1)** | | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations. | |

**Mapping with Programme Outcomes:**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  |  | M | L | M | L |  | M |
| CO2 |  |  |  |  |  | M | M | L | M |  | L |
| CO3 |  |  |  |  |  | L | M | M | L |  | M |
| CO4 |  |  |  |  |  | L | M | M | M |  | M |
| CO5 |  |  |  |  |  | M | M | M | M |  | M |

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| **Subject Code** | | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE2** | | **BIO**  **INSTRUMENTATION** | Elective Generic /Discipline Specific Elective II | **Y** | **-** | **-** | **-** | **3** | **4** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | | Understand the analytical instruments and study the basic principles in the field of sciences. | | | | | | | | | | | | |
| CO2 | | To gain knowledge about principles of spectroscopy | | | | | | | | | | | | |
| CO3 | | Understand the analytical techniques of Chromatography and electrophoresis | | | | | | | | | | | | |
| CO4 | | To understand the principle of different types of scans used in medical diagnosis | | | | | | | | | | | | |
| CO5 | | To gain information about the principles of radioactivity and its measurements | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | Basicinstruments:pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave**,** Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation. | | | | | | | | | 12 | | CO1 | |
| II | | Spectroscopic Techniques:Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy. | | | | | | | | | 12 | | CO2 | |
| III | | Chromatographic and Electrophoresis Techniques:Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE. | | | | | | | | | 12 | | CO3 | |
| IV | | Imaging techniques:Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes. | | | | | | | | | 12 | | CO4 | |
| V | | Fluorescence and radiation based techniques:Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography. | | | | | | | | | 12 | | CO5 | |
|  | | Total | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Gain knowledge about the basics of instrumentation. | | | | | | | | | PO1,PO4,PO11 | | | |
| CO2 | | Exemplify the structure of atoms and molecules by using the principles of spectroscopy. | | | | | | | | | PO4,PO10,PO11 | | | |
| CO3 | | Evaluate by separating and purifying the components. | | | | | | | | | PO4,PO7,PO11 | | | |
| CO4 | | Understand the need and applications of imaging techniques. | | | | | | | | | PO7,PO8,PO11 | | | |
| CO5 | | Categorize the working principle and applications of fluorescence and radiation. | | | | | | | | | PO10,PO11 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | | Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi . | | | | | | | | | | | | |
| 2. | | Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers. | | | | | | | | | | | | |
| 3 | | Veerakumari, L (2009).Bioinstrumentation- 5 thEdition -.MJP publishers. | | | | | | | | | | | | |
| 4 | | Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home. | | | | | | | | | | | | |
| 5 | | Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | | Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication. | | | | | | | | | | | | |
| 2 | | SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia. | | | | | | | | | | | | |
| 3 | | N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP  Publishers . | | | | | | | | | | | | |
| 4 | | Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7thEdition. Cambridge University Press . | | | | | | | | | | | | |
| 5 | | Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd,Singapore. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-  types- uses-and-other-details-with-diagram/12489 | | | | | | | | | | | | | |
| 2 | https://www.watelectrical.com/biosensors-types-its-working-andapplications/ | | | | | | | | | | | | | |
| 3 | http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75 | | | | | | | | | | | | | |
| 4 | https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html | | | | | | | | | | | | | |
| 5 | http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | L |  |  | M |  |  |  |  |  |  | S |
| CO2 |  |  |  | L |  |  |  |  |  | M | S |
| CO3 |  |  |  | L |  |  | M |  |  |  | S |
| CO4 |  |  |  |  |  |  | S | S |  |  | S |
| CO5 |  |  |  |  |  |  |  |  |  | M | S |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | | **External** | | **Total** |
| **22MBUGSEC2** | **Nutrition & Health Hygiene** | **Skill Enhancement Course -SEC-2 (NME)** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | Learn about nutrition and their importance | | | | | | | | | | | | | |
| CO2 | Make student understand thenutritional facts fora better life. | | | | | | | | | | | | | |
| CO3 | Learn information to optimize our diet | | | | | | | | | | | | | |
| CO4 | Impart knowledge on different health care programs taken up by India | | | | | | | | | | | | | |
| CO5 | Learn knowledge on different health indicators and types of hygiene methods | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | **No.of Hours** | | | **Course Objectives** | |
| I | Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency | | | | | | | | | 5 | | | CO1 | |
| II | Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods. | | | | | | | | | 5 | | | CO2 | |
| III | Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease. | | | | | | | | | 5 | | | CO3 | |
| IV | Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India. | | | | | | | | | 5 | | | CO4 | |
| V | Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places. | | | | | | | | | 5 | | | CO5 | |
|  | Total | | | | | | | | | 25 | | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | Learn the importance of nutrition for a healthy life | | | | | | | | | | PO5, PO6, PO7, PO8, PO10 | | | |
| CO2 | Study the nutrition for life cycle | | | | | | | | | | PO5, PO6, PO7, PO8, PO10 | | | |
| CO3 | Know the health care programmes of India | | | | | | | | | | PO5, PO6, PO7, PO8, PO10 | | | |
| CO4 | Learn the importance of community and personal health & hygiene measures | | | | | | | | | | PO5, PO6, PO7, PO10 | | | |
| CO5 | Create awareness on community health and hygiene | | | | | | | | | | PO5, PO6, PO7, PO10 | | | |

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| **Text Books** | | | | |
| 1. | Bamji, M.S., K. Krishnaswamy& G.N.V. Brahmam (2009) Textbook of Human  Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi | | | |
| 2. | Swaminathan (1995)Food &Nutrition(Vol I, Second Edition) The Bangalore Printing  &Publishing Co Ltd., , Bangalore | | | |
| 3 | SK. Haldar(2022). Occupational Health and Hygiene in Industry. CBS Publishers. | | | |
| 4 | Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices.Satish Serial Publishing House | | | |
| 5 | Dass (2021).Public Health and Hygiene, Notion Press | | | |
| **References Books** | | | | |
| 1 | | VijayaKhader (2000)Food, nutrition & health, Kalyan Publishers, New Delhi | | |
| 2 | | Srilakshmi, B., (2010)Food Science, (5th Edition) New Age International Ltd., New Delhi | | |
| 3 | | Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene,ABD Publishers | | |
| 4 | | Sharma D. (2015).Textbook on Food Science and Human Nutrition.Daya Publishing House. | | |
| 5 | | Revilla M. K. F., Titchenal A. and Draper J. (2020).Human Nutrition. University of Hawaii, Mānoa. | | |
| **Web Resources** | | | | |
| 1 | | National Rural Health Scheme:  https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49 | | |
| 2 | | National Urban Health Scheme:  https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137 | | |
| 3 | | Village health sanitation & Nutritional committee  https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225 | | |
| 4 | | Health Impact Assessment - https://www.who.int/hia/about/faq/en/ | | |
| 5 | | Healthy Living https://www.nhp.gov.in/healthylivingViewall | | |
| **Methods of Evaluation** | | | | |
| Internal Evaluation | | Continuous Internal Assessment Test | | 25 Marks |
| Assignments | |
| Seminars | |
| Attendance and Class Participation | |
| External Evaluation | | End Semester Examination | | 75 Marks |
|  | | Total | | 100 Marks |
| **Methods of Assessment** | | | | |
| **Recall (KI)** | | | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand /**  **Comprehend**  **(K2)** | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyse (K4)** | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  | S | M | M | M |  | S |  |
| CO2 |  |  |  |  | S | M | M | M |  | S |  |
| CO3 |  |  |  |  | S | M | M | M |  | S |  |
| CO4 |  |  |  |  | S | S | L |  |  | S |  |
| CO5 |  |  |  |  | S | S | M |  |  | S |  |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
| **22MBUGSEC3** | **SERICULTURE** | **Skill Enhancement Course -SEC-3** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | **75** | **100** |

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| **Course Objectives** | | | |
| CO1 | Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant. | | |
| CO2 | Describe the morphology and physiology of silkworm. | | |
| CO3 | Discuss effective management of silkworm diseases. | | |
| CO4 | Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects. | | |
| CO5 | Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises. | | |
| **Unit** | **Details** | **No.of Hours** | **Course Objectives** |
| I | General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species.Biology of Mulberry plant and Mulberry crop cultivation and protection. | 5 | CO1 |
| II | Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth. | 5 | CO2 |
| III | Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures. | 5 | CO3 |
| IV | Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms. | 5 | CO4 |
| V | Entrepreneurship and rural development in sericulture:Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities. | 5 | CO5 |
|  | Total | 25 |  |
| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| CO1 | Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant.Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions. | PO1,PO5,PO7 | |
| CO2 | Familiarize with the lifecycle of silk worm. | PO1, PO2 | |
| CO3 | Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices. | PO1, PO5 | |
| CO4 | Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products. | PO7, PO8, PO10 | |
| CO5 | Plan the facilities required for establishment of insectary.  Competent to transfer the knowledge and technical skills to the Seri-farmers.Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur. | PO5, PO7, PO8 | |
| **Text Books** | | | |
| 1 | Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi. | | |
| 2 | Dr. R. K. Rajan&Dr. M. T. Himantharaj(2005). Silkworm Rearing Technology, Central Silk Board, Bangalore. | | |
| 3 | Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies,Central Silk Board, Bangalore. | | |
| 4 | M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty(2010). Advances in Mulberry Sericulture,,CVG Publications, Bangalore | | |
| 5 | T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House. | | |
| **References Books** | | | |
| 1 | S. Morohoshi (2001). Development Physiology of Silkworms 2nd**E**dition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi | | |
| 2 | Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi. | | |
| 3 | M.Johnson, M.Kesary (2019).Sericulture, 5th.Edition.Saras Publications. | | |
| 4 | [**Manisha Bhattacharyya**](https://www.abebooks.com/book-search/author/manisha-bhattacharyya?cm_sp=det-_-srp-_-author) **(2019).**[Economics of Sericulture](https://www.abebooks.com/servlet/BookDetailsPL?bi=30305682892&searchurl=fe%3Don%26pt%3Dbook%26sortby%3D17%26tn%3Dsericulture&cm_sp=snippet-_-srp1-_-title1), Rajesh Publications. | | |
| 5 | [**Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd.Azam**](https://www.abebooks.com/book-search/author/muzafar-ahmad-bhat-suraksha-chanotra-zafar-iqbal-buhroo-abdul-aziz-and-mohd-azam?cm_sp=det-_-srp-_-author) **(2020).**[A Textbook on Entrepreneurship Development Programme in Sericulture](https://www.abebooks.com/servlet/BookDetailsPL?bi=30865738060&searchurl=sortby%3D17%26tn%3Dtextbook%2Bsericulture&cm_sp=snippet-_-srp1-_-title1), IP Innovative Publication. | | |
| **Web Resources** | | | |
| 1 | https://egyankosh.ac.in › bitstream | | |
| 2 | https://archive.org › details › SericultureHandbook | | |
| 3 | https://www.academic.oup.com | | |
| 4 | https://www.sericulture.karnataka.gov.in | | |
| 5 | https://www.silks.csb.gov.in | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S |  |  |  | S |  | S |  |  |  |  |
| CO2 | M |  |  |  | S |  |  |  |  |  |  |
| CO3 | S |  |  |  | S |  |  |  |  |  |  |
| CO4 |  |  |  |  |  |  | S | S |  | S |  |
| CO5 |  |  |  |  | S |  | S | S |  |  |  |

SEMESTER III

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGCT3** | **Molecular Biology and Microbial Genetics** | **Core Course V -Theory** | **4** | **1** | **-** | **-** | **4** | **5** | **25** | | **75** | | **100** |
| **Learning Objectives** | | | | | | | | | | | | | |
| CO1 | Provide knowledge on structure and replication of DNA. | | | | | | | | | | | | |
| CO2 | Illustrate the significance and functions of RNA in protein synthesis. | | | | | | | | | | | | |
| CO3 | Explain the cause and types of DNA mutation and DNA repair mechanisms. | | | | | | | | | | | | |
| CO4 | Outline the role of plasmids and phages in genetics. | | | | | | | | | | | | |
| CO5 | Examine mechanisms of gene transfer and recombination. | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | **No. of Hours** | | **Course Objectives** | |
| I | DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. DNA replication modes - rolling circle, D-loop modes. | | | | | | | | | 15 | | CO1 | |
| II | Transcription in Prokaryotes. Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - *lac, trp* and *ara* operons as examples. Regulation of gene expression by DNA methylation. | | | | | | | | | 15 | | CO2 | |
| III | Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair. | | | | | | | | | 15 | | CO3 | |
| IV | Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2µ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics. | | | | | | | | | 15 | | CO4 | |
| V | Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons. | | | | | | | | | 15 | | CO5 | |
|  | **Total** | | | | | | | | | 75 | |  | |

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| **Course Outcomes** | | |
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Analyze the significance of DNA and elucidate the replication mechanism. | PO4, PO5, PO7,PO9 |
| CO2 | Illustrate the types of RNA and protein synthesis machinery. | PO4, PO7,PO9 |
| CO3 | Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms. | PO5, PO7,PO9 |
| CO4 | Evaluate the importance of plasmids and phages in genetics. | PO7,PO9 |
| CO5 | Analyze gene transfer and recombination methods. | PO5, PO6, PO7,PO9 |
| **Text Books** | | |
| 1. | Malacinski G.M. (2008). Freifelder’s Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi. | |
| 2. | Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd. | |
| 3. | Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd. | |
| 4. | Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd. | |
| 5. | Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd. | |
| **References Books** | | |
| 1. | Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. | |
| 2. | Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn. | |
| 3. | Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman. | |
| 4. | Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition, ASM Press Washington-D.C. ASM Press. | |
| 5. | Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing | |
| **Web Resources** | | |
| 1. | [[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in](https://studymaterialz.in/lehninger-principles-of-biochemistry-8e/) | |
| 2. | <https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/> | |
| 3. | <https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/> | |
| 4. | [Molecular Biology Notes - Microbe Notes](https://microbenotes.com/category/molecular-biology/?adlt=strict&toWww=1&redig=85EF311AE06844889386F48A373E702F) | |
| 5. | [Molecular Biology Lecture Notes & Study Materials | Easy Biology Class](https://www.easybiologyclass.com/molecular-biology-online-tutorials-lecture-notes-study-materials/?adlt=strict&toWww=1&redig=E84F9577992346EDA4885469FB82FCCE) | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | S | S | M | S | M | S | M |  |
| CO2 |  |  |  | S | M | M | S | M | S | L |  |
| CO3 |  |  |  | M | S | M | S | M | S | L |  |
| CO4 |  |  |  | M | M | M | S | M | S | L |  |
| CO5 |  |  |  | M | S | S | S | M | S | L |  |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGCP3** | **Molecular Biology and Microbial Genetics** | | **Core Course –VI – Practical III** | **-** | **-** | **Y** | **-** | **4** | **5** | **40** | | **60** | | **100** |
| **Learning Objectives** | | | | | | | | | | | | | | |
| CO1 | | Provide knowledge on structure and replication of DNA. | | | | | | | | | | | | |
| CO2 | | Elucidate the methods of Genomic and Plasmid DNA isolation. | | | | | | | | | | | | |
| CO3 | | Explain methods of protein separation. | | | | | | | | | | | | |
| CO4 | | Explain artificial transformation method. | | | | | | | | | | | | |
| CO5 | | Outline the role of phages in genetics. | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | **No. of Hours** | | **Course Objectives** | |
| I | | Study of different types of DNA and RNA using micrographs and model / schematic representations.  Study of semi-conservative replication of DNA through micrographs / schematic representations. | | | | | | | | | 15 | | CO1 | |
| II | | Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis.  Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement). | | | | | | | | | 15 | | CO2 | |
| III | | Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration.  UV induced auxotrophic mutant production and isolation of mutants by replica plating technique – Demonstration. | | | | | | | | | 15 | | CO3 | |
| IV | | Perform artificial Transformation in *E*. *coli*.  Isolation of antibiotic resistant mutants by gradient plate method. - Demonstration | | | | | | | | | 15 | | CO4 | |
| V | | Screening and isolation of phages from sewage.  Perform RNA isolation.  Estimate RNA. | | | | | | | | | 15 | | CO5 | |
|  | | Total | | | | | | | | | 75 | |  | |

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| **Course Outcomes** | | |
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Illustrate different types of DNA and RNA. | PO4, PO7, PO9, PO11 |
| CO2 | Utilize hands-on training in isolation of genomic and plasmid DNA. | PO4, PO7, PO9, PO11 |
| CO3 | Analyze importance of experimental microbial genetics. | PO4, PO7, PO9, PO11 |
| CO4 | Apply the knowledge of molecular techniques in various fields. | PO4, PO7, PO9, PO11 |
| CO5 | Investigate the significance of Phages. | PO4, PO7, PO9, PO11 |
| **Text Books** | | |
| 1. | Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi. | |
| 2. | Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press. | |
| 3. | Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd. | |
| 4. | Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International. | |
| 5. | James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York. | |
| **References Books** | | |
| 1 | Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018. | |
| 2 | Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn. | |
| 3 | Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman. | |
| 4 | Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th edition, ASM Press Washington-D.C. ASM Press. | |
| 5 | Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd. | |
| **Web Resources** | | |
| 1 | <https://www.molbiotools.com/usefullinks.html> | |
| 2 | [(PDF) Molecular Biology Laboratory manual (researchgate.net)](https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual) | |
| 3 | <https://www.molbiotools.com/usefullinks.html> | |
| 4 | <https://geneticgenie.org3>. | |
| 5 | <https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5> | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | S | L | M | S | M | S | M | S |
| CO2 |  |  |  | S | L | M | S | M | S | M | S |
| CO3 |  |  |  | S | L | M | S | M | S | M | S |
| CO4 |  |  |  | S | L | M | S | M | S | M | S |
| CO5 |  |  |  | S | L | M | S | M | S | M | S |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE3** | **CLINICAL LABORATORY TECHNOLOGY** | **ELECTIVE GENERIC/DISCIPLINE SPECIFIC ELECTIVE -III** | **Y** | **-** | **-** | **-** | **3** | **4** | **25** | | **75** | | **100** |
| **Learning Objectives** | | | | | | | | | | | | | |
| CO1 | Demonstrate ethical and professional conduct with patients, laboratory personnel, health- care professionals, and the public. | | | | | | | | | | | | |
| CO2 | Explain how accurate and reliable information might be obtained about proper procurement, storage, and handling of laboratory specimens. | | | | | | | | | | | | |
| CO3 | Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice. | | | | | | | | | | | | |
| CO4 | Perform a full range of laboratory tests with accuracy and precision. | | | | | | | | | | | | |
| CO5 | Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information. | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | **Introduction to Clinical Laboratory Science**: Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices. | | | | | | | | | 12 | | CO1 | |
| II | **Specimen collection and processing** - Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results. | | | | | | | | | 12 | | CO2 | |
| III | **Introduction to histopathology**-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections. | | | | | | | | | 12 | | CO3 | |
| IV | **Introduction to Haematology**- Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time,partial thromboplastin time , activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors. | | | | | | | | | 12 | | CO4 | |
| V | Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing. | | | | | | | | | 12 | | CO5 | |
|  | Total | | | | | | | | | 60 | |  | |

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| **Course Outcomes** | | | |
| **Course Outcomes** | On completion of this course, students will; | | |
| CO1 | Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team.  Practice safety or infection control procedures in the clinical laboratory, properly use safety equipment and maintain a clean, safe work environment. | | PO3, PO11 |
| CO2 | Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and transmission-based precautions, Engage in the scientific process by understanding the principles and practices of clinical study design, implementation, and dissemination of results. | | PO5, PO6, PO11 |
| CO3 | Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures. Relate and recognize the histological appearance of affected tissues to the underlying pathology. | | PO6, PO8, PO9, PO11 |
| CO4 | Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies. | | PO5, PO6, PO9, PO11 |
| CO5 | Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies. | | PO1,PO10 |
| **Text Books** | | | |
| 1. | | Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata McGrawHill, Delhi. | |
| 2. | | Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education. | |
| 3 | | RamnikSood (2015).Concise Book of Medical Laboratory Technology:Methods and Interpretation, 2ndEdition, Jaypee Brothers Medical Publishers, NewDelhi. | |
| 4. | | S. Ramakrishnan, KN Sulochana**(2012). Manual of Medical Laboratory Techniques,**Jaypee Brothers Medical Publishers Pvt. Ltd | |
| 5. | | Talib V.H. (2019).Handbook Medical Laboratory Technology, 2ndEdition, Directorate of health services, Government of India. | |
| **References Books** | | | |
| 1 | | Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby. | |
| 2 | | Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7thEdition, CBS Publishers and Distributors Pvt. Ltd. | |
| 3 | | Godkar (2021).Textbook of Medical Laboratory Technology, 3rdEdition,Bhalani Publishing House. | |
| 4 | | M.N.Chatterjee and RanaShinde.(2008). Textbook of Medical Biochemistry, 7thEdition, Jaypee Brothers Medical Publishers Pvt. Limited. | |
| 5 | | James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual.(5th Edition).The Benjamin publishing company. New York. | |
| **Web Resources** | | | |
| 1 | | https://www.jaypeedigital.com › book | |
| 2 | | https://www.pdfdrive.com › wintrobes-clinical-hematology | |
| 3 | | <https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5> | |
| 4 | | <https://vlab.amrita.edu/index.php?sub=3&brch=272> | |
| 5 | | <https://nptel.ac.in/courses/102105087> | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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|  | PO1 | | | PO2 | PO3 | | PO4 | PO5 | | | PO6 | | | PO7 | | PO8 | | PO9 | | | PO10 | | | PO11 | |
| CO1 |  | | |  | M | |  |  | | |  | | |  | |  | |  | | |  | | | S | |
| CO2 |  | | |  |  | |  | M | | | S | | |  | |  | |  | | |  | | | S | |
| CO3 |  | | |  |  | |  |  | | | S | | |  | | S | |  | | | S | | | S | |
| CO4 |  | | |  |  | |  | M | | | S | | |  | |  | | S | | |  | | | S | |
| CO5 | M | | |  |  | |  |  | | |  | | |  | |  | |  | | | M | | |  | |
| **Subject Code** | | **Subject Name** | | | | **Category** | | | **L** | **T** | | **P** | **S** | | **Credits** | | **Inst.**  **Hours** | | **Marks** | | | | | | | |
| **CIA** | | | **External** | | | **Total** | |
| **22MBUGSEC4** | | **ORGANIC FARMING & BIOFERTILISER TECHNOLOGY** | | | | **SKILL ENHANCEMENT COURSE – SEC -4 (ENTREPRENEURIAL SKILL)** | | | **Y** | **-** | | **-** | **-** | | **1** | | **1** | | **25** | | | **75** | | | **100** | |
| **Learning Objectives** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO1 | | Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment. | | | | | | | | | | | | | | | | | | | | | | | | |
| CO2 | | To encourage organic farming in urban areas. | | | | | | | | | | | | | | | | | | | | | | | | |
| CO3 | | Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective. | | | | | | | | | | | | | | | | | | | | | | | | |
| CO4 | | Structure and characteristic featuresof Cyanobacterial and fungal biofertilizer | | | | | | | | | | | | | | | | | | | | | | | | |
| CO5 | | Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers. | | | | | | | | | | | | | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | | | | | | | | | | **No.of Hours** | | | **Course Objectives** | | | |
| I | | Principle of organic farming: principles of health, fairness, ecological balance, and care.Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling. | | | | | | | | | | | | | | | | | | 6 | | | CO1 | | | |
| II | | Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming) Composting, Vermicomposting | | | | | | | | | | | | | | | | | | 6 | | | CO2 | | | |
| III | | Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic features of bacterial biofertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia* | | | | | | | | | | | | | | | | | | 6 | | | CO3 | | | |
| IV | | Structure and characteristic features ofCyanobacterialbiofertilizers- *Anabaena, Nostoc ;*Structure and characteristic features offungal biofertilizers- AM mycorrhiza | | | | | | | | | | | | | | | | | | 6 | | | CO4 | | | |
| V | | Production of *Rhizobium, Azotobacter, Anabena*;Biofertilizers -Storage, shelf life, quality control and marketing | | | | | | | | | | | | | | | | | | 6 | | | CO5 | | | |
|  | | Total | | | | | | | | | | | | | | | | | | 30 | | |  | | | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO1 | | Become an Entrepreneur with wide knowledge about farming and sustainable resources. | | | | | | | | | | | | | | | | | | PO1, PO2, PO7, PO8, PO10 | | | | | | | |
| CO2 | | Implement organic farming in urban areas with knowledge on compost. | | | | | | | | | | | | | | | | | | PO1, PO5, PO10 | | | | | | | |
| CO3 | | Gain knowledge about the bacterial biofertilizers and its advantages | | | | | | | | | | | | | | | | | | PO1, PO5, PO7, PO8, PO10 | | | | | | | |
| CO4 | | Understand the significance about Cyanobacterial and fungal biofertilizers | | | | | | | | | | | | | | | | | | PO1, PO5, PO7, PO8, PO10 | | | | | | | |
| CO5 | | Understand and implement the use of bio fertilizers. | | | | | | | | | | | | | | | | | | PO1, PO5, PO7, PO8, PO10 | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | A.K. Sharma (2006). Hand book of Organic Farming | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi. | | | | | | | | | | | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics. | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | SujitChakrabarty(2018). Organic Home Gardening Made Easy, 1st Edition, | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | Singh and Purohit (2008). Biofertilizer technology. Agrobios, India. | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | Bansal M (2019). Basics of Organic Farming CBS Publisher. | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology. | | | | | | | | | | | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | <https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html> | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | <https://www.fao.org/organicag/oa-faq/oa-faq6/en/> | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | <https://www.india.gov.in/topics/agriculture/organic-farming> | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | <https://agriculture.nagaland.gov.in/bio-fertilizer/> | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | <https://vlab.amrita.edu/index.php?sub=3&brch=272> | | | | | | | | | | | | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **CO1** | S | S |  |  |  |  | S | S |  | S |  |
| **CO2** | S |  |  |  | S |  |  |  |  | S |  |
| **CO3** | S |  |  |  | S |  | S | S |  | S |  |
| **CO4** | S |  |  |  | S |  | S | S |  | S |  |
| **CO5** | S |  |  |  | S |  | S | S |  | S |  |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGSEC5** | **AQUACULTURE** | | **Skill Enhancement Course -5** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | | **75** | | **100** |
| **Learning Objectives** | | | | | | | | | | | | | | |
| CO1 | Provide a deeper knowledge in aquaculture systems and methods. | | | | | | | | | | | | | |
| CO2 | Explain the significance and functions of design, types and construction of aquaculture ponds. | | | | | | | | | | | | | |
| CO3 | Demonstrate the biological characteristics of various aquaculture species. | | | | | | | | | | | | | |
| CO4 | Discuss the methods involved in post stocking management. | | | | | | | | | | | | | |
| CO5 | Illustrate major cultivatable species for aquaculture. | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No. of Hours** | | **Course Objectives** | |
| I | Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture. | | | | | | | | | | 6 | | CO1 | |
| II | Aquaculture Engineering - Design and construction of pond, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds. | | | | | | | | | | 6 | | CO2 | |
| III | Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio. | | | | | | | | | | 6 | | CO3 | |
| IV | Post Stocking Management - Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship. | | | | | | | | | | 6 | | CO4 | |
| V | Major cultivable species for aquaculture –Culture of Indian Major Carps. Culture of Giant fresh water prawn, *Macrobrachiumrosenbergii* - seed collection formation sources. Hatchery management. Culture of tiger shrimp, *Penaeusmonodon* and *LitopenaeusVannamei.* Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs. | | | | | | | | | | 6 | | CO5 | |
|  | Total | | | | | | | | | | 30 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | | |
| CO1 | Analyze the significance and importance of aquaculture | | | | | | | | | | PO4, PO5, PO7,PO9 | | | | |
| CO2 | Illustrate the types and construction of aquaculture ponds | | | | | | | | | | PO4, PO7,PO9 | | | | |
| CO3 | Analyze the biological characteristics of species and choose the best species for aquaculture. | | | | | | | | | | PO5, PO7,PO9 | | | | |
| CO4 | Follow methods involved for optimal growth of aquaculture species | | | | | | | | | | PO7,PO9 | | | | |
| CO5 | Summarize major species suitable for aquaculture in a particular environment | | | | | | | | | | PO5, PO6, PO7,PO9 | | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1. | | Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019).Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi. | | | | | | | | | | | | | |
| 2. | | Stickney, R.R. (2016). [Aquaculture: An Introductory Text](https://www.amazon.in/Aquaculture-Introductory-Robert-R-Stickney/dp/1786390108/ref=sr_1_fkmr2_1?keywords=Aquaculture+%5BOP%5D+An+Introductory+Text&qid=1662968072&sr=8-1-fkmr2). 3rd Edition. Centre for Agriculture and Bioscience International Publishing. | | | | | | | | | | | | | |
| 3. | | [Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principles of Aquaculture. CRC Press.](https://books.google.co.in/books?id=RtRBDwAAQBAJ&printsec=frontcover&dq=Introduction+to+Aquaculture&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwik94qKhI_6AhWK-zgGHRD2AEAQ6AF6BAgJEAI) | | | | | | | | | | | | | |
| 4. | | Mushlisin Z. A. (2012). Aquaculture. In Tech. | | | | | | | | | | | | | |
| 5. | | Akpaniteaku R.C. (2018).Basic Handbook of Fisheries and Aquaculture.AkiNik Publications. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1. | | Arumugam N. (2014). Aquaculture. Saras Publication. | | | | | | | | | | | | | |
| 2. | | Pillay T. V. R. and Kutty M.N. (2005). Aquaculture : Principles and Practices. 2ndEdition. Wiley India Pvt. Ltd. | | | | | | | | | | | | | |
| 3. | | Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra Publishing House. | | | | | | | | | | | | | |
| 4. | | Rath R.K.(2011). Fresh Water Aquaculture. 3rdEdition. Scientific Publishers. | | | | | | | | | | | | | |
| 5. | | Lucas J. S., Southgate P.C. and Tucker C.S. (2019). Aquaculture: Farming Aquatic Animals and Plants. Wiley Blackwell. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | |
| 1. | | [Aquaculture: Types, Benefits and Importance (Fish Farming) - Conserve Energy Future (conserve-energy-future.com)](https://www.conserve-energy-future.com/aquaculture-types-benefits-importance.php?adlt=strict&toWww=1&redig=B68530EDA8954710ACD51DE00E18ECF6) | | | | | | | | | | | | | |
| 2. | | [Fisheries Department - Tamil Nadu (tn.gov.in)](https://www.fisheries.tn.gov.in/Aquaculture?adlt=strict&toWww=1&redig=2E076ED27B7E4936A74A62F6FF0DF3B5) | | | | | | | | | | | | | |
| 3. | | [Aquaculture - Google Books](https://books.google.co.in/books?id=wDqZDwAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false) | | | | | | | | | | | | | |
| 4. | | [aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica](https://www.britannica.com/topic/aquaculture) | | | | | | | | | | | | | |
| 5. | | [Fisheries & Aquaculture (investindia.gov.in)](https://www.investindia.gov.in/sector/fisheries-aquaculture?adlt=strict&toWww=1&redig=C3901BF14F21486684858680E50F427C) | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | S | S | M | S | M | S | M |  |
| CO2 |  |  |  | S | M | M | S | M | S | L |  |
| CO3 |  |  |  | M | S | M | S | M | S | L |  |
| CO4 |  |  |  | M | M | M | S | M | S | L |  |
| CO5 |  |  |  | M | S | S | S | M | S | L |  |

**SEMESTER VI**

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| **Subject Code** | | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGCT4** | | **IMMUNOLOGY AND IMMUNOTECHNOLOGY** | | **CORE COURSE – VII** | **Y** | **-** | **-** | **-** | **4** | **5** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | |
| CO1 | | To gain knowledge about immune system, organs of immunity and cells involved. | | | | | | | | | | | | | |
| CO2 | | To distinguish the types of antigens and antibodies; their properties. | | | | | | | | | | | | | |
| CO3 | | To provide in-depth knowledge on immuno-techniques. | | | | | | | | | | | | | |
| CO4 | | To discuss the role of MHC system in transplantation; functions of Tumor specific antigens. | | | | | | | | | | | | | |
| CO5 | | To impart knowledge on immunological disorders. | | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | Organs and Cells in Immune System and Immune Response:Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology. | | | | | | | | | | 12 | | CO1 | |
| II | | Antigen and Antibody:Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule. | | | | | | | | | | 12 | | CO2 | |
| III | | Immunoassay and Immunotechniques **-** Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, ELISA, Immuno fluorescence techniques and Flow cytometry | | | | | | | | | | 12 | | CO3 | |
| IV | | Transplantation and TumorImmunology - MHC Antigens - structure and function; HLA system - Regulation and response to immune system; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immune therapy. | | | | | | | | | | 12 | | CO4 | |
| V | | Immunological disorders and diseases **-** Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non-organ specific. | | | | | | | | | | 12 | | CO5 | |
|  | | Total | | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | | Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses. | | | | | | | | | | PO1, PO4, PO6, PO9, | | | |
| CO2 | | Investigate the structures of Ag and Ab; Immunization. | | | | | | | | | | PO1, PO4, PO5, PO9 | | | |
| CO3 | | Justify the Immunoassay and Immunotechniques. | | | | | | | | | | PO1, PO4, PO5, PO7 | | | |
| CO4 | | Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation | | | | | | | | | | PO1, PO3, PO4, PO5, PO9 | | | |
| CO5 | | Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences. | | | | | | | | | | PO1, PO4, PO5, PO6 | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1. | | | Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York. | | | | | | | | | | | | |
| 2. | | | Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York. | | | | | | | | | | | | |
| 3. | | | Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition.,Elsevier. | | | | | | | | | | | | |
| 4. | | | Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018).Clinical Immunology: Principles and Practice, 5th Edition. Elsevier. | | | | | | | | | | | | |
| 5. | | | Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1 | | | Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition. | | | | | | | | | | | | |
| 2 | | | Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt’s Essential Immunology, 11thEdition.,Wiley-Blackwell. | | | | | | | | | | | | |
| 3 | | | William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York. | | | | | | | | | | | | |
| 4 | | | Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell. | | | | | | | | | | | | |
| 5 | | | Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | |
| 1 | | <https://www.ncbi.nlm.nih.gov/books/NBK279395/> | | | | | | | | | | | | | | | |
| 2 | | <https://med.stanford.edu/immunol/phd-program/ebook.html> | | | | | | | | | | | | | | | |
| 3 | | <https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/> | | | | | | | | | | | | | | | |
| 4 | | [Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)](https://www.ncbi.nlm.nih.gov/books/NBK7795/?adlt=strict&toWww=1&redig=E3C425EFB1CD4E46ABF9B8B1BAAAB566) | | | | | | | | | | | | | | | |
| 5 | | [Immunology - an overview | ScienceDirect Topics](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/immunology?adlt=strict&toWww=1&redig=F57A024FAC4048BFA4952FB325A7B33A) | | | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | | | **Marks** | | | | |
| **CIA** | **External** | | **Total** | |
| **22MBUGCP4** | **IMMUNOLOGY AND IMMUNOTECHNOLOGY** | | CORE COURSE –VIII- PRACTICAL  IV | **-** | **-** | **Y** | **-** | **4** | **5** | | | **40** | **60** | | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | To gain hands-on knowledge to identify Blood group and typing. | | | | | | | | | | | | | | | |
| CO2 | To acquire adequate skill to perform latex agglutination reactions. | | | | | | | | | | | | | | | |
| CO3 | To analyze precipitation reactions in gels. | | | | | | | | | | | | | | | |
| CO4 | To investigate the antigen & antibody reactions in electrophoresis. | | | | | | | | | | | | | | | |
| CO5 | To familiarize with Separation of Lymphocytes. | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | | **Course Objectives** | | |
| I | Identification of blood group and typing.  Coomb’s test. TPHA | | | | | | | | | | 12 | | | CO1 | | |
| II | T cell identification (Demonstration)  Latex Agglutination reactions- RF, ASO, CRP | | | | | | | | | | 12 | | | CO2 | | |
| III | Ouchterlony’s Double Diffusion Method (antigen pattern).  Single Radial Immuno Diffusion Method. | | | | | | | | | | 12 | | | CO3 | | |
| IV | Electrophoresis - Serum, Counter and Immuno. | | | | | | | | | | 12 | | | CO4 | | |
| V | Separation of Lymphocytes by gradient centrifugation method.  ELISA: Hepatitis/ HIV | | | | | | | | | | 12 | | | CO5 | | |
|  | Total | | | | | | | | | | 60 | | |  | | |
| **Course Outcomes** | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | | On completion of this course, students will; | | | | | | | | | | | | | |
|  | | |  | | | | | | | | | | | | | |
| CO1 | | | Assess the blood groups and types | | | | | | | | PO1,PO5, PO6, PO7, PO8 | | | | | |
| CO2 | | | Competently perform serological diagnostic tests such as RF, ASO, CRP | | | | | | | | PO4, PO5, PO6, PO7, PO8 | | | | | |
| CO3 | | | Illustrate the antigen antibody reactions in gel. | | | | | | | | PO5, PO6, PO7, PO8, PO9 | | | | | |
| CO4 | | | Compare & contrast antigens and antibodies in electrophoresis | | | | | | | | PO5, PO6, PO7, PO8, PO9 | | | | | |
| CO5 | | | Examine the concept of ELISA. | | | | | | | | PO5, PO6, PO7, PO8, PO9 | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | |
| 1. | | | **Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.** | | | | | | | | | | | | | |
| 2. | | | Asim Kumar Roy. (2019). Immunology Theory and Practical**,** Kalyani Publications. | | | | | | | | | | | | | |
| 3. | | | Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York. | | | | | | | | | | | | | |
| 4. | | | Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York. | | | | | | | | | | | | | |
| 5. | | | Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | |
| 1 | | | Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley-Blackwell. | | | | | | | | | | | | | |
| 2 | | | Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing. | | | | | | | | | | | | | |
| 3 | | | Rose. (1992). Manual of Clinical Lab Immunology, ASM. | | | | | | | | | | | | | |
| 4 | | | Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition. | | | | | | | | | | | | | |
| 5 | | | Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt’s Essential Immunology, 11thEdition.,Wiley-Blackwell. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | |
| 1 | | | <https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual> | | | | | | | | | | | | | |
| 2 | | | <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf> | | | | | | | | | | | | | |
| 3 | | | <https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf> | | | | | | | | | | | | | |
| 4 | | | [Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)](https://www.ncbi.nlm.nih.gov/books/NBK7795/?adlt=strict&toWww=1&redig=E3C425EFB1CD4E46ABF9B8B1BAAAB566) | | | | | | | | | | | | | |
| 5 | | | [Immunology - an overview | ScienceDirect Topics](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/immunology?adlt=strict&toWww=1&redig=F57A024FAC4048BFA4952FB325A7B33A) | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE4** | **FOOD PROCESSING TECHNOLOGY** | | **ELECTIVE GENERIC/DISCIPLINE SPECIFIC ELECTIVE -IV** | **Y** | **-** | **-** | **-** | **3** | **4** | **25** | | **75** | | **100** |
| **Learning Objectives** | | | | | | | | | | | | | | |
| CO1 | To provide knowledge on objectives of food preservation. | | | | | | | | | | | | | |
| CO2 | To explain the freshness criteria and quality assessment of meat and fish. | | | | | | | | | | | | | |
| CO3 | To outline the methods of milk processing and fermented milk products. | | | | | | | | | | | | | |
| CO4 | To explain the importance of fat and oil processing. | | | | | | | | | | | | | |
| CO5 | To discuss the methods of microbiological examination of foods. | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Introduction to food preservation –objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives. | | | | | | | | | | 12 | | CO1 | |
| II | Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material. | | | | | | | | | | 12 | | CO2 | |
| III | Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries. | | | | | | | | | | 12 | | CO3 | |
| IV | Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil- degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil. | | | | | | | | | | 12 | | CO4 | |
| V | Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food. | | | | | | | | | | 12 | | CO5 | |
|  | Total | | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Assess the fundamental concepts of food preservation. | | | | | | | | | PO1, PO3, PO5,PO6, PO8 | | | |
| CO2 | | Investigate the quality assessment of meat and fish. | | | | | | | | | PO1, PO5, PO6, PO7, PO8 | | | |
| CO3 | | Design the processing of milk and milk quality assessment. | | | | | | | | | PO1, PO5, PO6, PO7, PO8 | | | |
| CO4 | | Explain about the importance of fats and oils. | | | | | | | | | PO1, PO4, PO6, PO7, PO8 | | | |
| CO5 | | Plan the food safety and adulteration detection. | | | | | | | | | PO3, PO4, PO6, PO7, PO8 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | | Avantina Sharma. (2006). Text Book of Food Science and Technology, International Book  Distributing Co, Lucknow, UP. | | | | | | | | | | | | |
| 2. | | Sivasankar. (2005). Food Processing and Preservation, 3rd Edition.,Prentice hall of India Pvt Ltd,  NewDelhi. | | | | | | | | | | | | |
| 3 | | Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis. | | | | | | | | | | | | |
| 4 | | NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi. | | | | | | | | | | | | |
| 5 | | Adams M.R. and Moss M. O (2007).Food Microbiology.New Age International. | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | |
| 1 | | Fellos PJ. (2005). Food Processing Technology: Principle &Practice 2ndEdition. CRC. | | | | | | | | | | | | |
| 2 | | Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, WoodlandPublishing Ltd, Cambridge, England.**1** | | | | | | | | | | | | |
| 3 | | Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano. (2004). Novel Food Processing Technologies, CRC. | | | | | | | | | | | | |
| 4 | | Suman Bhatti, Uma Varma. (1995). Fruit and vegetable processing organizations and  institutions, 1st Edition., CBS Publishing, New Delhi. | | | | | | | | | | | | |
| 5 | | MirdulaMirajkar, Sreelatha Menon. (2002). Food Science and Processing Technology Vol-2,Commercial processing and packaging, Kanishka publishers, New Delhi. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | | <https://sites.google.com/a/uasd.in/ecourse/food-processing-technology> | | | | | | | | | | | | |
| 2 | | <https://nptel.ac.in/courses/126105015> | | | | | | | | | | | | |
| 3 | | <https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/> | | | | | | | | | | | | |
| 4 | | [food processing | Definition, Purpose, Examples, & Facts | Britannica](https://www.britannica.com/technology/food-processing) | | | | | | | | | | | | |
| 5 | | [Food Processing Technology | Food News & Views Updated Daily (foodprocessing-technology.com)](https://www.foodprocessing-technology.com/?adlt=strict&toWww=1&redig=4C33CE2A4802441981D557FC5D26934F) | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

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

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGSEC6** | **Vaccine Technology** | | **Skill Enhancement Course SEC -6** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | | To provide knowledge on the basics of immunization and induction of immunity. | | | | | | | | | | | | |
| CO2 | | To learn the types of vaccines, its immunological effects and regulatory guidelines. | | | | | | | | | | | | |
| CO3 | | To learn the role of rDNA in vaccine technology. | | | | | | | | | | | | |
| CO4 | | To provide the knowledge on conventional to recent technology of vaccine production | | | | | | | | | | | | |
| CO5 | | To learn about ethical issues and regulations in vaccine production and clinical trials | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity, | | | | | | | | | 3hrs | | CO1 | |
| II | | Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines;Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine. | | | | | | | | | 6 | | CO2 | |
| III | | Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV. | | | | | | | | | 5 | | CO3 | |
| IV | | Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens,Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies. | | | | | | | | | 5 | | CO4 | |
| V | | Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues. | | | | | | | | | 5 | | CO5 | |
|  | | Total | | | | | | | | | 24 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines. | | | | | | | | | PO1,PO10 | | | |
| CO2 | | Understand the types of vaccines. | | | | | | | | | PO5 | | | |
| CO3 | | Construct vaccine applying rDNA technology. | | | | | | | | | PO7,PO10 | | | |
| CO4 | | Formulate the strategies for developing an innovative vaccine technology with different mode of vaccine delivery. | | | | | | | | | PO9,PO10 | | | |
| CO5 | | Evaluate the regulatory issues and guidelines for the management of vaccine production. | | | | | | | | | PO3,PO5 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | | Ronald W. Ellis.(2001). New Vaccine Technologies.Landes Bioscience. | | | | | | | | | | | | |
| 2. | | Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery.Espicom Business Intelligence. | | | | | | | | | | | | |
| 3 | | Male, David. Ed. (2007). Immunology. 7th Edition. Mosby Publication. | | | | | | | | | | | | |
| 4 | | Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. (2002). Immunology. 6th Edition, Freeman. | | | | | | | | | | | | |
| 5 | | Brostoff J, Seaddin JK, Male D, Roitt IM. (2002). Clinical Immunology. 6th Edition, Gower Medical Publishing. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | | Stanley A. Plotkin, Walter Orenstein& Paul A. Offit.(2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication. | | | | | | | | | | | | |
| 2 | | Coico, R. etal. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss. | | | | | | | | | | | | |
| 3 | | Parham, Peter.(2005). The Immune System. 2nd Edition, Garland Science. | | | | | | | | | | | | |
| 4 | | Abbas, A.K. etal. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier. | | | | | | | | | | | | |
| 5 | | Weir, D.M. and Stewart, John (2000). Immunology. 8th Edition, Churchill Pvt. Ltd. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | | https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567 | | | | | | | | | | | | |
| 2 | | <https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf> | | | | | | | | | | | | |
| 3 | | [https://www.dcvmn.org/IMG/pdf/ge\_healthcare\_dcvmn\_introduction\_to\_pd\_for\_vaccine\_ production\_29256323aa\_10mar2017.pdf](https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_%20production_29256323aa_10mar2017.pdf) | | | | | | | | | | | | |
| 4 | | <https://www.sciencedirect.com/science/article/pii/B9780128021743000059> | | | | | | | | | | | | |
| 5 | | https://www.researchgate.net/publication/313470959\_Vaccine\_Scaleup\_and\_Manufacturing | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |  |
| Seminars |  |
| Attendance and Class Participation |  |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (KI)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand /**  **Comprehend**  **(K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyse (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**

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|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | M |  |  |  |  |  |  |  |  | M |  |
| CO2 |  |  |  |  | S |  |  |  |  |  |  |
| CO3 |  |  |  |  |  |  | M |  |  | M |  |
| CO4 |  |  |  |  |  |  |  |  | L | M |  |
| CO5 |  |  | L |  | M |  |  |  |  |  |  |

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| **Subject Code** | **Subject Name** | | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGSEC7** | **APICULTURE** | | | | **SKILL ENHANCEMENT COURSE- SEC – 7** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | | To understand the biology of honey bees. | | | | | | | | | | | | | | |
| CO2 | | To study on honey bee colony establishment. | | | | | | | | | | | | | | |
| CO3 | | To develop knowledge on honey extraction. | | | | | | | | | | | | | | |
| CO4 | | To understand the diseases of honey bees and their control. | | | | | | | | | | | | | | |
| CO5 | | To gain information on financial assistance and funding agencies for bee keeping industry. | | | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | Biology of Bees: Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone. | | | | | | | | | | | 6 | | CO1 | |
| II | | Social life in Bees:Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management. | | | | | | | | | | | 6 | | CO2 | |
| III | | Bee Rearing:Apiary – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments. | | | | | | | | | | | 6 | | CO3 | |
| IV | | Bee Economy: Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture. | | | | | | | | | | | 6 | | CO4 | |
| V | | Entrepreneurship: venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens. | | | | | | | | | | | 6 | | CO5 | |
|  | | Total | | | | | | | | | | | 30 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | |
| CO1 | | Understand the systematic position and life history of honey bee. | | | | | | | | | | | PO1, PO2, PO10 | | | |
| CO2 | | Reveal the different stages and types of bees and discuss about the care and management of apiculture. | | | | | | | | | | | PO1, PO2, PO4, PO5 | | | |
| CO3 | | Describe the practice of bee rearing process and analyze instruments employed in apiary. | | | | | | | | | | | PO2,PO4, PO5, PO10, PO11 | | | |
| CO4 | | Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets. | | | | | | | | | | | PO4, PO5, PO7, PO8, PO10 | | | |
| CO5 | | Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives. | | | | | | | | | | | PO5, PO8, PO9, PO10, PO11 | | | |
| **Text Books** | | | | | | | | | | | | | | | | |
| 1. | | Dewey M. Caron. (2013). Honey Bee Biology and Beekeeping. Revised Edition. Wicwas Press, Kalamazoo. ISBN 10: 1878075292 | | | | | | | | | | | | | | |
| 2. | | R. A. Morse. (1993). Rearing queen honey bees. Wicwas press, NY. ISBN-10 ‏ : ‎ 1878075055 | | | | | | | | | | | | | | |
| 3. | | Ted Hooper. (2010). Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books. Oxford. ISBN 10: 1904846513 | | | | | | | | | | | | | | |
| 4. | | Jayashree K. V., Tharadevi C.S. and Arumugam N. (2014) Apiculture. Saras Publication | | | | | | | | | | | | | | |
| 5. | | Raj H. (2020).Vinesh Text Book of Apiculture. S. Vinesh and Co. | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | |
| 1 | | | Dewey M. Caron. (2020). The Complete Bee Handbook: History, Recipes, Beekeeping Basics, and More,Rockridge Press. ISBN-10 ‏ : ‎ 1646119878 | | | | | | | | | | | | | |
| 2 | | | Joachim Petterson. (2016). Beekeeping: A Handbook on Honey, Hives & Helping the Bees, Weldon Owen. | | | | | | | | | | | | | |
| 3 | | | Eva Crane. (1999). The World History of Beekeeping and Honey Hunting. Routledge. India.ISBN-10 ‏ : ‎ 0415924677 | | | | | | | | | | | | | |
| 4 | | | Pagar B. S. (2016). Textbook Of Apiculture. Sahitya Sagar. | | | | | | | | | | | | | |
| 5 | | | Sehgal P.K. (2018). Text Book of Sericulture, Apiculture **a**nd Entomology.Kalayani. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | |
| 1 | | | | Bee Keeping Basics. Retrieved from:<https://denton.agrilife.org/files/2013/08/beekeeping-basics.pdf> | | | | | | | | | | | | |
| 2 | | | | Beekeeping as an Entrepreneurship, Retrieved from: <https://lupinepublishers.com/agriculture-journal/pdf/CIACR.MS.ID.000270.pdf> | | | | | | | | | | | | |
| 3 | | | | Raising Bumble Bees at Home: A Guide to Getting Started. Retrieved from: <https://www.ars.usda.gov/ARSUserFiles/20800500/BumbleBeeRearingGuide.pdf> | | | | | | | | | | | | |
| 4 | | | | [Apiculture – Biology for Everybody (homeomagnet.com)](https://biology.homeomagnet.com/apiculture/?adlt=strict&toWww=1&redig=AD4F2B2418A84F7D97A27706F78610E5) | | | | | | | | | | | | |
| 5 | | | | [Apiculture: Introduction to Apiculture (iasri.res.in)](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=16178&adlt=strict&toWww=1&redig=ECA47C0BBEF9490485EC0BC44F6BDBE2) | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

Mapping with Programme Outcomes:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S | S |  |  |  |  |  |  |  | S |  |
| CO2 | S | S |  | S | S |  |  |  |  |  |  |
| CO3 |  | S |  | S | M |  |  |  |  | S | S |
| CO4 |  |  |  | S | M |  | S | S |  | M |  |
| CO5 |  |  |  |  | S |  |  | S | S | S | S |

**V- SEMESTER**

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| **Subject Code** | **Subject Name** | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | | **External** | | **Total** |
| **22MBUGCT5** | **BACTERIOLOGY AND MYCOLOGY** | | | **Core**  **Course IX** | **Y** | **-** | **-** | **-** | **4** | **5** | **25** | | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques. | | | | | | | | | | | | | | | |
| CO2 | Basic knowledge about Gram positive pathogenic bacteria and their epidemiology | | | | | | | | | | | | | | | |
| CO3 | Acquire knowledge about Gram negative pathogenic bacteria and nosocomial infections | | | | | | | | | | | | | | | |
| CO4 | Comprehensive knowledge about medically important, its classification and its significance | | | | | | | | | | | | | | | |
| CO5 | Gain knowledge about the general characteristics and mode of action of various antibacterial agents | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | | **No.of Hours** | | | **Course Objectives** | |
| I | History, Classification of Medically Important Microbes, Koch’s, and River’s postulates-A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections. | | | | | | | | | | | 12 | | | CO1 | |
| II | Medically important Gram Positive infections **-** Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (*Streptococcus pyogenes*, *Streptococcus faecalis*), (b) Staphylococcal infections (*Staphylococcus aureus*), (c) Tetanus (*Clostridium tetani*)(d) Diphtheria (*Corynebacteriumdiphtheriae*) (e) Anthrax (*Bacillus anthracis*) (f) Tuberculosis (*Mycobacterium tuberculosis*), (g) Leprosy (*Mycobacterium leprae*). | | | | | | | | | | | 12 | | | CO2 | |
| III | Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (*Streptococcus pneumoniae, Neisseria meningitidis*) (b) typhoid (*Salmonella typhi, Salmonella paratyphi*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigelladysenteriae*); Sexually Transmitted disease (syphilis–*Treponemapallidum*.Gonorrhoea - *Neisseria gonorrhoeae*); Nosocomial infections – definition, importance, and their control (*Pseudomonas aeruginosa*). | | | | | | | | | | | 12 | | | CO3 | |
| IV | Medically important Fungi - Classification of medically important fungi; Superficial mycoses:PityriasisVersicolor; TineaNigra; Piedra. Cutaneous mycoses: *Microsporum*spps.,*Trichophyton*spps., and *Epidermophytonfloccosum*. Subcutaneous mycoses:Chromoblastomycosis; Sporotrichosis; Systemic Mycoses **-**Blastomycosis; Histoplasmosis*;* Opportunistic Infections **-**Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin | | | | | | | | | | | 12 | | | CO4 | |
| V | Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. | | | | | | | | | | | 12 | | | CO5 | |
|  | Total | | | | | | | | | | | 60 | | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | |
| CO1 | | Understand the importance of normal flora of human body and acquire knowledge on the process of infectious disease. | | | | | | | | | | PO1, PO3, PO5, PO7, PO10, PO11 | | | | |
| CO2 | | Explain the various bacterial pathological events during the progression of an infectious disease, and apply the underlying mechanisms of spread of disease and its control. | | | | | | | | | | PO1, PO3, PO5, PO7, PO10, PO11 | | | | |
| CO3 | | Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment. | | | | | | | | | | PO1, PO3, PO5, PO7, PO10, PO11 | | | | |
| CO4 | | Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process. | | | | | | | | | | PO1, PO3, PO5, PO7, PO10, PO11 | | | | |
| CO5 | | Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins. | | | | | | | | | | PO1, PO3, PO4, PO5,PO6, PO7,PO9, PO10 | | | | |
| **Text Books** | | | | | | | | | | | | | | | | |
| 1 | | Tom Parker, M. Leslie H. Collier. (1990). Topley&Wilson’s Principles of Bacteriology, Virology and Immunity,8th Edition. London: Edward Arnold. | | | | | | | | | | | | | | |
| 2 | | Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18thEdition. Churchill Livingstone, London. | | | | | | | | | | | | | | |
| 3 | | Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis. | | | | | | | | | | | | | | |
| 4 | | Ananthanarayanan, R. and JayaramPanicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad. | | | | | | | | | | | | | | |
| 5 | | JagdishChander (2018). Textbook of Medical Mycology, 4th edition, Jaypeebrothers medical publishers. | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | |
| 1 | | Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC. | | | | | | | | | | | | | | |
| 2 | | Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers. | | | | | | | | | | | | | | |
| 3 | | C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers. | | | | | | | | | | | | | | |
| 4 | | A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications. | | | | | | | | | | | | | | |
| 5 | | Christopher C. Kibbler ,Richard Barton,Neil A. R. Gow, Susan Howell,Donna M. MacCallum, Rohini J. Manuel (2017). Oxford Textbook of Medical Mycology. Oxford University Press. | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | |
| 1 | | <http://textbookofbacteriology.net/nd> | | | | | | | | | | | | | | |
| 2 | | <https://microbiologysociety.org/members-outreach-resources/links.html> | | | | | | | | | | | | | | |
| 3 | | <http://mycology.cornell.edu/fteach.html> | | | | | | | | | | | | | | |
| 4 | | <https://www.adelaide.edu.au/mycology/> | | | | | | | | | | | | | | |
| 5 | | <https://www.isham.org/mycology-resources/mycological-links> | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | |
| **Internal Evaluation** | | | **Continuous Internal Assessment Tests** | | | | | | | | | | 25 Marks | | | |
|  | | | Assignments | | | | | | | | | |  | | | |
|  | | | Seminars | | | | | | | | | |  | | | |
|  | | | Attendance and Class Participitation | | | | | | | | | |  | | | |
| **External Evaluation** | | | End Semester Examination | | | | | | | | | | 75 Marks | | | |
|  | | | Total | | | | | | | | | | 100 Marks | | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | |
| Recall (KI) | | | Simple definitions, MCQ, Recall steps, Concept definitions | | | | | | | | | | | | | |
| Understand /  Comprehend  (K2) | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | |
| Application (K3) | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | |
| Analyse (K4) | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | |
| Evaluate (K5) | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | |
| Create (K6) | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S |  | S |  | S |  | S |  |  | M | S |
| CO2 | S |  | S |  | S |  | S |  |  | M | S |
| CO3 | S |  | S |  | S |  | S |  |  | M | S |
| CO4 | S |  | S |  | S |  | S |  |  | M | S |
| CO5 | S |  | S | M | S | M | S |  | S | M |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | | **External** | | **Total** |
| **22MBUGCT6** | **VIROLOGY AND PARASITOLOGY** | | **CORE COURSE X** | **Y** | **-** | **-** | **-** | **4** | **5** | **25** | | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | |
| CO1 | To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections. | | | | | | | | | | | | | | |
| CO2 | To understand pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body. | | | | | | | | | | | | | | |
| CO3 | To gain knowledge about reemerging viral infections and develop diagnostic skills, including the use and interpretation of laboratory test in the diagnosis of infectious diseases. | | | | | | | | | | | | | | |
| CO4 | Understand the types of parasites causing infections in the intestine. | | | | | | | | | | | | | | |
| CO5 | To develop skills in the diagnosis of parasitic infections. | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | | **Course Objectives** | |
| I | General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections. | | | | | | | | | | 12 | | | CO1 | |
| II | Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus), Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations. | | | | | | | | | | 12 | | | CO2 | |
| III | Emerging and reemerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules. | | | | | | | | | | 12 | | | CO3 | |
| IV | General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Entameobahistolytica*, flagellates (*Giardia lamblia, Leishmaniadonovani*), Sporozoa- *Plasmodium*spps. | | | | | | | | | | 12 | | | CO4 | |
| V | Introduction to Helminthes, Platyhelminthes – *Taenia – Fasciola – Paragonimus* – *Schistosoma*spps*.*. Nemathelminthes – Ascaris*– Ankylostoma – Enterobius – Trichuris – Trichinella – Wuchereria – Dracanculus.* Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites. | | | | | | | | | | 12 | | | CO5 | |
|  | Total | | | | | | | | | | 60 | | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | | Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases. | | | | | | | | | PO5,PO10 | | | | |
| CO2 | | Knowledge of basic and general concepts of causation of disease by the pathogenic microorganisms and various parameters of assessment of their severity and the methods of diagnosis. | | | | | | | | | PO5,PO10 | | | | |
| CO3 | | Insights to treatment options of viral diseases. | | | | | | | | | PO5,PO10 | | | | |
| CO4 | | Knowledge about the importance of protozoans in the intestine. | | | | | | | | | PO5,PO10 | | | | |
| CO5 | | Knowledge of Nematodes as infectious agent | | | | | | | | | PO5,PO10 | | | | |
| **TEXT BOOKS** | | | | | | | | | | | | | | | |
| 1. | | S., Rajan(2007). Medical microbiology, MJP publisher. | | | | | | | | | | | | | |
| 2. | | JeyaramPaniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers,NewDelhi. | | | | | | | | | | | | | |
| 3 | | AroraD.R. and AroraB. (2002). Medical Parasitology, 1stEdition CBS Publishers & Distributors, New Delhi. | | | | | | | | | | | | | |
| 4 | | Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta. | | | | | | | | | | | | | |
| 5 | | Parija S. C. (1996). Text Book of Medical Parasitology.4th edition, Orient Longman, AllIndia Publishers & Distributors. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1 | | Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19thEdition. Lange Medical Publications, U.S.A. | | | | | | | | | | | | | |
| 2 | | Ananthanarayan, R. and JeyaramPaniker, C.K. (2009). Text Book of Microbiology, 8thEdition. Orient Longman, Chennai . | | | | | | | | | | | | | |
| 3 | | Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall,  Englewood Cliff, New Jersey.. | | | | | | | | | | | | | |
| 4 | | Topley& Wilsons’s (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London. | | | | | | | | | | | | | |
| 5 | | Finegold, S.M. (2000). Diagnostic Microbiology, 10th Edition. C.V. Mosby Company,St.Louis. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | |
| 1 | | <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/> | | | | | | | | | | | | | |
| 2 | | <https://www.ncbi.nlm.nih.gov/pubmed/21722309> | | | | | | | | | | | | | |
| 3 | | <https://www.sciencedirect.com/science/article/pii/S2211753919300193> | | | | | | | | | | | | | |
| 4 | | <https://cmr.asm.org/content/30/3/811> | | | | | | | | | | | | | |
| 5 | | <https://www.nejm.org/doi/full/10.1056/NEJMoa1811400> | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | |
| **Internal Evaluation** | | Continuous Internal Assessment Test | | | | | | | | | | 25 Marks | | | |
| Assignments | | | | | | | | | |
| Seminars | | | | | | | | | |
| Attendance and Class Participation | | | | | | | | | |
| **External Evaluation** | | End Semester Examination | | | | | | | | | | 75 Marks | | | |
|  | | Total | | | | | | | | | | 100 Marks | | | |

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| --- | --- |
| **Methods of Assessment** | |
| **Recall (KI)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand /**  **Comprehend**  **(K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyse (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  | M |  |  |  |  | M |  |
| CO2 |  |  |  |  | M |  |  |  |  | M |  |
| CO3 |  |  |  |  | M |  |  |  |  | M |  |
| CO4 |  |  |  |  | M |  |  |  |  | M |  |
| CO5 |  |  |  |  | M |  |  |  |  | M |  |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | | |
| **CIA** | | | **External** | | **Total** | |
| **22MBUGCP5** | **PRACTICAL V** | | **Core course XI** | **Y** | **-** | **-** | **-** | **4** | **5** | **40** | | | **60** | | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | **Learning Objectives**  To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples. | | | | | | | | | | | | | | | |
| CO2 | To learn the techniques for isolation and identification of bacterial pathogens. | | | | | | | | | | | | | | | |
| CO3 | To gain expertise in various techniques of clinically important viral pathogens and their identification. | | | | | | | | | | | | | | | |
| CO4 | To get acquainted with medically important fungi and their metabolism. | | | | | | | | | | | | | | | |
| CO5 | To categorize parasites and understand their role in infections. | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | | **Course Objectives** | | |
| I | 1. Collection and Transport of Clinical specimens. 2. Simple, Differential and Special staining of Clinical materials. 3. Culture techniques used to isolate microorganisms. | | | | | | | | | | 12 | | | CO1 | | |
| II | 1. Identification of bacterial pathogens by their biochemical reactions. 2. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration. | | | | | | | | | | 12 | | | CO2 | | |
| III | 1. Isolation of Bacteriophages from Sewage and other natural sources. 2. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining). 3. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane. | | | | | | | | | | 12 | | | CO3 | | |
| IV | 1. Microscopic identification of medically important Fungi – KOH and Lactophenol cotton Blue staining. 2. Slide culture techniques for fungal Identification 3. Identification of Dermatophytes. 4. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts. | | | | | | | | | | 12 | | | CO4 | | |
| V | 1. Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs. 2. Concentration techniques of stool specimen – Floatation and Sedimentation methods. 3. Examination of blood for Malarial parasites – thin and thick smear preparations. 4. Identification of Medically important parasites in slides / specimens as spotters. | | | | | | | | | | 12 | | | CO5 | | |
|  | Total | | | | | | | | | | 60 | | |  | | |
| **Course Outcomes** | | | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | | | |
| CO1 | Demonstrate methods to observe and measure microorganisms by standard microbiological techniques | | | | | | | | | | PO4, PO5, PO7. | | | | | |
| CO2 | Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics. | | | | | | | | | | PO4, PO5, PO7, PO8. | | | | | |
| CO3 | Understand experimental tools used to cultivate and characterize clinically important viruses and bacteriophages | | | | | | | | | | PO4, PO5, PO7, PO8. | | | | | |
| CO4 | Elucidate clinically important fungi. | | | | | | | | | | PO4, PO5, PO7, PO8. | | | | | |
| CO5 | Investigate Parasites of medical importance and identify them from clinical specimens. | | | | | | | | | | PO4, PO5, PO7, PO8. | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | |
| 1. | Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538. | | | | | | | | | | | | | | | |
| 2. | K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302. | | | | | | | | | | | | | | | |
| 3 | Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934. | | | | | | | | | | | | | | | |
| 4 | Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypee digital publishing. | | | | | | | | | | | | | | | |
| 5 | James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock (2015). Manual of Clinical Microbiology, 11th Edition, ASM press | | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | **References Books**  (Latest editions and the style as given below must be strictly adhered to) |
| 1 | Patricia M. Tille (2021). Bailey & Scott’s Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056. | | | | | | | | | | | | | | | |
| 2 | Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571. | | | | | | | | | | | | | | | |
| 3 | Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374. | | | | | | | | | | | | | | | |
| 4 | Josephine A. Morello, Paul A. Granato and Helen EckelMizer (2002). Laboratory Manual and Workbook in Microbiology. 7th Edition. The McGraw Hill Company. ISBN: 0-07-246354-6. | | | | | | | | | | | | | | | |
| 5 | Rowland, S.S., Walsh, S.R., Teel, L.D. and Carnahan, A.M. ((1994). Pathogenic and Clinical Microbiology: A Laboratory Manual. Lippincott Williams & Wilkins. ISBN-10: 0316760498, ISBN-13: 9780316760492. | | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | **Web Resources** |
| 1 | <https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf> | | | | | | | | | | | | | | | |
| 2 | <http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf> | | | | | | | | | | | | | | | |
| 3 | <https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology> | | | | | | | | | | | | | | | |
| 4 | <https://cmr.asm.org/content/31/3/e00062-17.full.pdf> | | | | | | | | | | | | | | | |
| 5 | <https://microbiologyinfo.com/techniques-of-virus-cultivation/> | | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | | | | | | | | | | | 25 Marks | | | | |
| Assignments | | | | | | | | | | |  | | | | |
| Seminars | | | | | | | | | | |  | | | | |
| Attendance and Class Participation | | | | | | | | | | |  | | | | |
| **External Evaluation** | End Semester Examination | | | | | | | | | | | 75 Marks | | | | |
|  | Total | | | | | | | | | | | 100 Marks | | | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | |
| **Recall (K1)** | | Simple definitions, MCQ, Recall steps, Concept definitions | | | | | | | | | | | | | |
| **Understand/ Comprehend (K2)** | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | |
| **Application (K3)** | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | |
| **Analyze (K4)** | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | |
| **Evaluate (K5)** | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | |
| **Create (K6)** | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | S | M |  | S |  |  |  |  |
| CO2 |  |  |  | S | S |  | S | L |  |  |  |
| CO3 |  |  |  | S | S |  | S | L |  |  |  |
| CO4 |  |  |  | S | S |  | S | L |  |  |  |
| CO5 |  |  |  | S | S |  | S | L |  |  |  |

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
| **22MBUGCPR** | **GROUP PROJECT** | **Project with Viva-Voce CC-XII** | **-** | **-** | **-** | **-** | **4** | **5** | **40** | **60** | **100** |

Group projects enable students to get hands-on training in microbiological techniques needed for research. Thus the students can share diverse perspectives resulting in pooling of knowledge and skills. Group work may approach tasks and solve problems in novel, interesting ways, thereby converting established theoretical concepts to practical skills. If structured properly, it will promote team work and collaboration. Group projects also will help students to choose a research design, solve real life problems and benefit the society at large. Thus group project facilitates the students to convert ideas to practice thereby creating a research culture among students.

**Guidelines for group project:**

A research problem need to be selected based on creative ability and scientific thought.

A brief description of the problem needs to be given.

Hypothesis statement should be framed.

Objectives by which the project work is to be carried out should be clearly stated.

Methodology has to be designed to test the hypothesis.

Results obtained need to be replicable.

Documented report has to be submitted on completion of the project.

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| **Subject Code** | **Subject Name** | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | | | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE5** | **RECOMBINANT DNA TECHNOLOGY** | | | **ELECTIVE GENERIC/ DISCIPLINE SPECIFIC ELECTIVE- V** | **Y** |  | **-** | **-** | **3** | **4** | | | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | | | |
| CO1 | Understand the principles of rDNA technology. | | | | | | | | | | | | | | | | |
| CO2 | Illustrate the molecular tools employed in gene cloning. | | | | | | | | | | | | | | | | |
| CO3 | Discuss the importance of various molecular techniques and their importance in Biotechnology. | | | | | | | | | | | | | | | | |
| CO4 | Acquire knowledge about the concepts of tissue culture methods and transgenic organisms. | | | | | | | | | | | | | | | | |
| CO5 | Examine recent trends in genetic engineering and its application in human welfare. | | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No. of Hours** | | | | | **Course Objectives** | |
| I | MilestonesinrDNATechnology-GeneManipulation-StepsinvolvedinGeneCloning.Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types,Mode of action-Application of Ligase,DNAPolymerase,DNA Modifying enzymesandTopoisomerases.UseofLinkersandAdapters. | | | | | | | | | | 12 | | | | | CO1 | |
| II | ArtificialGeneTransfermethods-CalciumChlorideInduction,Electroporation,Microinjection, Biolistic method, Liposome and Viral-mediated delivery.Cloning vectors –Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1.Artificial Vectors- pBR322 and pUC.Phage Based Vectors- Lambda phage. Hybrid Vectors,Phagemid, Cosmid, BAC and YAC.Screening of Recombinants.Genomic DNA and cDNAlibrary-ConstructionandScreening. | | | | | | | | | | 12 | | | | | CO2 | |
| III | Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGEBlottingTechniques-Southern,Western&Northern.DNAsequencingmethods-Sanger’sandAutomated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs,TALENs,CRISPRs.GeneTargeting-Knock-in &Knock-outs.DNAFingerPrinting, | | | | | | | | | | 12 | | | | | CO3 | |
| IV | Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture-Explant Culture- Micropropagation- Callus and Protoplast Culture-Production of Bio-ActiveSecondary Metabolites by Plant Tissue Culture -Agrobacterium and Crown Gall Tumors, TiPlasmidandRiPlasmid-AnimalBiotechnology-PrinciplesofAnimalCellCulture,MediaandEquipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types,EstablishmentandMaintenanceofCellLines. | | | | | | | | | | 12 | | | | | CO4 | |
| V | Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep-RecombinantCytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies inTherapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy-GermlineandSomaticCellTherapy-*Ex-vivo*GeneTherapy-SCID(SevereCombinedImmunoDeficiency) – *In-vivo* Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) –Vectors inGeneTherapy-ViralandNon-ViralVectors.TransgenicPlants– BtCotton,BtCorn, RoundReadysoybean,FlavrSavrTomatoandGoldenRice. | | | | | | | | | | 12 | | | | | CO5 | |
|  | Total | | | | | | | | | | 60 | | | | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | | |
| CO1 | | Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening. | | | | | | | | | | PO4, PO6, PO7, PO9 | | | | | |
| CO2 | | Discuss the various cloning vectors and their applications. | | | | | | | | | | PO4, PO6, PO7, PO9 | | | | | |
| CO3 | | Assess the usage and advantages of molecular tools. | | | | | | | | | | PO4, PO6, PO7, PO9 | | | | | |
| CO4 | | Explain plant and animal tissue culture protocols and gene transfer mechanism. | | | | | | | | | | PO4, PO6, PO7, PO9 | | | | | |
| CO5 | | Elucidate and understand the application of genetic engineering and gene therapy. | | | | | | | | | | PO4, PO6, PO7, PO9 | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | |
| 1. | | Brown T.A.(2016). Gene Cloning and DNA Analysis. 7thEdition . John Wiley and Jones, Ltd. | | | | | | | | | | | | | | | |
| 2. | | Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. 3rd Edition. John Wileys and Sons Ltd. | | | | | | | | | | | | | | | |
| 3. | | Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute | | | | | | | | | | | | | | | |
| 4. | | Siddra Ijaz, Imran UlHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing. | | | | | | | | | | | | | | | |
| 5. | | Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition,Alpha Science International Ltd | | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | |
| 1. | | Maloy S. R., Cronan J.E. Jr. and FreifelderD.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd. | | | | | | | | | | | | | | | |
| 2. | | Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. | | | | | | | | | | | | | | | |
| 3. | | Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition. | | | | | | | | | | | | | | | |
| 4. | | Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria,4th Edition. ASM Press Washington-D.C. ASM Press. | | | | | | | | | | | | | | | |
| 5. | | James D.Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books | | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | |
| 1 | | https://www.britannica.com/recombinant-DNA-technology | | | | | | | | | | | | | | | |
| 2 | | https://www.byjus.com/recombinant-dna-technology | | | | | | | | | | | | | | | |
| 3 | | https://www..rpi.edu | | | | | | | | | | | | | | | |
| 4 | | https://www..ncbi.nlm.nih.gov | | | | | | | | | | | | | | | |
| 5 | | https://www.le.ac.uk/recombinant-dna-and-genetic-techniques | | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | | |
| **Internal Evaluation** | | Continuous Internal Assessment Test | | | | | | | | | | | | 25 Marks | | | |
| Assignments | | | | | | | | | | | |  | | | |
| Seminars | | | | | | | | | | | |  | | | |
| Attendance and Class Participation | | | | | | | | | | | |  | | | |
| **External Evaluation** | | End Semester Examination | | | | | | | | | | | | 75 Marks | | | |
|  | | Total | | | | | | | | | | | | 100 Marks | | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | | |
| **Recall (KI)** | | | Simple definitions, MCQ, Recall steps, Concept definitions | | | | | | | | | | | | | | |
| **Understand /**  **Comprehend**  **(K2)** | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | | |
| **Application (K3)** | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | | |
| **Analyse (K4)** | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | | |
| **Evaluate (K5)** | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | | |
| **Create (K6)** | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  | S | L | S | S | M | S |  |  |
| CO2 |  |  |  | S | L | S | S | M | S |  |  |
| CO3 |  |  |  | S | L | S | S | M | S |  |  |
| CO4 |  |  |  | S | L | S | S | M | S |  |  |
| CO5 |  |  |  | S | L | S | S | M | S |  |  |

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| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | | **External** | **Total** | |
| **22MBUGDE6** | **BIOSAFETY&BIOETHICS** | | **CORE ELECTIVE VI** | **Y** | **-** | **-** | **-** | **3** | **4** | **25** | | | **75** | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | |
| CO1 | To create a research environment - encourage investigation, analysis and studying the bioethical principles, values, concepts, and social and juridical implications contained in the Universal Declaration on Bioethics and Human | | | | | | | | | | | | | | |
| CO2 | Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine. | | | | | | | | | | | | | | |
| CO3 | To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products. | | | | | | | | | | | | | | |
| CO4 | To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries. | | | | | | | | | | | | | | |
| CO5 | To understand the importance of IPR, Patents and Patent laws. | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | **No.of Hours** | | | | **Course Objectives** |
| I | Basics of Biosafety **-** Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP). | | | | | | | | | | 12 | | | | CO1 |
| II | Hazardous materials in Biotechnology **-** Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO’s, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories. | | | | | | | | | | 12 | | | | CO2 |
| III | Biological Safety Containment in Laboratory **-** Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC. | | | | | | | | | | 12 | | | | CO3 |
| IV | Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons. | | | | | | | | | | 12 | | | | CO4 |
| V | IPR, Patents and Patent laws **-** Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms. | | | | | | | | | | 12 | | | | CO5 |
|  | Total | | | | | | | | | | 60 | | | |  |
| **Course Outcomes** | | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | | |
| CO1 | Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment | | | | | | | | | | PO1, PO2, PO3, PO7, PO10 | | | | |
| CO2 | Develop stratagems for the use of genetically modified organisms and Hazardous materials | | | | | | | | | | PO1, PO3, PO4 | | | | |
| CO3 | Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care. | | | | | | | | | | PO1, PO6 | | | | |
| CO4 | Analyze and respond to the comments of other students regarding philosophical issues. | | | | | | | | | | PO3, PO4 | | | | |
| CO5 | Pave the way for the students to catch up Intellectual Property(IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur | | | | | | | | | | PO1, PO7, PO10 | | | | |
| **Text Books** | | | | | | | | | | | | | | | |
| 1. | Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-10‎1645878856 | | | | | | | | | | | | | | |
| 2. | Satheesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703 | | | | | | | | | | | | | | |
| 3 | DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700 | | | | | | | | | | | | | | |
| 4 | Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher. | | | | | | | | | | | | | | |
| 5 | Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd. | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | |
| 1 | Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: ‎9386668572 | | | | | | | | | | | | | | |
| 2 | Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896 | | | | | | | | | | | | | | |
| 3 | Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659. | | | | | | | | | | | | | | |
| 4 | Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press | | | | | | | | | | | | | | |
| 5 | Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers. | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | |
| 1 | Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>. | | | | | | | | | | | | | | |
| 2 | World Intellectual Property Organisation. (2004). WIPO Intellectual propertyHandbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo\_pub \_489.pdf. | | | | | | | | | | | | | | |
| 3 | https://www..niehs.nih.gov/bioethics | | | | | | | | | | | | | | |
| 4 | https://www.sist.sathyabama.ac.in | | | | | | | | | | | | | | |
| 5 | https://www.longdom.org/bioethics-and-biosafety | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | |
| **Internal Evaluation** | | Continuous Internal Assessment Test | | | | | | | | | | 25 Marks | | | |
| Assignments | | | | | | | | | |  | | | |
| Seminars | | | | | | | | | |  | | | |
| Attendance and Class Participation | | | | | | | | | |  | | | |
| **External Evaluation** | | End Semester Examination | | | | | | | | | | 75 Marks | | | |
|  | | Total | | | | | | | | | | 100 Marks | | | |

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| --- | --- |
| **Methods of Assessment** | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S | S | S |  |  |  | M |  |  | M |  |
| CO2 | S |  | S | S |  |  |  |  |  |  |  |
| CO3 | S |  |  |  |  | S |  |  |  |  |  |
| CO4 |  |  | S | S |  |  |  |  |  |  |  |
| CO5 | S |  |  |  |  |  | M |  |  | S |  |

**VI - SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | | **External** | **Total** | |
| **22MBUGCT7** | **ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY** | | | | CORE COURSE –XIII | **Y** | **-** | **-** | **-** | **4** | **6** | **25** | | | **75** | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | | | |
| CO1 | To discuss the distribution and association of microorganism in various ecosystems and to know about the role of microorganism in water pollution and water quality. | | | | | | | | | | | | | | | | |
| CO2 | To acquire knowledge about the role of microorganism in water pollution and water quality | | | | | | | | | | | | | | | | |
| CO3 | Gain knowledge about microbes as biofertilizers and the aspects of application. | | | | | | | | | | | | | | | | |
| CO4 | To learn about the process of solid waste management and sewage water treatment. | | | | | | | | | | | | | | | | |
| CO5 | Gain knowledge on various plant diseases and pathogens | | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | | | | **No. of Hours** | | | **Course Objectives** |
| I | Microorganisms and their Habitats: Structure and function of ecosystems  Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen.  Aquatic Environment: Microflora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments.  Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation.  Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.  Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases. Environmental Protection Agency (EPA) - role in environmental protection. | | | | | | | | | | | | | 12 | | | CO1 |
| II | Water potability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD. Advanced molecular methods for water analysis. Water borne diseases. Central Pollution Control Board (CPCB) standards**.** | | | | | | | | | | | | | 11 | | | CO2 |
| III | Microbial Interactions: Rhizosphere microflora. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers.Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers and biocontrol agents – Bacterial, cyanobacterial, VAM. Mass production of Rhizobialbiofertilizer. Biocontrol agents – Bacterial, viral, fungal. | | | | | | | | | | | | | 12 | | | CO3 |
| IV | Waste treatment and bioremediation**:** Solid waste management: Sources and types of solid waste, composting, vermin composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: Need and scope of bioremediation. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB. | | | | | | | | | | | | | 15 | | | CO4 |
| V | Plant pathology: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases. Plant defense mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management. | | | | | | | | | | | | | 10 | | | CO5 |
|  | Total | | | | | | | | | | | | | 60 | | |  |
| **Course Outcomes** | | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | | |
| CO1 | | Describe about the structure and function of ecosystems and understand the role of microbes in various environments | | | | | | | | | | | PO1 | | | | |
| CO2 | | Identify the cause of water pollution, and perform methods to assess the quality of water. | | | | | | | | | | | PO4,PO5,PO6,PO7,PO8 | | | | |
| CO3 | | Explain the productionof biofertilizers and biopesticides. | | | | | | | | | | | PO1, PO7,PO8 | | | | |
| CO4 | | Explainabout waste treatment process and microbial decomposition and bio-remediation process. | | | | | | | | | | | PO6 | | | | |
| CO5 | | Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction | | | | | | | | | | | PO1,PO5 | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | |
| 1. | | | Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun Publications. | | | | | | | | | | | | | | |
| 2. | | | Pradipta. K.M. (2008). Textbook of Environmental Microbiology.I.K.Publishing. House. | | | | | | | | | | | | | | |
| 3. | | | Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology.OmSakthiPathipagam, Annamalai Nagar. | | | | | | | | | | | | | | |
| 4. | | | K. Vijaya Ramesh.(2004).Environmental Microbiology. 1st Edition. MJP Publishers. | | | | | | | | | | | | | | |
| 5. | | | SubbaRao.N.S.(2017). Soil Microbiology.4th Edition. Oxford and IBH Publishing Pvt.Ltd. | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | |
| 1 | | | Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil  Microbiology, Marcel Dekker INC, New York, Hong Kong. | | | | | | | | | | | | | | |
| 2 | | | EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and  Biotreatment – Longman Scientific Technical. | | | | | | | | | | | | | | |
| 3 | | | Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc.  Publications, New York. | | | | | | | | | | | | | | |
| 4 | | | Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for  Examination of Water and Wastewater, 20thEdition. American Public Health Association. | | | | | | | | | | | | | | |
| 5 | | | Atlas, R.M. and Bartha, R.(1992). Microbial Ecology: Fundamentals andApplications, 2nd Edition. The Benjamin / Cummings Publishing Co.,Redwood City, CA. | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | |
| 1 | | | <https://nptel.ac.in/courses/126105016> | | | | | | | | | | | | | | |
| 2 | | | <https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236> | | | | | | | | | | | | | | |
| 3 | | | <https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm> | | | | | | | | | | | | | | |
| 4 | | | <https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf> | | | | | | | | | | | | | | |
| 5 | | | <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x> | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | | |
| Internal Evaluation | | | Continuous Internal Assessment Test | | | | | | | | | | 25 Marks | | | | |
| Assignments | | | | | | | | | |
| Seminars | | | | | | | | | |
| Attendance and Class Participation | | | | | | | | | |
| External Evaluation | | | End Semester Examination | | | | | | | | | | 75 Marks | | | | |
|  | | | Total | | | | | | | | | | 100 Marks | | | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | | |
| Recall (KI) | | | | **Simple definitions, MCQ, Recall steps, Concept definitions** | | | | | | | | | | | | | |
| Understand /  Comprehend  (K2) | | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | |
| Application (K3) | | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | |
| Analyse (K4) | | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | |
| Evaluate (K5) | | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | |
| Create (K6) | | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | S |  |  |  |  |  |  |  |  |  |  |
| CO2 |  |  |  | M | S | S | S | S |  |  |  |
| CO3 | S |  |  |  |  |  | S | S |  |  |  |
| CO4 |  |  |  |  |  | S |  |  |  |  |  |
| CO5 | M |  |  |  | M |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGCT8** | **FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY** | | **CORE COURSE - XIV** | **Y** | **-** | **-** | **-** | **4** | **6** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety. | | | | | | | | | | | | | |
| CO2 | Gives an insight into various types of food borne diseases and their prevention | | | | | | | | | | | | | |
| CO3 | To gain information about microflora of milk | | | | | | | | | | | | | |
| CO4 | To study about the production of fermented dairy products | | | | | | | | | | | | | |
| CO5 | To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits  To create a sustainable environmentally and technologically advanced dairy farm | | | | | | | | | | | | | |
| **UNIT** | **Details** | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Food as a substrate for micro organisms-.Micro organisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of micro organisms, - High temperature - Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation. | | | | | | | | | | 12 | | CO1 | |
| II | Contamination and spoilage of food products -Food borne infections (Bacillus cereus, ,Salmonellosis, Shigellosis, ,*Listeria monocytogenes* and *Campylobacter jejuni*) and intoxications – (*Staphylococcus aureus*, *Clostridium botulinum* ,*Clostridium perfringens* and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees’ health standards. Regulatory Agencies &criteria for food safety. | | | | | | | | | | 15 | | CO2 | |
| III | Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies. | | | | | | | | | | 15 | | CO3 | |
| IV | Food fermentations: Indian Pickles Bread,vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, AcidophilusMilk,Kefir,Koumiss). Oriental fermented foods-Miso –Tempeh **Ontjom .****Natto,****Idli** Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods. | | | | | | | | | | 15 | | CO4 | |
| V | Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods.Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods. | | | | | | | | | | 15 | | CO5 | |
|  | **Total** | | | | | | | | | | 72 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Gain knowledge about food as a substrate for various microbes, Understand about the principles and application of different types of food spoilage and preservation technique, | | | | | | | | | PO7,PO8,PO10 | | | |
| CO2 | | Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique | | | | | | | | | PO5,PO10 | | | |
| CO3 | | Gain information about spoilage of milk and its products and its antimicrobial properties | | | | | | | | | PO5,PO7 | | | |
| CO4 | | Learn about the various fermented product and its various stage spoilage | | | | | | | | | PO7,PO8,PO10 | | | |
| CO5 | | Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits | | | | | | | | | PO5,PO6 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | | Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi. | | | | | | | | | | | | |
| 2. | | Adams, M.R., Moss, M.O.(2018). Food Microbiology 1stedition. New Age Publishers by New Age International (P) Ltd., Publishers. | | | | | | | | | | | | |
| 3 | | R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers. | | | | | | | | | | | | |
| 4 | | Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York. | | | | | | | | | | | | |
| 5 | | Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | | Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7th Edition  CBS Publishers and Distributors, Delhi, India. | | | | | | | | | | | | |
| 2 | | Prescott, Harley and Klein Wim.(2008). Microbiology, 7th Edition McGraw Hill Publications. | | | | | | | | | | | | |
| 3 | | Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York. | | | | | | | | | | | | |
| 4 | | Yuankunlee,Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc. | | | | | | | | | | | | |
| 5 | | DharumauraiDhansekaran, AlwarappanSankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916. | | | | | | | | | | | | |
| **WEB RESOURCES** | | | | | | | | | | | | | | |

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| --- | --- |
| 1 | https://www.researchgate.net/publication/15326559\_A\_Dynamic\_Approach\_to\_Predicting\_BacterialGrowth\_in\_Food/link/5a1d2e02aca2726120 b28eba/download |
| 2 | <https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate> |
| 3 | https://www.researchgate.net/publication/243462186\_Foodborne\_diseases\_in\_India\_-  \_A\_review |
| 4 | <https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/>  download |
| 5 | <https://www.fda.gov/food> |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |  |
| Seminars |  |
| Attendance and Class Participation |  |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| Recall (KI) | Simple definitions, MCQ, Recall steps, Concept definitions | |
| Understand /  Comprehend  (K2) | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| Application (K3) | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| Analyse (K4) | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| Evaluate (K5) | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 |  |  |  |  |  |  | S | S |  | M |  |
| CO2 |  |  |  |  | S |  |  |  |  | M |  |
| CO3 |  |  |  |  | S |  | M |  |  |  |  |
| CO4 |  |  |  |  |  |  | S | S |  | M |  |
| CO5 |  |  |  |  | M | M |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | | |
| **CIA** | | **External** | | **Total** | |
| **22MBUGCP6** | **PRACTICAL VI** | | | **CORE COURSE – XV- PRACTICAL VI** | **Y** | **-** | **-** | **-** | **4** | **6** | **25** | | **75** | | **100** | |
| **Course Objectives** | | | | | | | | | | | | | | | | |
| CO1 | Toassess the water quality and potability. | | | | | | | | | | | | | | | |
| CO**22MU**2 | To acquire knowledge on enumeration of bacteria from milk and milk quality analysis | | | | | | | | | | | | | | | |
| CO3 | To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of biofertilizers | | | | | | | | | | | | | | | |
| CO4 | Improve knowledge on plant pathogens | | | | | | | | | | | | | | | |
| CO5 | To acquire knowledge on preparation of probiotics and prebiotics | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | | **No.of Hours** | | | | **Course Objectives** |
| I | 1. Physical, chemical, and microbiological assessment of water and potability test forwater.  o Physical a – Color, pH,  o Chemical - alkalinity, acidity, DO, BOD, COD  o Microbiological – MPN index (Presumptive, Completed and Confirmatorytest)  2. Study of air microflora by settle plate method. | | | | | | | | | | | 12 | | | | CO1 |
| II | 3. Isolation and identification of bacteria and fungi from fruits and vegetables  4. Direct microscopic count of milk.  5. Methylene blue reductase test and Resazurin test  6. Microbiological examination of milk by SPC. | | | | | | | | | | | 12 | | | | CO2 |
| III | 7. Isolation of extracellular enzyme producers –Amylase, protease, lipase  8. Microbiological assay of antibiotics by cup plate method and other methods  9. Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms  10. Preparation of biofertilizers – Demonstration | | | | | | | | | | | 12 | | | | CO3 |
| IV | 11. Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus canker, Blight of paddy.  12. Study of fungi - *Mucor,Curvularia, Alternaria, Rhizopus, Aspergillus* | | | | | | | | | | | 10 | | | | CO4 |
| V | 13. Isolation of constituent flora of fermented milk.  14. Growth of probiotic LAB in broth, milk and whey.  15. Preparation of probiotic fermented milks like dahi, yoghurt, lassi and whey drink.  16. Effect of prebiotics on the growth of LAB in milk and broth.  17. Survivability of probiotic organisms in fermented milks.  18. Antimicrobial potential of the functional dairy products. | | | | | | | | | | | 14 | | | | CO5 |
|  | Total | | | | | | | | | | | 60 | | | |  |
| **Course Outcomes** | | | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | | | |
| CO1 | | Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies | | | | | | | | | | PO1, PO4,PO5,PO6, PO7, PO8 | | | | |
| CO2 | | Evaluate the quality of milk and enumerate bacteria in milk by standard plate count method | | | | | | | | | | PO5,PO6, PO7, PO8 | | | | |
| CO3 | | Identify extracellular enzyme producing and nitrogen fixing microorganism form soil and to prepare a biofertilizer. | | | | | | | | | | PO1,PO8 | | | | |
| CO4 | | Identifyvarious plant pathogenic bacteria | | | | | | | | | | PO1 | | | | |
| CO5 | | Synthesize probiotic fermented milks using microorganisms | | | | | | | | | | PO1,PO7,PO8 | | | | |
| **Text Books** | | | | | | | | | | | | | | | | |
| 1. | | Cappucino J and Sherman N.(2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited. | | | | | | | | | | | | | | |
| 2. | | Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications. | | | | | | | | | | | | | | |
| 3. | | R C Dubey and D K Maheswari.(2002). Practical Microbiology. S. Chand Publishing. | | | | | | | | | | | | | | |
| 4. | | Neelima Garg, K.L. Garg, K.G. Mukerji (2010).Laboratory Manual of Food Microbiology, Wiley publication | | | | | | | | | | | | | | |
| 5. | | Aneja, KR.(2010). Experiments in Microbiology, Plant pathology and Biotechnology.  New Age International (P) Limited. | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | |
| 1 | | Christon J. Hurst Editor in Chief, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach (2007). Manual of Environmental Microbiology, Third Edition,Wiley publication. | | | | | | | | | | | | | | |
| 2 | | James G Cappucino and Natalie Sherman.(2016). Microbiology – A laboratory  manual. 4thEdition. The Benjamin publishing company, New York. | | | | | | | | | | | | | | |
| 3 | | Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai 2016). Manual of Environmental Microbiology, 4th Edition,ASM press. | | | | | | | | | | | | | | |
| 4 | | Burns, Richard G (2005). Environmental MicrobiologyA Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc. | | | | | | | | | | | | | | |
| 5 | | Ian Pepper, Charles Gerba, Jeffrey Brendecke (2004). Environmental Microbiology-A laboratory manual, Elsevier. | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | |
| 1 | | https://micobenotes.com/fields-of-microbiology/ | | | | | | | | | | | | | | |
| 2 | | https://bio.libretexts.org | | | | | | | | | | | | | | |
| 3 | | https://www.google.com | | | | | | | | | | | | | | |
| 4 | | https://www.sfamjournals.onlinelibrary.wiley.com | | | | | | | | | | | | | | |
| 5 | | https://www.degruyter.com | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | |
| Internal Evaluation | | | Continuous Internal Assessment Test | | | | | | | | | | | 25 Marks | | |
| Assignments | | | | | | | | | | |
| Seminars | | | | | | | | | | |
| Attendance and Class Participation | | | | | | | | | | |
| External Evaluation | | | End Semester Examination | | | | | | | | | | | 75 Marks | | |
|  | | | Total | | | | | | | | | | | 100 Marks | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | |
| Recall (KI) | | | Simple definitions, MCQ, Recall steps, Concept definitions | | | | | | | | | | | | | |
| Understand /  Comprehend  (K2) | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | |
| Application (K3) | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | |
| Analyse (K4) | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | |
| Evaluate (K5) | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | |
| Create (K6) | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

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

ELECTIVE GENERIC /DISCIPLINE SPECIFIC ELECTIVE- VIII- PHARMACEUTICAL MICROBIOLOGY

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | | **Category** | **L** | **T** | **P** | **S** | **Credits** | | **Inst.**  **Hours** | | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE7** | **PHARMACEUTICAL MICROBIOLOGY** | | | ELECTIVE GENERIC /DISCIPLINE SPECIFIC ELECTIVE- VII- | **Y** | **-** | **-** | **-** | **3** | | **5** | | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | | | | |
| CO1 | To provide the knowledge on basics of chemotherapy | | | | | | | | | | | | | | | | |
| CO2 | To learn the assays and testing methods of antibiotics. | | | | | | | | | | | | | | | | |
| CO3 | To gain information about spoilage of pharmaceutical products | | | | | | | | | | | | | | | | |
| CO4 | To provide the knowledge on drug discovery and clinical trials | | | | | | | | | | | | | | | | |
| CO5 | To learn about regulations in pharmaceutical industry | | | | | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing. | | | | | | | | | | | | | 12 | | CO1 | |
| II | Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants. | | | | | | | | | | | | | 10 | | CO2 | |
| III | Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals. | | | | | | | | | | | | | 12 | | CO3 | |
| IV | Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests. | | | | | | | | | | | | | 16 | | CO4 | |
| V | Quality Assurance and Validation:Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control; Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification. | | | | | | | | | | | | | 10 | | CO5 | |
|  | Total | | | | | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | | | | |
| CO1 | Learn the basics of chemotherapy and action of antibiotics | | | | | | | | | PO1,PO10 | | | | | | | |
| CO2 | Carry out the microbiological assay of antibiotics | | | | | | | | | PO7 | | | | | | | |
| CO3 | Analyse Microbiological standardization of Pharmaceuticals ,sterility testing of pharmaceutical productsApplysterilization in pharmaceutical industry | | | | | | | | | PO5,PO8,PO10 | | | | | | | |
| CO4 | Evaluate the process and develop new strategies for rational drug design | | | | | | | | | PO9,PO10 | | | | | | | |
| CO5 | Learn the Regulatory guidelines in pharmaceuticals product. | | | | | | | | | PO3,PO5 | | | | | | | |
| **Text Books** | | | | | | | | | | | | | | | | | |
| 1. | Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher. | | | | | | | | | | | | | | | | |
| 2. | Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford. | | | | | | | | | | | | | | | | |
| 3 | Franklin,DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action.Chapman& Hall. | | | | | | | | | | | | | | | | |
| 4 | Kuntal Das (2019). Pharmaceutical Microbiology, second edition, NiraliPrakashan. | | | | | | | | | | | | | | | | |
| 5 | PriyatamaPowar, Shital Nimbargi, VaijayantiSapre (2020). Pharmaceutical Microbiology, I edition, Technical publications. | | | | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | | | | |
| 1 | Handa, S.S. and Kapoor, V.K. (2022) .Pharamcognosy. 4thEdition.VallabhPrakashanPublishers,New Delhi. | | | | | | | | | | | | | | | | |
| 2 | Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition  NiraliPrakasham Publishers, Pune. | | | | | | | | | | | | | | | | |
| 3 | S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi. | | | | | | | | | | | | | | | | |
| 4 | Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi. | | | | | | | | | | | | | | | | |
| 5 | Garrod, L.P., Lambert, HP. And C’Grady, F. (1973). Antibiotics and Chemotherapy. (eds). Churchill Livingstone. | | | | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | | | | |
| 1 | https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/ | | | | | | | | | | | | | | | | |
| 2 | <https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf> | | | | | | | | | | | | | | | | |
| 3 | <https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html> | | | | | | | | | | | | | | | | |
| 4 | <https://snscourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5> | | | | | | | | | | | | | | | | |
| 5 | https://www.thermofisher.com | | | | | | | | | | | | | | | | |
| **Methods of Evaluation** | | | | | | | | | | | | | | | | | |
| **Internal Evaluation** | | Continuous Internal Assessment Test | | | | | | | | | | 25 Marks | | | | | |
| Assignments | | | | | | | | | |
| Seminars | | | | | | | | | |
| Attendance and Class Participation | | | | | | | | | |
| **External Evaluation** | | End Semester Examination | | | | | | | | | | 75 Marks | | | | | |
|  | | Total | | | | | | | | | | 100 Marks | | | | | |
| **Methods of Assessment** | | | | | | | | | | | | | | | | | |
| **Recall (KI)** | | | Simple definitions, MCQ, Recall steps, Concept definitions | | | | | | | | | | | | | | |
| **Understand /**  **Comprehend**  **(K2)** | | | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | | | | | | | | | | | | | | |
| **Application (K3)** | | | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | | | | | | | | | | | | | | |
| **Analyse (K4)** | | | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | | | | | | | | | | | | | | |
| **Evaluate (K5)** | | | Longer essay/ Evaluation essay, Critique or justify with pros and cons | | | | | | | | | | | | | | |
| **Create (K6)** | | | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | | | | | | | | | | | | | | |

**Mapping with Programme Outcomes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | M |  |  |  |  |  |  |  |  | M |  |
| CO2 |  |  |  |  |  |  | M |  |  |  |  |
| CO3 |  |  |  |  | S |  |  | M |  | M |  |
| CO4 |  |  |  |  |  |  |  |  | L | M |  |
| CO5 |  |  | L |  | M |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | **Subject Name** | | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGDE8** | **ENTREPRENEURSHIP AND BIO-BUSINESS** | | ELECTIVE GENERIC /DISCIPLINE SPECIFIC ELECTIVE- VIII | **Y** | **-** | **-** | **-** | 3 | 5 | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | | |
| CO1 | | Understanding basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development | | | | | | | | | | | | |
| CO2 | | Developing personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business idea. | | | | | | | | | | | | |
| CO3 | | Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures. | | | | | | | | | | | | |
| CO4 | | Explain the central components of successful business strategies in biotechnology, and create a business plan. | | | | | | | | | | | | |
| CO5 | | Understand the various funding resources and develop as Entrepreneur | | | | | | | | | | | | |
| **Unit** | | **Details** | | | | | | | | | **No.of Hours** | | **Course Objectives** | |
| I | | Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale. | | | | | | | | | 12 | | CO1 | |
| II | | Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural waste, Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management. | | | | | | | | | 12 | | CO2 | |
| III | | Entrepreneurship Opportunity in Industrial Biotechnology**:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production- microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein. | | | | | | | | | 12 | | CO3 | |
| IV | | Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics. | | | | | | | | | 12 | | CO4 | |
| V | | Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.,), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Successful start-ups-case study. | | | | | | | | | 12 | | CO5 | |
|  | | Total | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | | On completion of this course, students will; | | | | | | | | | | | | |
| CO1 | | Describe and apply several entrepreneurial ideas and business theories in practical framework. | | | | | | | | | PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PO13, PO14 | | | |
| CO2 | | Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures, evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan. | | | | | | | | | PO2, PO5, PO7, PO8, PO10, PO12, PO14 | | | |
| CO3 | | Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response. | | | | | | | | | PO4, PO6, PO9, PO11 | | | |
| CO4 | | Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits. | | | | | | | | | PO5, PO6, PO9, PO11 | | | |
| CO5 | | Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective, and gain effective team work skills, with an awareness of cultural diversity and social inclusiveness. | | | | | | | | | PO2,PO7, PO8 | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1. | | Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press. | | | | | | | | | | | | |
| 2. | | Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholorly Editions: Atlanta, Georgia. | | | | | | | | | | | | |
| 3. | | Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher. | | | | | | | | | | | | |
| 4. | | Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher. | | | | | | | | | | | | |
| 5. | | Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite. | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | | Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology, 2nd Edition, Sinauer Associates: Sunderland.Mass. | | | | | | | | | | | | |
| 2 | | Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company. | | | | | | | | | | | | |
| 3 | | Charles E. Bamford, Garry D. Bruton (2015). ENTREPRENEURSHIP: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher. | | | | | | | | | | | | |
| 4 | | Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication. | | | | | | | | | | | | |
| 5 | | Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paperwhite. | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | | <https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf> | | | | | | | | | | | | |
| 2 | | https://www.crg.eu/biobusiness-entrepreneurship | | | | | | | | | | | | |
| 3 | | <https://www.entrepreneur.com> | | | | | | | | | | | | |
| 4 | | <https://www.birac.nic.in> | | | | | | | | | | | | |
| 5 | | <https://www.springer.com> | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes**:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C**O/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **CO1** | S | S | S | S | S | S | S | S | S | S | S |
| **CO2** |  | S |  |  | M |  | S | S |  | M |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  |
| **CO4** |  |  |  | S |  | S |  |  | S |  | S |
| **CO5** |  | S |  |  |  |  | S | S |  |  |  |

**PROFESSIONAL COMPETENCY SKILL- MICROBIAL QUALITY CONTROL**

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| **Subject Code** | **Subject Name** | **Category** | **L** | **T** | **P** | **S** | **Credits** | **Inst.**  **Hours** | **Marks** | | | | |
| **CIA** | | **External** | | **Total** |
| **22MBUGPCS** | **MICROBIAL QUALITY CONTROL AND TESTING** | **PROFESSIONAL COMPETENCY SKILL** | **Y** | **-** | **-** | **-** | **2** | **2** | **25** | | **75** | | **100** |
| **Course Objectives** | | | | | | | | | | | | | |
| CO1 | To understand the use of various advanced techniques for application in the field of quality control and quality assurance. | | | | | | | | | | | | |
| CO2 | To cultivate skills involved execution of microbiological techniques and to develop the good laboratory practices. | | | | | | | | | | | | |
| CO3 | To ensure the food safety regulations and its standards. | | | | | | | | | | | | |
| CO4 | To acquire knowledge on laboratory testing, Control & safety process. | | | | | | | | | | | | |
| CO5 | To analyze microbial standards to establish the quality of food products. | | | | | | | | | | | | |
| **Unit** | **Details** | | | | | | | | | **No. of Hours** | | **Course Objectives** | |
| I | Microbial quality control: definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices. | | | | | | | | | 12 | | CO1 | |
| II | Instruments associated in QC & QA**:** Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges, colorimeter/ spectrophotometer, ELISA and storage devices. Methodology of Disinfection, Autoclaving & Incineration. | | | | | | | | | 12 | | CO2 | |
| III | Culture media used in QC and QA**:** Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH.Uses of media.Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. | | | | | | | | | 12 | | CO3 | |
| IV | Determining Microbes in Pharmaceutical Samples**:**  Sterility testing for pharmaceutical products, Bioburden, pyrogen test, inprocess and final process control, safety and sterility test. | | | | | | | | | 12 | | CO4 | |
| V | HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers. | | | | | | | | | 12 | | CO5 | |
|  | Total | | | | | | | | | 60 | |  | |
| **Course Outcomes** | | | | | | | | | | | | | | |
| **Course Outcomes** | On completion of this course, students will; | | | | | | | | | | | | | |
| CO1 | Understand the theoretical assessment of microbial quality methods and its good laboratory practices. | | | | | | | | | PO1, PO5, PO6, PO9, PO10 | | | | |
| CO2 | Describe the microbiological aspects of quality control of food and pharmaceutical products. | | | | | | | | | PO1, PO4, PO5, PO6 | | | | |
| CO3 | Explain the identification of pathogenic microorganisms and good laboratory practices. | | | | | | | | | PO1, PO3, PO5, PO6, PO9 | | | | |
| CO4 | Acquire the knowledge of different sterility test for the pharmaceutical products. | | | | | | | | | PO1, PO4, PO5, PO6 | | | | |
| CO5 | Illustrate the safety concern management and regulations of food and pharmaceutical industry and learn the basic standard methods and procedures for the microbiological analysis of food. | | | | | | | | | PO1,PO3, PO4, PO5, PO6, PO9, PO10 | | | | |
| **Text Books** | | | | | | | | | | | | | | |
| 1 | W.B.Hugo&A.D.Russell. (1998). Pharmaceutical Microbiology.6thEdition. Blackwell scientific Publications. | | | | | | | | | | | | | |
| 2 | Kulkarni A. K. Bewoor V. A. ()Quality Control,Wiley India Pvt. Ltd, | | | | | | | | | | | | | |
| 3 | Chandrakant Kokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication. | | | | | | | | | | | | | |
| 4 | Brown.M.R.W. (2017).Microbiological Quality AssuranceA Guide Towards Relevance and Reproducibility of Inocula,1st Edition. CRC press. | | | | | | | | | | | | | |
| 5 | Dev Raj Rakesh Sharma And V K Joshi (2011).Quality Control For Value Addition In Food Processing, New India Publishing Agency. | | | | | | | | | | | | | |
| **References Books** | | | | | | | | | | | | | | |
| 1 | Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press. | | | | | | | | | | | | | |
| 2 | Konieczka, (2012). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group. | | | | | | | | | | | | | |
| 3 | Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company. | | | | | | | | | | | | | |
| 4 | David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing, Wiley publication. | | | | | | | | | | | | | |
| 5 | Amihud Kramer Bernard A. Twigg (2017). Quality Control For The Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication. | | | | | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | | | |
| 1 | https://www.study.com/microbiology-quality-control-testing-definition-procedures. | | | | | | | | | | | | | |
| 2 | https://www.sigmaaldrich.com | | | | | | | | | | | | | |
| 3 | <https://www.coursera.org> | | | | | | | | | | | | | |
| 4 | <https://www.atcc.org> | | | | | | | | | | | | | |
| 5 | <https://www.fao.org> | | | | | | | | | | | | | |

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| **Methods of Evaluation** | | |
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| Assignments |
| Seminars |
| Attendance and Class Participation |
| **External Evaluation** | End Semester Examination | 75 Marks |
|  | Total | 100 Marks |
| **Methods of Assessment** | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

**Mapping with Programme Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** |
| **CO1** | S |  |  |  | S | S |  |  | S | S |  |
| **CO2** | S |  |  | M | M | M |  |  |  |  |  |
| **CO3** | S |  | M |  | S | S |  |  | M |  |  |
| **CO4** | S |  |  | S | M | M |  |  |  |  |  |
| **CO5** | S |  | S | M | S | S |  |  | S | S |  |

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