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| B.sc.,  microbiology and clinical lab technology |
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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 and Clinical Lab Technology** |
| **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.

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| **Programme Code:** |  |
| **Duration:** | **3 years [UG]** |
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| **Programme Specific Outcomes:** | **PSO1 – Placement:**  To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. PSO 2 - Entrepreneur:To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizationsPSO3 – Research and Development:Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.PSO4 – Contribution to Business World:To produce employable, ethical and innovative professionals to sustain in the dynamic business world.PSO 5 – Contribution to the Society:To contribute to the development of the society by collaborating with stakeholders for mutual benefit |

**Value additions in the Revamped Curriculum:**

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| Semester | Newly introduced Components | Outcome / Benefits |
| I | **Foundation Course**  To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world. | * Instil confidence among students * Create interest for the subject |
| I, II, III, IV | **Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial) | * Industry ready graduates * Skilled human resource * Students are equipped with essential skills to make them employable |
| * Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects |
| * Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc. |
| * Entrepreneurial skill training will provide an opportunity for independent livelihood * Generates self – employment * Create small scale entrepreneurs * Training to girls leads to women empowerment |
| * Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools |
| III, IV, V & VI | Elective papers-  An open choice of topics categorized under Generic and Discipline Centric | * Strengthening the domain knowledge * Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature * Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background * Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective sectors |
| IV | DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research | * Exposure to industry moulds students into solution providers * Generates Industry ready graduates * Employment opportunities enhanced |
| II year Vacation activity | Internship / Industrial Training | * Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens. |
| V Semester | Project with Viva – voce | * Self-learning is enhanced * Application of the concept to real situation is conceived resulting in tangible outcome |
| VI Semester | Introduction of  Professional Competency component | * Curriculum design accommodates all category of learners; ‘Statistics for Advanced Explain’ component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; * ‘Training for Competitive Examinations’ –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc. |
| Extra Credits:  For Advanced Learners / Honors degree | | * To cater to the needs of peer learners / research aspirants |

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| **Skills acquired from the Courses** | Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |

**Credit Distribution for UG Programmes**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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**

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| **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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| **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 | |

PROGRAMME STRUCTURE

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sem** | **Part** | **Course Code** | **Title of the Paper** | **Cr.** | **Hrs.**  **/ Wee k** | **Max. Marks** | | |
| **Int.** | **Ext.** | **Total** |
| I | I | T | Language Tamil | 3 | 6 | 25 | 75 | 100 |
| II | E | English | 3 | 6 | 25 | 75 | 100 |
| II I | CC | Theory–I- **Cell Biology** | 5 | 5 | 25 | 75 | 100 |
| CC | Practical –I- **Lab in Cell**  **Biology** | 5 | 5 | 40 | 60 | 100 |
| Allied | Theory- IA- **Body Fluid**  **Analysis** | 3 | 4 | 25 | 75 | 100 |
| Allied | Practical-IA- **Lab in Body**  **Fluid Analysis** | 2 | 2 | 40 | 60 | 100 |
| IV | SEC -I | Value Education | 2 | 2 | 25 | 75 | 100 |
|  |  |  |  |  |  |  |  |  |
|  |  |  | Total | **23** | **30** | **205** | **495** | **700** |
| II | I | T | Language Tamil | 3 | 6 | 25 | 75 | 100 |
| II | E | English | 3 | 6 | 25 | 75 | 100 |
| II I | CC | Theory–II – **General**  **Microbiology** | 5 | 5 | 25 | 75 | 100 |
| CC | Practical-II – **Lab in General**  **Microbiology** | 5 | 5 | 40 | 60 | 100 |
| Allied | Theory – IB - **Blood Banking**  **Technology** | 3 | 4 | 25 | 75 | 100 |
| Allied | Practical-IB – **Lab in Blood**  **Banking Technology** | 2 | 2 | 40 | 60 | 100 |
| IV | SEC -II | Environmental Studies | 2 | 2 | 25 | 75 | 100 |
|  |  |  |  |  |  |  |  |
|  |  | Total | **23** | **30** | 205 | 495 | **700** |

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| III | I | T | Language Tamil | | 3 | 6 | | 25 | | 75 | | 100 | |
| II | E | English | | 3 | 6 | | 25 | | 75 | | 100 | |
| II I | CC | Theory-III –**Human Anatomy**  **and Haematology** | | 5 | 5 | | 25 | | 75 | | 100 | |
| CC | Theory-IV – **Clinical**  **Biochemistry** | | 5 | 5 | | 25 | | 75 | | 100 | |
| CC | Practical-III – **Lab in**  **Haematology and Clinical Biochemistry** | | 3 | 4 | | 40 | | 60 | | 100 | |
| Allied | Theory – IIA – **Hospital**  **Infection Control Measures** | | 1 | 1 | | 25 | | 75 | | 100 | |
| Allied | Practical-IIA – **Lab in**  **Hospital Infection Control Measures** | | 2 | 2 | | 40 | | 60 | | 100 | |
|  | IV | SEC -III | | Entrepreneurship |  | 1 | | 25 | | 75 | | 100 |
|  |  |  | | **Total** | **22** | **30** | | **255** | | **645** | | **900** |
| IV | I | T | | Tamil | 3 | 6 | | 25 | | 75 | | 100 |
| II | E | | English | 3 | 6 | | 25 | | 75 | | 100 |
| II I | CC | | Theory–V - **Molecular**  **Biology and Microbial Genetics** | 5 | 5 | | 25 | | 75 | | 100 |
| CC | | Theory-VI – **Clinical**  **Parasitology and Mycology** | 5 | 5 | | 25 | | 75 | | 100 |
| CC | | Practical –IV – **Lab in**  **Molecular Biology, Clinical Parasitology and Mycology** | 3 | 3 | | 40 | | 60 | | 100 |
| Allied | | Theory – IIB – **Microbial**  **Biotechnology** | 2 | 2 | | 25 | | 75 | | 100 |
| Allied | | Practical-IIB – **Lab in**  **Microbial Biotechnology** | 2 | 2 | | 40 | | 60 | | 100 |
| IV | SEC -V | | NME- II  1.Adipadai Tamil 2.Advance Tamil  3. Small Business Management / MOOC’S | 2 | 2 | | 25 | | 75 | | 100 |
|  |  | | Total | **25** | **30** | | **230** | | **570** | | **800** |
| V | III | CC | | Theory-VII – **Systematic**  **Bacteriology and Virology** | 4 | | 5 | | 25 | | 75 | 100 |
| CC | | Theory-VIII – **Clinical**  **Immunology** | 4 | | 5 | | 25 | | 75 | 100 |
| CC | | Theory–IX – **Recombinant**  **DNA Technology and Molecular Diagnostics** | 4 | | 5 | | 25 | | 75 | 100 |
| CC | | Theory-X – **Clinical**  **Bioinstrumentation and Diagnostics** | 4 | | 5 | | 25 | | 75 | 100 |
| CC | | Practical-V- **Lab in**  **Bacteriology, Virology and Bioinstrumentation** | 3 | | 4 | | 40 | | 60 | 100 |
| CC | | Practical-VI - **Lab in**  **Clinical Immunology and rDNA Technology** | 3 | | 4 | | 40 | | 60 | 100 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Career development/employability  skills | 2 | 2 |  |  |  | |
|  |  |  | Internship | 2 |  |  |  |  | |
|  |  |  | Total | **26** | **30** | **180** | **420** | **600** | |
| VI | III | DSE |  |  |  | **150** | **250** | **400** | |
| **Or** | | | | | | |
| Theory I – **Basics of**  **Bioinformatics** | 6 | 6 | 25 | 75 | | 100 |
| Theory II – **Food and Dairy**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory III – **Agricultural**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory IV – **Environmental**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Library / Yoga etc |  | 2 |  |  | |  |
| Career development  /employability skills/Field trip | - | 4 | - | - | |  |
|  | 24 | 3  0 | **100** | **300** | | **400** |
| **Or** | | | | | | |
| Project | 6 | 10 | 25 | 75 | | 100 |
| Theory I – **Medical**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory II – **Microbial**  **Physiology and Metabolism** | 6 | 6 | 25 | 75 | | 100 |
| Theory III –**Communicable**  **and Non-Communicable Diseases** | 6 | 6 | 25 | 75 | | 100 |
|  |  | others | Library / Yoga / Career development  /employability skills/Field trip etc |  | 2 |  |  | |  |
| **Total** | | | | **24** | **30** | **100** | **300** | | **400** |
| **Grand Total** | | | | **140** | **--** | **--** | **--** | | **4100** |

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

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

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| **Semester – I** | | | | | | | | |
| **CC/DSE/NME** | | | **Core I** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Cell Biology** | **4** |  |  | **4** | **4** |
| **Objectives** | * Make the students to understand the different aspects to the classification of Prokaryotes and Eukaryotes. * Make the students knowledgeable on the role of cell organelles. * In-depth an on knowledge on the cell cycle and cell signaling. | | | | | | | |
| **Unit –I** | **Cell as a basic unit of living systems:** History of cell biology, cell as basic unit of life, cell theory, protoplasm theory and organismal theory, broad classification of cell types, Bacteria, Archaea (prokaryotic) and eukaryotic cells and their similarities and  differences. | | | | | | | |
| **Unit-II** | **Structure and function of cell organelles:** Structure and functions of cell wall: bacterial cell wall – plant cell wall and fungal cell wall, plasma membrane – exocytosis,  endocytosis, phagocytosis – vesicles and their importance in transport. Cytoskeleton structure – microtubules, microfilaments, intermediate filament. | | | | | | | |
| **Unit III** | **Structure and functions of cell organelles**:- Endoplasmic reticulum (rough endoplasmic reticulum and smooth endoplasmic reticulum), golgi apparatus, lysosomes, microbodies (peroxysomes and glyoxysomes), vacuoles, ribosomes, centriole and basal bodies. **Mitochondria** – organization of respiratory chain, chloroplasts – photophosphorylation, nucleus, nucleolus, nuclear membrane and organization of chromosomes. | | | | | | | |
| **Unit IV** | **Cell cycle: -** Eukaryotic cell cycle and its regulation, Cell division- Mitosis and Meiosis  **Cell death:-** Development of cancer, causes and types, Programmed cell death. **Cell renewal: -** Stem cells Embryonic stem cell, induced pleuripotent stem cells. | | | | | | | |
| **Unit V** | **Cell signaling: - Overview** – types of cell signaling – Signalling molecules and their receptors– signal amplification –– Function of cell surface receptors, Quorum sensing. **Pathways of intra-cellular receptors** – Cyclic AMP pathway, cyclic GMP and MAP  kinase pathway. | | | | | | | |
| **Reference and Textbooks**   1. Alberts, B. Johnson, A. Lewis, J. Raff, M. Roberts K., (2002). Molecular Biology of the Cell, (4th ed), 2. Garland Publishing (Taylor & Francis Group), New York. 3. Lewin, B. (2004). Genes VIII, Pearson Prentice Hall. 4. Harvey Lodish, (2004). Molecular Cell Biology, 5th edition, W.H.Freeman and Company, New York. 5. Geoffrey Cooper M, Robert E. Hausman, The Cell: A Molecular Approach, (4th ed), ASM Press, Washington D.C. & Sinauer Associates, Inc, Massachusetts. 6. Karp, G.Harris, D, (1999). Cell and Molecular Biology – Concepts and Experiments, (2nd ed), John Wiley & Sons, New York. 7. De Roberties, E.D.P. and De Roberties, (1995). Cell and Molecular Biology, (8th ed), Waverly Pvt. Ltd., New Delhi. | | | | | | | | |
| **Outcomes** | | * The students will get depth knowledge in fundamental principles of cellular biology * Able to understand the principles behind cell movement, cell growth, cell division, cell death, and cell signaling. * Aware of the pathways of intracellular receptors. | | | | | | |

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| **Semester –I** | | | | | | | | |
| **CC/DSE/NME** | | | **Core Practical I** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Cell Biology** |  |  |  |  |  |
| **Objectives** | * Improve the student’s knowledge and impress upon them the important aspects of microorganisms * Give practical knowledge and skill in the isolation and handling of microorganisms. * Make acquainted with pure culture techniques and methods of culturing preservation   and maintenance of microorganisms | | | | | | | |
| 1. Principles of sterile techniques and cell propagation 2. Detection of different stages of Mitosis. 3. Detection of different stages of Meiosis. 4. Identification of given plant, animal and bacterial cells and their components by microscopy 5. Staining for different stages of mitosis in *AlliumCepa* (Onion) 6. Examination of polyploidy in Onion root tip by colchicine treatment. 7. Separation of Peripheral Blood Mononuclear Cells from blood 8. Identification of cells by Giemsa staining and Leishman staining. 9. Enumeration of cells by Tryphan blue assay 10. Osmosis and Tonicity | | | | | | | | |
| **Reference and Textbooks**   1. Rajan, S, (2012). Manual for Medical Laboratory Technology, Anjanaa Book House, Chennai. 2. [Kanai](http://www.tatamcgrawhill.com/cgi-bin/same_author.pl?author=Kanai), L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers 3. Rajan S and Selvi Christy R (2012).Experimental procedures in Life Sciences, Anjanaa Book house, Chennai. 4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York, 5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, Churchill Livingstone, London 6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, (16thed), Churchill, Livingstone, London 7. Hardin J, Bertoni G and Kleinsmith LJ. (2010).Becker’s World of the Cell. 8th edition. Pearson. 8. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc. 9. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. LipincottWilliams and Wilkins, Philadelphia. 10. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. | | | | | | | | |
| **Outcomes** | | * The students are be able to identify standard methods for the isolation, identification and culturing of microorganisms. * The students can able to identify the different groups of microorganisms from different habitats. | | | | | | |

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| **Semester – II** | | | | | | | | |
| **CC/DSE/NME** | | | **Core II** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **General Microbiology** |  |  |  |  |  |
| **Objectives** | * Become familiar with the basic concepts of history of Microbiology * Impart knowledge on structural organization and morphology of microbes * Gain the knowledge of microscopy, sterilization and staining concepts | | | | | | | |
| **Unit –I** | **History and Scope of Microbiology:** Definition and scope of microbiology.History- Spontaneous generation, Contribution of Leeuwanhoek, Louis Pasteur, Robert Koch, Edward Jenner, Lazaro Spallanzani, John Tyndall, Joseph Lister, Alexander Fleming and Kary B Mullis. Microbial Kingdoms- Haeckel’s Three Kingdom and Whittaker’s Five Kingdom concept. Bacterial classification (outline) according to Bergey’s manual of systemic  Bacteriology. | | | | | | | |
| **Unit-II** | **General characteristics and Ultra structure of bacteria:** Size, shape and arrangement of bacterial cells, Cell wall of Gram negative, Gram positive bacteria, Capsule composition and function, Cell membrane structure and functions, Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions,  Bacterial endospores. Bacterial Reproduction. | | | | | | | |
| **Unit III** | **Staining techniques, Bacterial Growth and Nutrition:** Types of staining – Principle and procedure –Simple, Differential – Gram, Acid fast, Structural – capsule, endospore. Bacterial Growth curve – Lag Phase, Exponential Phase and decline Phase. Factors influencing and  affecting microbial growth – pH, temperature and light. Nutritional groups of bacteria. | | | | | | | |
| **Unit IV** | **Principles and methods of Sterilization and Types of media:** Physical methods (Heat, Filtration and radiation) and Chemical methods. Chemotherapy – antibiotics – source – classification – mode of action – antimicrobial resistance. Types of growth media (natural,  synthetic, complex, enriched and selective media). | | | | | | | |
| **Unit V** | **Microscope Principles and applications:** Principles of microscopy, Simple, compound light microscopy– construction and function of parts, principle, construction, and applications of Dark field, Phase contrast and Fluorescence microscopes. Electron microscopy – TEM and  SEM – principle, construction, and uses. | | | | | | | |
| **Reference and Textbooks**   1. Prescott, Joanne Willey, Linda Sherwood, & Christopher,J.W., (2017). *Microbiology* (10th ed). New York: McGraw Hill. 2. Tortora G.J., Funke, B.R.and Case, C.L. (2009). *Microbiology* (9th ed). Noida: Dorling Kindersely (India) Pvt. Ltd. 3. Pelczar, M.J., Schan, E.C. and Kreig, N.R. (2010). *Microbiology: An Application Based Approach*. Tata McGraw Hill Education Private Limited. 4. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). *Biology Microorganisms* (12th ed). New Jerry: Prentice Hall. 5. Atlas, R.A., & Bartha, R., (2000). *Microbial Ecology, Fundamentals and Application*. New York: Benjamin Cummings. 6. Stanier R.Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi. | | | | | | | | |
| **Outcomes** | | * Can clearly understand history and classification of bacteria * The students are getting depth knowledge of various microscopes and their application. * Able to understand various (physical and chemical) methods of control of microorganisms * The students are aware of the structure of bacterial cells and also the staining methods used to identify the bacteria. | | | | | | |

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| **Semester –II** | | | | | | | | |
| **CC/DSE/NME** | | | **Core Practical II** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in General Microbiology** |  |  |  |  |  |
| **Objectives** | * Improve the student’s knowledge and impress upon them the important aspects of microorganisms * Practical knowledge and skill in the isolation and handling of microorganisms. * Make acquainted with pure culture techniques and methods of culturing preservation and maintenance of microorganisms | | | | | | | |
| 1. Safety measures and rules of conduct to be followed in a microbiological laboratory. 2. Cleaning of Glasswares and media Preparation; Bacterial Culture Characteristics & identification 3. Handling and Care of Microbiological Instruments. Preparation & dispensing of Culture media 4. Enumeration of microbes by serial dilution method 5. Pure culture techniques- Spread plate, streak plate and pours plate technique. 6. Staining Techniques – Gram’s staining, Acid-fast staining, Endospore Staining and Capsule staining 7. Test for Motility of bacteria - Hanging drop technique 8. Identification of bacteria by biochemical reactions. 9. Identification of bacteria using selective media. 10.Micrometry – Microscopic measurements of Bacterial cell | | | | | | | | |
| **Reference and Textbooks**   1. Rajan S, Manual for Medical Laboratory Technology (2012), Anjanaa Book House, Chennai. 2. [Kanai](http://www.tatamcgrawhill.com/cgi-bin/same_author.pl?author=Kanai), L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers 3. Rajan S and Selvi Christy R (2012). Experimental procedures in Life Sciences, Anjanaa Book house, Chennai. 4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York, 5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, Churchill Livingstone, London 6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, (16thed), Churchill, Livingstone, London 7. Hardin J, Bertoni G and Kleinsmith LJ. (2010).Becker’s World of the Cell. 8th edition. Pearson. 8. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc. 9. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. LipincottWilliams and Wilkins, Philadelphia. 10. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition.   ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. | | | | | | | | |
| **Outcomes** | | * The students are be able to identify standard methods for the isolation, identification and culturing of microorganisms. * The students can able to identify the different groups of microorganisms from different habitats. | | | | | | |

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| **Semester - III** | | | | | | | | |
| **CC/DSE/NME** | | | **Core III** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Human Anatomy and Haematology** |  |  |  |  |  |
| **Objectives** | * Understand the cellular and tissue level organization in the human body * Provide an-in depth knowledge about the structure and functions of the internal organs. * Understand the human blood and its disorders based on an up-to-date knowledge. * Provide in depth knowledge about the pathology and pathophysiology of haematologicaldisorders. | | | | | | | |
| **Unit –I** | **Cellular level of organization: -** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, **Forms of**  **intracellular signaling:** a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine. | | | | | | | |
| **Unit-II** | **Tissue level of organization:-** Classification of tissues, structure, location and functions of epithelial, muscular, nervous and connective tissues. Structure, organization and functions of **Integumentary system (**skin), **Respiratory System, Digestive System, Circulatory System and Skeletal system: -** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system.  Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction. | | | | | | | |
| **Unit III** | **Endocrine system:-** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. **Nervous system:-** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, receptors, synapse, neurotransmitters. **Central nervous system**: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity. **Peripheral nervous system**: Classification of peripheral nervous system: Structure and  functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. | | | | | | | |
| **Unit IV** | **Composition of Blood and its functions:-** Definition**,** Plasma, Red blood cells (erythrocytes), white blood cells (Leucocytes) and platelets. **Plasma proteins** – Albumin, globulin and fibrinogen**. Common anticoagulants -** composition, amount and mechanism of action**.Haemopoietic system of the body-** Leukopoiesis, erythropoiesis and thrombopoiesis**. Physiology and anatomy of bone marrow. Haematopoiesis-** Definition, hematopoietic stem cell lineages and growth factors, regulation of hematopoiesis and programmed cell death. Components for control of hematopoiesis-  cytokines and growth factors. **Haemostasis: -** Definition, mechanism of preventing blood loss- Vasoconstrictive phase, platelet phase and Coagulation phase. | | | | | | | |
| **Unit V** | **Blood clotting factors: -** plasma coagulating factors and platelet coagulating factors**-** Extrinsic and intrinsicpathways – **Blood clotting inhibitors:-** anticoagulant, heparin and antithrombin, fibrinolysis by plasmin. **Blood Disorder: -** blood disorders that cause a decrease in blood components - [anemia](https://www.medicalnewstoday.com/articles/158800.php), leucopenia and thrombocytopenia. Blood disorders that cause an increase in blood components- erythrocytosis, leukocytosis and  thrombocythemia or thrombocytosis. **Types of white blood cell disorders: -** lymphoma, leukemia and myeloma**.** | | | | | | | |

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| **Reference and Textbooks**   1. Pal, G. K., & Pravati, P., (2010). Text Book of Practical Physiology, (3rd edn.).Universities Press (India)Private Limited. 2. Pal, G. K., Pal, P., Nanda. N. & Amudharaj. D. (2015). Atlas of Human Anatomy, (1st ed.). Jordi Vigue.Chambarlen Press. 3. Amitrano, R., & Tortora, G. (2012). Update: anatomy & physiology laboratory manual. Cengage Learning 4. Tortora, G. J., & Derrickson, B. (2014). Anatomy and Physiology-WorkBook. CBS publication 5. Kanai L. Mukherjee, (1996). Medical Laboratory Technology, Volume-I. Tata Mc Graw Hill, New Delhi. Sabitri sanyal, (2000). Clinical pathology, B. I. Churchill Livingstone ( p) Ltd, New Delhi. 6. Judith Ann Lewis, (1994). Illustrated guide to diagnostic tests – students version, Springhouse corporation. Praful. B. Godkar, et al., (1996). Extbook of Medical Laboratory Technology, 2nd edition, Bhalani publication House. 7. Fischbach F.T., Dunning, M.B, (2002). A Manuel of Laboratory and Diagnostic   Tests. Lippinocott Williams and Wilkins, Baltimore. | |
| **Outcomes** | After completion of the course, students are expected to be able to:   * Identify the structure and functions of internal organs. * Acquire knowledge on cellular level and tissue level organizations. * Identify the structure and functions of the blood cell * Correlate hematological findings with those generated in other areas of the clinicallaboratory |

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| **Semester – III** | | | | | | | | |
| **CC/DSE/NME** | | | **Core IV** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Clinical Biochemistry** |  |  |  |  |  |
| **Objectives** | * Learn the structure and classification of Biomolecules. * Gain knowledge on clinically important enzymes and diagnostic tests. | | | | | | | |
| **Unit –I** | **Clinical sample Collection and preservation -** Blood, Plasma, Serum, CSF, Urine and feces. Acid base balance. Buffer systems and Electrolytes. Clinically  important enzymes. | | | | | | | |
| **Unit-II** | **Carbohydrates:** Definition and applications- Monosaccharides, Disaccharides,  Oligosaccharides and polysaccharides. Disorders of carbohydrate metabolism- Hypo and hyperglycimea, Diabetes Mellitus- Types, Clinical features and metabolic changes. Glucose tolerance test (GTT) importance and principle and  techniques of GTT. | | | | | | | |
| **Unit III** | **Lipids:** Definition, Classification and properties of lipids. Disorders of lipid metabolism- Lipidosis and Xanthomatosis. Atherosclerosis- aetiology, clinical  features and complication | | | | | | | |
| **Unit IV** | **Aminoacids and Proteins: Aminoacids** – classifications, structure and  properties. Protein- Classification and structures (primary, secondary, tertiary & quaternary). Disorders in protein metabolism- Introduction, aetiology and clinical features of phenylketonuria and cystinuria. Clinical Significance of non-protein  nitrogen- urea, uric acid & creatinine. | | | | | | | |
| **Unit V** | **Vitamins and Function Tests:** Deficiency disorders of vitamins. Function Test:  Liver function test (Serum - Bilirubin SGPT, SGOT & Alakaline phosphatase and urine analysis – Bile salts, bile pigments and urobilinogen). Kidney function test (Urea, Uric acid, Creatinine). Pediatric Clinical chemistry: Diseases of new born and their complications. | | | | | | | |
| **Reference and Textbooks**   1. Zubay G.L. (1998). Biochemistry, W.M.C.Brown Publishers, New York. 2. Deb A.C, (2002). Fundamentals of biochemistry, Books and allied (P) Ltd. 3. Satyanarayanan U, (2002). Essentials of biochemistry, Books and allied (P) Ltd. 4. Campbell, P.N and A.D .Smith, (2010). Biochemistry Illustrated, 4th ed, Churchill Livingstone. 5. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper’s 6. Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill 7. Lehninger Principles of Biochemistry 4th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company. | | | | | | | | |
| **Outcomes** | | * The students are be able to understand the basic fundamentals of Bio   molecules   * The students can able to identify the different groups of enzymes from different habitats and their clinical importance. | | | | | | |

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| **Semester-III** | | | | | | | | |
| **CC/DSE/NME** | | | **Core Practical III** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Human Anatomy, Haematology and Clinical Biochemistry** |  |  |  |  |  |
| **Objectives** | * Equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods. * Provide hands-on training for the collection of blood sample and staining methods * Provide in depth knowledge about the estimation of ESR and Hb. | | | | | | | |
| 1. Collection and preparation of blood for separation of plasma & serum 2. Determination of bleeding time and clotting time 3. Preparation and staining of blood smears 4. Differential counting of blood cells in normal and pathological smears 5. Estimation of erythrocyte sedimentation rate 6. Testing blood by anti-globulin test 7. Estimation of haemoglobin and blood glucose 8. Test for urine sugar (Benedict’s method) 9. Estimation of blood glucose, cholesterol and iron. 10. Kidney function tests: Quantitative Determination of Urine Creatinine 11.Liver function tests: blood SGOT, SGPT & bilirubin   12.Identification of human models | | | | | | | | |
| **Reference and Textbooks**   1. Rajan, S (2012). Manual for Medical Laboratory Technology, Anjanaa Book House, Chennai. 2. [Kanai](http://www.tatamcgrawhill.com/cgi-bin/same_author.pl?author=Kanai), L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers 3. Rajan S and Selvi Christy R, (2012). Experimental procedures in Life Sciences, Anjanaa Book house, Chennai. 4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York, 5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, Churchill Livingstone, London 6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16th edition, Churchill, Livingstone, London 7. Lisa Anne Shimeld, Delmar, (1999). Essential of Diagnostic Microbiology, New York. 8. Judith Ann Lewis, (1994). Illustrated guide to diagnostic tests – students version, Springhouse corporation. Praful. B. Godkar, et al., (1996). Extbook of Medical Laboratory Technology, 2nd edition, Bhalani publication House. 9. Fischbach F.T., Dunning, M.B, (2002). A Manuel of Laboratory and Diagnostic Tests. Lippinocott Williams and Wilkins, Baltimore. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Collect the blood sample from patients * Identify the sugar level in the urine, blood glucose, cholesterol, and iron * Perform staining techniques and calculate the levels of uric acid and creatinine * Isolate and identify the peripheral cells. | | | | | | |

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| **Semester – IV** | | | | | | | | |
| **CC/DSE/NME** | | | **Core V** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Molecular Biology and Microbial Genetics** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Expand the knowledge on structure and functions of genetic material * Obtain depth knowledge of genome organization, transcription, and translation process in Prokaryotes. * Understand the principles of gene regulation and oncogenes | | | | | | | |
| **Unit -I** | **Gene**: Structure and function. DNA as a genetic material (Griffth, Avery and Mcleoid, Hershey and Chase experiments). **Genetic code:** Definition, deciphering of codons.  **DNA**: Structure (Watson and Crick model) and forms of DNA. **RNA:** Structure, types and Function. | | | | | | | |
| **Unit-II** | **Mutation:** Definition and Types of mutations: Spontaneous and induced, Base pair changes, Frameshift, Deletion, Inversion, Tandem duplication, Insertion. **Mutagens:** Mode of action of Physical and chemical mutagens. **DNA damage and repair** (Direct, Excision and recombination repair). **Gene transfer among bacteria** –  Transformation , Transduction and Conjugation | | | | | | | |
| **Unit III** | **DNA replication**: Types of replication (Semiconservative replication, experimental evidence for semi conservative replication), Enzymes and proteins involved in DNA  replication. Mechanism of DNA replication. Inhibitors of DNA replication. Various models of DNA replication: Rolling circle, D- loop (mitochondrial), Ө (theta) | | | | | | | |
| **Unit IV** | **Transcription:** Initiation, Elongation, Termination; Differences between prokaryotic and eukaryotic transcription process. Inhibitors of transcription, Reverse transcription,  RNA Polymerase. **Translation:** ribosomal cycle including phenomena of initiation, elongation, termination; Post translational modifications. | | | | | | | |
| **Unit V** | **Regulation of gene in prokaryotes** - Operon concept- lac, trp, arabinose operons, **Functional units in gene**-promoters, repressors, operator, enhancer, introns and exons. **Oncogenes**: Activation of oncogenes. Oncogenic proteins - protein kinases, growth  factors, ras protein. | | | | | | | |
| **Reference and Textbooks**:-   1. Freifelder, D. (1997). *Essentials of Molecular Biology*. Narosa Publishing House, New Delhi. 2. Glick, B.P. and Pasternack, J. (1998). *Molecular Biotechnology*, ASM Press, Washington D.C., USA. 3. Freifelder, D. (1990). *Microbial Genetics.* Narosa Publishing House, New Delhi. 4. Glazer, A.N. and Nikaido, H. (1995). *Microbial Biotechnology – Fundamentals of Applied Microbiology*, W.H. Freeman and company, New York. 5. Old, R.W. and Primrose, S.B. (1994) *Principles of Gene Manipulation*, Blackwell Science Publication, New York. 6. Verma, P.S. and Agarwal, V.K. (2004). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand & Co. Ltd., New Delhi. 7. Jeyanthi, G.P. (2009). *Molecular Biology*, MJP Publishers, Chennai. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Able to understand the function of genes and their regulation * Understand the level of gene expressions * Acquire depth knowledge on the activation of oncogenes. | | | | | | |

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| **Semester – IV** | | | | | | | | |
| **CC/DSE/NME** | | | **Core VI** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Clinical Parasitology and Mycology** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Obtain the knowledge on parasitic infections and their diagnostic techniques. * Know about the structure and functions of fungi and the action of fungal toxins * Understand the characteristics of helminthes and nematodes | | | | | | | |
| **Unit -I** | Introduction and definitions, common pathogenic effects of human parasites - host parasite relationship. General diagnostic procedures for parasitic infections (direct methods and indirect methods). Immunology of parasitic infections, and  Prophylaxis. | | | | | | | |
| **Unit-II** | Protozoology: General characters, morphology, life cycle, epidemiology, pathogenesis - clinical sign, and control measures of amoebae (*Entamoeba histolytica),* Flagellates (Haemoflagellates-I – Leishmania, Haemoflagellates-II –  Trypanosomes), Sporozoites (Plasmodium,) and ciliates (Balantidium). | | | | | | | |
| **Unit III** | Medical Mycology: General properties structure and classification of fungi, structure and applications. Mycotic infections such as superficial mycosis, cutaneous mycosis, subcutaneous mycosis, systemic mycosis (dimorphic, endemic  mycosis). | | | | | | | |
| **Unit IV** | Actinomycetes infections, hypersensitivity to fungi, mycotoxins, and antifungal  chemotherapy. Lab diagnosis and treatment of fungal infections. | | | | | | | |
| **Unit V** | Helminthology and Nematodology: General characters, morphology, life cycle, epidemiology, pathogenesis - clinical sign, and control measures of Platyhelminthes (flat warm- *Taenia solium*, trematode), Nemathelminthes (round  worm- *Ascaris lumbricoides*,). Nematodes (*Wuchereria bancrofti*,). | | | | | | | |
| **Reference and Textbooks**   1. Cook GC, (1996). Manson’s Tropical Diseases, 20th edition, WB Saunders. 2. Chiodini PL, (2000). Atlas of Medical Helminthology and Protozoology – 4th Edition, Churchill Livingstone, London. 3. Chatterjee, K.D, (1890). Parasitology, 12 Edition, Chatterjee Medical Publishers, Calcutta 4. Murray, Patrick R. Baron. Jorgensen. Pfaller. Yolken, Robert H. (2003). Manual of clinical microbiology, ASM Press, Washington. 5. A.Ballows et al., (1998). Laboratory diagnosis of infectious diseases, Volume 1, Springer-Vertlag, New York. | | | | | | | | |
| **Outcomes** | | * Able to understand the effects of human parasites and their diagnostic methods. * Able to prevent the parasitic and helminthic infections. * Acquire depth knowledge on the role of mycotoxins and other fungal toxins. | | | | | | |

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| **Semester – IV** | | | | | | | | |
| **CC/DSE/NME** | | | **Core Practical VI** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Molecular Biology,**  **Microbial Genetics, Clinical Parasitology and Mycology** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Know to isolate genomic and plasmid DNA from bacteria * Determine the ability of microorganisms to produce mutants. * Become familiar with gradient plate method for isolating antibiotic resistant mutants. * Provide knowledge to identify fungi isolated from clinical specimens | | | | | | | |
|  | 1. Isolation of Genomic DNA from bacteria 2. Isolation of plasmid DNA from bacteria 3. Characterization of plasmid DNA by agarose gel electrophoresis 4. Restriction digestion of DNA 5. Isolation of UV induced mutants of *E. coli* 6. Isolation of mutants by spontaneous mutation – Gradient plate technique 7. Isolation of Auxotrophic Antibiotic Resistant mutant by Induced mutagenesis in Bacteria by Replica plating technique 8. Microscopic examination of stool specimens for ova & parasites 9. Dip stick test for Malaria 10. Isolation and identification of common pathogenic fungi from clinical specimens | | | | | | | |
| **Reference and Textbooks**:-   1. De Robertis EDP and De Robertis EMF (2006) *Cell and Molecular Biology* (8thed.)., Lippincott Williams and Wilkins, Philadelphia 2. Karp G (2010) *Cell and Molecular Biology: Concepts and Experiments* (6thed.)., John Wiley & Sons.Inc. 3. Sambrook J and Russell DW. (2001). *Molecular Cloning: A Laboratory Manual*   (4thed.).,Cold Spring Harbour Laboratory press.   1. Krebs J, Goldstein E, Kilpatrick S (2013). *Lewin’s Essential Genes* (3rded.)., Jones and Bartlett Learning 2. Gardner EJ, Simmons MJ, Snustad DP (2008). *Principles of Genetics*. (8thed.)., Wiley- India 3. A.Ballows et al., (1998). Laboratory diagnosis of infectious diseases, Volume 1, Springer-Vertlag, New York. | | | | | | | | |
| **Outcomes** | | * Able to perform isolation of nucleic acids and its confirmation by gel   electrophoresis   * Understand the principles of inducing mutation * Students will be familiar with the identification of pathogenic organism from clinical samples. | | | | | | |

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| **Semester V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core VII** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Systemic Bacteriology and virology** |  |  |  |  |  |
| **Objectives** | * Study about the basic principles and application relevance of clinical disease. * Learn the biology of bacteria and viruses related with infectious diseases | | | | | | | |
| **Unit –I** | **General characteristics, epidemiology, pathogenicity, Laboratory diagnosis and treatment of diseases caused by Gram positive bacteria**- *Staphylococcus aureus, Streptococcus pyogenes, Corynebacterium diphtheria.* **Gram negative bacteria***: - E.coli, Shigella dysenteriae,, Neisseria gonorrhoea* and *Pseudomonas aeruginosa,.* | | | | | | | |
| **Unit-II** | **General characteristics, Epidemiology, Pathogenicity, Laboratory diagnosis and Treatment of diseases caused by** *Clostridium sp, Klebsiella, Proteus, Salmonella, Haemophilus influenzae,* and*.* Acid fast bacteria- *Mycobacterium leprae and M. tuberculae* | | | | | | | |
| **Unit III** | **General characteristics, Epidemiology, Pathogenicity, Laboratory diagnosis and treatment of diseases caused by Spirochetes** – *Borrelia burgdorferi and Leptospira*  *mayottensis, Rickettsiae prowazekii* and *Chlamydiae trachomatis.* | | | | | | | |
| **Unit IV** | **Virology:** Viral architecture- Capsid, viral genome and envelope. Baltimore Virus  classification. **Life cycle of virus**: Lytic and lysogenic cycle of lambda phage; structure and Life cycle of TMV; Structure and life cycle of T4 phage. **Viral diseases** :- Causative agent, symptoms, pathogenesis, treatment and prevention of Polio, rabbies, yellow fever, mumps, influenza, measles, encephalitis, hepatitis and AIDS. | | | | | | | |
| **Unit V** | **Cultivation and Diagnosis of viruses:** Tissue culture techniques, embryonated egg,  chick embryo fibroblast, animal inoculation, CPE, inclusion bodies. Visualization and enumeration of virus particles:- **Measurement of infectious units**: Plaque assay, Fluorescent focus assay, Infectious center assay, Transformation assay, Endpoint  dilution assay.Measurement of virus particles and their components by haemagglutination. | | | | | | | |
| **Reference and Textbooks**   1. Jawetz and Melnick, (2004). Review of Medical Microbiology, Lange, New York 2. Morag C Timbury (2002). Notes on Medical Microbiology and Immunology, 3rd edition, Churchill Livingstone, London. 3. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16th edition, 4. Churchill Livingstone, London 5. Benjamin A. Pierce (2008), “Genetics a conceptual approach”, 3rd ed., W.H.Freeman and company. 6. Edward Arnold (2000) Principles of Virology. | | | | | | | | |
| **Outcomes** | | After completion of the course students are expected to be able to:   * Acquire information about the concepts of systematic bacteriology and gain knowledge on medically important micro-organisms. * Attain knowledge of morphology, cultural characteristics, biochemical tests, epidemiology, laboratory diagnosis etc of pathogenic organisms. * Understand the concepts involved in the cultivation and diagnosis of viruses. | | | | | | |

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| **Semester –V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core VIII** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | | **MBT09** | **Clinical Immunology** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Provide knowledge on the human immune system and immune response. * Understand the mechanism of antigen- antibody interaction * Inculcate recent clinical immunodiagnostic methods and monoclonal antibodies production for treating most of the human diseases. | | | | | | | |
| **Unit -I** | **Introduction to Immune System: -** History and scope of Immunology. Microflora of normal human body. **Lymphoid organs: -** Primary and Secondary lymphoid organs. **Immune Cells -** Lymphoid cells (B-lymphocytes, T-lymphocytes and Null cells), Mononuclear cells (Phagocytic cells and their killing mechanisms), granulocytic cells  (neutrophils, eosinophils and basophils), mast cells and dendritic cells. | | | | | | | |
| **Unit-II** | **Antigen: -** Types and properties, haptens, adjuvants, antigenicity and immunogenicity. **Immunity: -**Types of immunity- Innate immunity and Acquired immunity, immunization. **Immune response**-Humoral and cell mediated immunity and their interaction. **MHC: -** properties, class I and class II. Antigen processing and  presentation, | | | | | | | |
| **Unit III** | **Immunoglobulins: -** Structure, types, properties and biological functions. **Antigen- Antibody interactions: -** Precipitation, agglutination and complement fixation.  **Hybridoma Technology: -** monoclonal antibody production. **Vaccines: -** types and principles in vaccine development**-** DNA vaccines, subunit vaccines- Recombinant  vaccines. | | | | | | | |
| **Unit IV** | **Immunity to infection: -** Hypersensitivity reactions:- causes, mechanism and types of  hypersensitivity reactions. **Transplantation** – Immunologic response graft rejection mechanism and prevention of graft rejection. | | | | | | | |
| **Unit V** | **Immunochemical Techniques:- Immunodiffusion**- Radial and ouchterlony double  immunodiffusion, Immuno-electrophoresis, **Immunofluorescence:**- principle, types, uses and limitations. Principle, technique and applications of RIA and ELISA. | | | | | | | |
| **Reference and Textbooks**:   1. Emily P. Wen, Ronald Ellis and Narahari S. Pujar, (2014). “Vaccine Development and Manufacturing” (1st ed), Wiley. 2. Judith A. Owen, Jenni Punt, Sharon A. Stranford (2013). *Kuby Immunology*. (7th ed). W. H. Freeman and Company. 3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt (2017). *Roitt’s Essential Immunology*, (13th ed). John Wiley & Sons, Ltd. 4. Abul, K. Abbas Andrew H. H. Lichtman& Shiv Pillai. (2015). Basic Immunology, Functions and Disorders of the Immune System (5th ed). Elsevier. 5. Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew and Cornelia M. Weyand, (2013). “Clinical Immunology-Principles and Practice” (5th ed) Elsevier. 6. Joseph, A. Bellanti. (2016). Immunology IV: Clinical Applications in Health and Disease. Washington, DC: Georgetown University School of Medicine. | | | | | | | | |
| **Outcomes** | | * The students after completing the course would be aware of structure and functions of immune system. * Aware of immunity to various pathogens * Able to understand the concepts and mechanism behind antigen-antibody interactions, hypersensivity reactions and immunochemical reactions. | | | | | | |

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| **Semester – V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core IX** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Clinical Bioinstrumentation and**  **Diagnostics** |  |  |  |  |  |
| **Objectives** | To impart knowledge on   1. Fundamentals of medical instruments based on physiological parameter and biological system 2. Concepts of ECG and EEG 3. Various medical instruments for biomedical applications. | | | | | | | |
| **Unit –I** | **Fundamental of medical instrumentation:** Sources of biomedical Signals: Generalized medical instrumentation block diagram. **Classification of medical instruments based on different principles**: Based on application (diagnostic, therapeutic, Imaging, analytical), Based on physiological parameter and bio-potential, Based on Biological system, Based on different departments in the hospital. | | | | | | | |
| **Unit-II** | **Electrocardiograph**: ECG - Block diagram, working principle; **Electroencephalograph** - EEG  - Block diagram, working principle; **Electromyograph** - EMG -Block diagram, working principle. Techniques of heart rate measurement: Average heart rate meter,Instantaneous heart rate meter; Measurement of pulse rate; Blood Pressure measurement - Direct method & Indirect method (Sphygmomanometer), Manual & automatic BP Instrument; Measurement of respiration  rate. | | | | | | | |
| **Unit III** | **Pneumography** : Impedance pneumography - Apnoea monitor. **Oxygen Saturation measurement** (Oxymetry) - Ear oxymeter &Pulse oxymeter. Spirogram: Lung volumes and capacities (Respiratory volumes), Spirometry -Basics Spirometer, Wedge Spirometer, Ultrasonic Spirometer. Audiometers: Hearing transducers, Types of audiometers, Hearing aid -  Conventional & Digital | | | | | | | |
| **Unit IV** | Spectroscopy – Basic principles, Instrumentation and application of Visible, ultraviolet (UV) and Infra red (IR). Centrifugation – Basic Principle of Centrifugation, Types of centrifuge and rotors.  Instrumentation of Ultracentrifuge (Preparative, Analytical) and Rate-Zonal centrifugation. | | | | | | | |
| **Unit V** | Chromatography: Basic principles, Instrumentation and application of Paper Chromatography, Adsorption Chromatography, TLC, GC, Ion Exchange Chromatography, Gel Chromatography,  HPLC, Affinity Chromatography. | | | | | | | |
| **Reference and Textbooks:-**   1. Khandpur. R. S., (2004). *Handbook of Biomedical Instrumentation*, Prentice Hall of India, New DelhiCromwell, (2007) *Biomedical Instrumentation and Measurements*, Prentice Hall of India, New Delh,. 2. Arthur C. Guyton( 2012): *Textbook of Medical Physiology*, Prism Books (Pvt) Ltd &W.B.Saunders Company,12th edition, 3. Joseph J. Carr and John M. Brown (2004), *Introduction to Biomedical Equipment Technology*,PearsonEducation India, Delhi,. 4. Jacobson B and Webster J G (1999) *Medical and Clinical Engineering* – Prentice Hall of India New Delhi. John. G. Webster. (2011).*Medical Instrumentation, Application and Design*, Fourth   Edition. Wiley &sons, Inc, New York. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Identify the need of understanding human anatomy and physiology system * Select the suitable acquisition method for analysing biomedical signal and vital parameter measurement. * Apply the knowledge of biomedical instruments to practical applications * Categorize the parameter monitoring techniques based on the application and relevance. | | | | | | |

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| **Semester –V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core X** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Recombinant DNA Technology and Molecular Diagnostics** |  |  |  |  |  |
| **Objectives** | * Endow with knowledge on the role of enzymes in rDNA technology. * Know the gene cloning strategies and construction of DNA libraries * Make acquainted with the synthesis of recombinant products and molecular diagnostic methods * Understand the concepts of polymerase chain reaction in diagnostics. | | | | | | | |
| **Unit -I** | **Introduction to rDNA technology: -** History of rDNA technology. **Tools used in rDNA technology:- Enzymes : -** Ribonuclease-H (RNase-H), Klenow enzymes or klenow Fragment, SI Nuclease, Taq DNA Polymearse, Restriction Endonucleases, Terminal Nucleotidyl Transferase, Alkaline Phosphatase, Polynucleotide Kinase, DNA ligase, T4 DNA ligase and  Methyl transferase. **Ligation**: - definition and process. **Coupling Tools** – Linkers and Adaptors. | | | | | | | |
| **Unit-II** | **Gene cloning: -** Strategies in gene cloning. **Plasmids –** Introduction and classification**. Gene cloning vectors: -** pBR322, pUC, ColE1 plasmid**.** Cosmids and phagemid as vectors**.** Shuttle vectors, Expression vectors. **Application and limitations of vectors**. | | | | | | | |
| **Unit III** | **Direct Gene transfer techniques: -** Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication and Liposome fusion. *Agrobacterium* mediated gene transfer. **Selection of recombinant Bacteria: -** Direct selection, Insertional inactivation, Blue-white colony selection and colony hybridization. **Genetically Engineered Microorganisms (GEMOs)**. **Production of Healthcare products from GEMOs**-Insulin, Human growth  hormone, Interferons, Blood products and Vaccines. | | | | | | | |
| **Unit IV** | Polymerase Chain Reaction (PCR): History, definition, types and applications. **DNA sequencing: -** Maxam-Gilbert’s and Sanger’s method, Automated sequencing. **Construction**  **of DNA libraries:** Genomic and cDNA libraries: Preparation and uses. Screening of libraries by colony hybridization and colony PCR. Chromosome walking and jumping**.** | | | | | | | |
| **Unit V** | **Molecular diagnostic methods**: RAPD, RFLP techniques, DNA Finger Printing and DNA Foot Printing techniques, Fluorescence In-Situ Hybridization (FISH), Molecular beacons and Real Time PCR. | | | | | | | |
| **Reference and Textbooks**:-   1. Brown TA. (2006). *Gene Cloning and DNA Analysis*. (5th ed). Blackwell Publishing, Oxford, U.K 2. James D. Watson, Micheal Gilman, Mark Zoller, 2001. Recombinant DNA (2nd ed). W.H. Freeman and Company, New York. 3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, (7th ed). Blackwell Publishing, Oxford, U.K. 4. Dubey, R.C. 2001. A Text Book of Biotechnology .S. Chand & Company Ltd, (1st ed). Ramnagar, New Delhi 5. Sambrook J, Fritsch EF and Maniatis T. (2001). *Molecular Cloning-A Laboratory Manual*. (3rd ed). Cold Spring Harbor Laboratory Press. 6. Verma, P. S., & Agrawal, V. K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution & Ecology (1st ed.). S .Chand and company Ltd. 7. Satyanarayana. U, (2008), Biotechnology. Books and Allied (p) Ltd | | | | | | | | |
| **Outcomes** | | * The students are be able to understand the concepts and methods in rDNA technology * Enable the students to know about cloning vectors. * Acquire knowledge on the construction of DNA libraries and DNA sequencing and an applications of rDNA technology * The students are being able to diagnose the genetic diversity and gene pattern by molecular methods. | | | | | | |

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| **Semester-V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core Practical V** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Bacteriology, Virology, Clinical Bioinstrumentation**  **and Diagnostics** |  |  |  |  |  |
| **Objectives** | * Familiarize with microbiological techniques applied in the clinical laboratories * Perform the basic techniques to identify the antibiotic sensitivity * Understand about effect of environmental condition on microbes | | | | | | | |
| 1. **Collection, coding and transport of clinical specimens for microbiological Examinations** 2. **Study of bacterial flora of skin by swab method** 3. Preparation of media for culturing autotrophic and heterotrophic microorganisms – algal medium, mineral salts medium , nutrient agar medium, MacConkey agar and Blood agar. 4. Biochemical tests: IMViC, TSI, Urease, Catalase, Oxidase, Hydrogen sulphide, Starch hydrolysis, coagulase, nitrate reduction tests and sugar fermentation test. 5. **Isolation and identification of upper respiratory tract bacterial pathogen – *Streptococcus pyogenes, Staphylococcus aureus, Salmonella*, *Shigella, Klebsiella, E.coli, Pseudomonas, Vibrio.*** 6. **Isolation and identification of clinically important yeast and molds – *Candida albicans*, *Cryptococcus neoformans*, *Fusarium* spp. and *Aspergillus* spp.** 7. **Perform antibacterial sensitivity by Kirby-Bauer method.** 8. **Determination of minimal inhibitory concentration (MIC) of an antibiotic.** 9. Turbidometric measurement of bacterial growth. 10. Separation of amino acids and sugar by paper chromatography. 11. Demonstration     1. Cultivation of virus in chick embryo method. (b)Cultivation of virus in cell culture   (c) Plaque assay | | | | | | | | |
| **Reference and Textbooks**:-   1. Rajan.S, Manual for Medical Laboratory Technology (2012), Anjanaa Book House, Chennai. 2. Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers 3. Rajan.S and Selvi Christy (2012).- Experimental procedures in Life Sciences, Anjanaa Book house, Chennai, 4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York, 5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, Churchill Livingstone, London 6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16th edition, Churchill, Livingstone, London 7. Lisa Anne Shimeld, Delmar, (1999). Essential of Diagnostic Microbiology, New York. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Able to isolate and identify the pathogen from the clinical samples. * Knowledge in the analysis of antibiotic sensitivity. * Understand the role of environmental factors affecting bacterial growth. | | | | | | |

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| **Semester –V** | | | | | | | | |
| **CC/DSE/NME** | | | **Core** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Clinical Immunology and rDNA Technology** |  |  |  |  |  |
| **Objectives** | * Give depth knowledge on the clinical diagnostic methods. * Perform enumeration of blood components * Make familiar with the immunodiffusion methods | | | | | | | |
| 1. Identification of blood group by ABO Blood grouping and Rh typing. 2. Evaluation of total erythrocyte count (RBC). 3. Evaluation of total WBC count. 4. Identification of immune cells in a blood smear 5. Examination of differential count of blood cells. 6. Evaluation of erythrocyte Sedimentation Rate (ESR). 7. Haemoglobin estimation Shalli’s method. 8. Immuno diffusion- radial immune diffusion and ouchterlony double immunodiffusion 9. Testing for typhoid antigens by Widal test 10. Construction of recombinant DNA 11. Protein separation by SDS- PAGE 12. Demonstration of     1. PCR     2. Immunofluorescence     3. ELISA | | | | | | | | |
| **Reference and Textbooks**   1. Charles A Janeway, (2001). Immunobiology – (5th ed), Churchill livingstone, London. 2. Helen C, Mansel H, (1993). Essentials of Clinical Immunology – (3rd ed), Blackwell Scientific, LondonStefan HE Kaufmann, (2002). Immunology of Infectious Diseases, ASM Press. 3. Patrick R Murray, (2003). Manual of Clinical Microbiology, (8th ed), ASM Press., Washinton. 4. Manual of Clinical Laboratory and Immunology (6th ed). 2002 by Noel R.Rose, 5. Roitt I, Male, Brostoff, (2002) Immunology, Mosby Publishers. 6. Sambrook J, Fritsch EF and Maniatis T. (2001). *Molecular Cloning-A Laboratory Manual*. (3rd ed). Cold Spring Harbor Laboratory Press. 7. Brown TA. (2006). *Gene Cloning and DNA Analysis*. (5th ed). Blackwell Publishing, Oxford, U.K | | | | | | | | |
| **Outcomes** | | * The students will be able to enumerate the RBC and WBC and also identify the blood cells based on their color and shape. * The students can identify the blood grouping and also diagnose the infectious agents by performing immunological techniques. * The students will have technical knowledge of immunological /clinical tests. * The students are able to construct rDNA | | | | | | |

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| **Semester – V I** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory I** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Basics of Bioinformatics** |  |  |  |  |  |
| **Objectives** | * To provide an- in depth study on Bioinformatics * To create the students to understand sequence alignments, genome analysis, sequence analysisand protein analysis * To familiarize the tools used in Bioinformatics | | | | | | | |
| **Unit –I** | **Introduction to Genes and Proteins**: Genome Sequences - ORFs, Genes, Introns, Exons,  Splice Variants. DNA Structure: Watson & Crick Model. Aminoacid: Definition and Structure, Triplet Codon; Protein Structure: Secondary, Tertiary, Quaternary | | | | | | | |
| **Unit-II** | **Introduction to Bioinformatics and Biological Databases:** Definition and scope of Computational Biology and Bioinformatics**. DNA and protein databases –** preliminary level analysis of DNA and protein sequences using bioinformatics tools. Examples of related tools (FASTA, BLAST), databases (GENBANK, PUBMED, PDB) and softwares  (RASMOL, Ligandxplorer). Applications of Bioinformatics. | | | | | | | |
| **Unit III** | **Pairwise sequence alignments:** Sequence similarity, identity, and homology. Global and localalignment, Dot plots for sequence comparison, Dynamic programming, BLAST and PSI-Blast,Application of Blast tool, Concept of Scoring matrix (PAM and BLOSUM). | | | | | | | |
| **Unit IV** | **Multiple sequence alignments:** Progressive Alignment Algorithm (ClustalW), Application of multiple sequence alignment. **Phylogenetic analysis**: Definition and description of phylogenetic trees, a primer on computational phylogenetic  analysis. **Visualization of proteinsstructure:** Protein DataBank. Ramachandran plot. | | | | | | | |
| **Unit V** | **Structural Bioinformatics:** Tertiary structure Prediction methods (Homology modeling, Fold recognition and ab-initio method). Molecular dynamics and simulation study of protein, Force field concepts. Molecular Docking (Basic concepts). Drug target  identification and Drug design. | | | | | | | |
| **Reference and Textbooks**   1. Claverie, J.M. and Notredame C. (2003) Bioinformatics for Dummies. Wiley Editor. 2. Durbin R., Eddy S., Krogh A. and Mithchison G. (2007) Biological Sequence Analysis, Cambridge UniversityPress. 3. Lesk, A.M. (2005), Introduction to Bioinformatics. Oxford University Press. 4. Rastogi S.C., Mendiratta N. and Rastogi P. Bioinformatics: methods and applications, genomics, proteomicsand drug discovery, Prentice Hall India Publication. 5. Pradeep and Sinha Preeti. Foundations of Computing, BPB publications 6. Primrose and Twyman. Principles of Genome Analysis & Genomics. Blackwell 7. Mount, D.W. (2004),, Bioinformatics: Sequence and Genome Analysis. CSHL Press. 8. Phil Bourne and HelgeWeissig, (2009) Structural Bioinformatics, Wiley-Blackwell 8. Leech Andrew, (2001) Molecular Modelling: Principles and applications (2nded) Prentice Hall | | | | | | | | |
| **Outcomes** | | After completion of the course students are expected to be able to:   * Understand the different tools for data analysis and apply the appropriate tool for dataprocessing. * Know the whole genome analysis methods and the computational tools used for sequenceanalysis. * Acquire knowledge on Homology modeling of protein | | | | | | |

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| **Semester –VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory II** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Food and Dairy Microbiology** |  |  |  |  |  |
| **Objectives** | * To transmit information on the scope and development of food microbiology * To make awareness among the students about the food quality analysis and the role of government organizations involved in food quality control. * To provide an overview on food spoilage organisms- Food borne diseases- to understand infection process and food-borne outbreaks. | | | | | | | |
| **Unit -I** | **Microbiology of foods**:- Role, and Significance of Microorganisms in Foods- Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi & viruses. **Factors affecting the growth of microorganisms**: - Intrinsic factors (Nutrient Content, Redox Potential, pH and Buffering Capacity), water activity and Extrinsic  factors (Relative Humidity and Temperature) influence the growth and survival of microorganisms in foods. | | | | | | | |
| **Unit-II** | **Microbial spoilage of food:** - Fruit and vegetables. Spoilage of meat and meat products – Bacon and Ham. Spoilage of milk and milk products – butter and canned foods. **Food- intoxications:**- *Staphylococcus aureus, Clostridium botulinum* and mycotoxins. **Food**  **infection: -** *Bacillus cereus, Vibrio parahaemolytics, Escherichia coli,* Salmonellosis, Shigellosis*, Yersinia enterocolitica, Listeria monocytogenes and Camphylobacter jejuni.* | | | | | | | |
| **Unit III** | **Principles of food preservation:** - general principles and application methods – asepsis, removal of microorganisms, anaerobic conditions, high temperature, low temperature, osmotic pressure, drying and food additives. **Chemicals-** organic acids. **Radiation** – UV light,  irradiation. Advanced microbiological method for examination of foods | | | | | | | |
| **Unit IV** | **Microbial Fermentation:-** Bread making, Alcoholic Beverages. **Production of fermented**  **dairy products**: Cheese, yoghurt, butter milk, sour cream. **Fermented vegetables**; Sauerkraut, pickles, olives and soy sauce. **Microorganisms as food**- single cell protein. | | | | | | | |
| **Unit V** | **Quality and safety assurance: -** Quality and safety assurance in food and dairy industry Good manufacturing practice, hazard analysis and critical control point (HACCP) concept. FDA, AGMARK, Bureau of Indian Standards (BIS). | | | | | | | |
| **Reference and Textbooks**:-   1. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi. 2. Frazier, W.C. 1978. Food Microbiology (3rd ed), McGraw Hill 3. Adams, M. R. and Moss, M.O. 1995. Food Microbiology, (4th ed ) McGraw Hill, New York. 4. Jay, J.M.2000 Modern Food Microbiology 6th Ed. Aspen Publication, USA. 5. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, (3rd Ed). Wiley Publishers. 6. Brain J. Wood. Microbiology of Fermented Foods. Volume I and II Elsevier Applied Science Publication 7. Prescott, L.M., Harley, J.P. and Helin, D.A. (2008). Microbiology (5th ed). New York: McGraw Hill 8. Joshi V. K and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology (VOL II). | | | | | | | | |
| **Outcomes** | | * The students are able to know the role of microorganisms in food (beneficial as well as   harmful) and also the factors influencing their growth.   * The students can be easily understood in depth the techniques/process involved in the production of microbial products in food and dairy industries. * Able to identify the key problems and prospects in food processing and preservation of perishable food products and also understand the microbial hazards involved in food   spoilage. | | | | | | |

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| **Semester – VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory III** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Agricultural Microbiology** |  |  |  |  |  |
| **Objectives** | * Make the students understand the role of microbes in agriculture * Give an overview on plant microbe interaction. * Understand infection process and control measures. * Know the importance and applications of biofertilizers and biopesticides | | | | | | | |
| **Unit –I** | **Soil Microbiology: -** Physio-chemical properties of soil. **Microbial interactions** - mutualism,  commensalism, amensalism, synergism, parasitism, predation and competition. **Microbial interactions between plants**–phyllosphere, mycorrhizae, rhizosphere and rhizoplane organisms. | | | | | | | |
| **Unit-II** | **Plant pathogenic microorganisms:-** pathogens, symptoms and control measures Algal, fungal, bacterial, viral, mycoplasma, Nematode diseases and symptoms. Phenolic compounds. Interactionof plant pathogens with host. **Definition and History of Biopesticides** – Viral (NPV, CPV & GV), bacterial (Bacillus thuringiensis & Pseudomonas sp.), Fungal (Entomophthora  mucosa & Verticillium sp.), Protozoan (Mattesia sp & Lambornella sp). | | | | | | | |
| **Unit III** | **Non Leguminous associations:-** Azotobacter sp and Azospirillum sp and their functions - Cyanobacteria (BGA) and their associations in Nitrogen fixation. Phospahte solubilizing microbes. Mycorhizae and plant growth promoting rhizobacteria (PGPR). **Biofertilizer production:-** Role of biofertilizers. Quality control (BIS specification), marketing, Evaluation of  field performance and economics of production. Role of biofertilizer in integrated nutrient management. Regulation and standards, Marketing and Monitoring field performance. | | | | | | | |
| **Unit IV** | **Biological Nitrogen fixation:- Nitrogen fixers-** free living nitrogen fixing bacteria and cyanobacteria, symbiotic nitrogen fixing bacteria and cyanobacteria. **Symbiotic nitrogen fixation:-** nodule formation and mechanism of nitrogen fixation**. Assimilation of Ammonia:** reductive amination, catalytic amidation and transamination. **Nitrate Assimilation:-** reduction of  nitrate to nitrite. | | | | | | | |
| **Unit V** | **Microbial transformations of minerals**:- Phosphrous, sulphur, iron and other elements -  Chemistry, cycles, mineralization and immobilization and oxidation/reduction. | | | | | | | |
| **Reference and Textbooks**   1. Atlas, R.M. and Bartha, R. (1992). Microbial Ecology: Fundamentals and Applications. (III Ed) BenjaminCummings, Redwood City.CA. 2. Subba Rao, N. S. (1995). Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. Gupta, S.K.2014 Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India. 3. Subba Rao, N. S. (1997). Biofertilizers in Agriculture and Forestry, III Ed., Oxford & IBH Publishing Co.Pvt.Ltd.,New Delhi. 4. Mark Wheelis, (2010). Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi. 5. Gaur, A.C., (1999). Microbial technology for Composting of Agricultural Residues by Improved Methods, 1stprint, ICAR, New Delhi. 6. Glick, B.R. AND Pasternak, J.J (1994). Molecular Biotechnology, ASM Press, Washington DC. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Understand the role of microbes in the different cycles and their role in agriculture * Be familiar with biological nitrogen fixation in symbiotic and non symbiotic associations with plants. * Know the value, production, application in pest control and crop response of biofertilizers and biopesticides. | | | | | | |

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| **Semester - VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory IV** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Environmental Microbiology** |  |  |  |  |  |
| **Objectives** | * Provide the student with an understanding of the current views of microbial association in various environments. * Evaluate the continuing roles played by microbes in the environment. * Recognize microorganisms as indicators of alteration of an ecosystem. * Understand microbial processes aimed to solve environmental problems. | | | | | | | |
| **Unit –I** | **Soil characteristics**:- Composition of Lithosphere, Soil Microbes, Factors influencing soil microbial population. The soil environment-Distribution and abundance, generic groups and nutrition of bacteria, actinomycetes, fungi, algae, protozoa and viruses. **Biogeochemical cycling:-**Carbon cycling, nitrogen cycling,Phosphorus cycling and sulphur cycling. Ecological  groups based on oxygen requirement, nutrition, temperature, habitat (soil, water & air). | | | | | | | |
| **Unit-II** | **Microbial analysis of drinking water: -** Tests for coliforms (presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. **Aeromicrobiology:-** Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol,  droplet nuclei and infectious dust. Examination of air microflora. | | | | | | | |
| **Unit III** | **Waste management:-** Utilization of solid and liquid waste pollutants for production of Single- Cell protein. **Sewage Treatment:-** Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment - primary, secondary and tertiary  treatments (Trickling filters, activated sludge process and Oxidation lagoons. | | | | | | | |
| **Unit IV** | **Bioremediation & Microbial leaching: -** Polluted heterogeneous environment. Indicator organisms for pollution and abatement of pollution. **Bioremediation** – Types and uses - Genetically Engineered microbes for Bioremediation. **Microbial leaching:-** In situ & Ex situ  methods –copper and uranium mining. | | | | | | | |
| **Unit V** | **Biosafety & Environmental monitoring**:- Environmental regulations - Biohazards - Types of hazardous emission – Biosafety measures - Biomonitority of waste water toxics - Monitoring of  Genetically Engineered Microbes in the Environment. | | | | | | | |
| **Reference and Textbooks:-**   1. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications. (III Ed) BenjaminCummings, Redwood City.CA. 2. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press.New York. 3. Clescri, L.S., Greenberk, A.E. and Eaton, A.D.1998. Standard Methods for Examination of Water and WasteWater, 20th Edition, American Public Health Association. 4. Mara. D and Horan. N 2003. The Handbook of Water and Waste Water Microbiology.Academic. Press,California. 5. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. (4th ed) Prentice Hall Int. Inc.,London. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Understand on soil characteristics and biogeochemical cycling * Be familiar with the microbial analysis of drinking water and Aeromicrobiology * Know the different aspects of waste management and sewage Treatment systems * Acquire knowledge on bioremediation and microbial leaching | | | | | | |

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| **Semester –VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory I** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Medical Microbiology** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Identify common infectious agents and the diseases that they cause. * Evaluate methods used to identify infectious agents in the clinical microbiology lab. * Recognize and diagnose common infectious diseases from the clinical presentation and associated microbiology. | | | | | | | |
| **Unit –I** | **Introduction to Medical Microbiology: Normal microflora of the human body:** Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. **Antibacterial substance**: Lysozyme, Complement, Properdin, Antiviral substances, Phagocytosis. **Host pathogen interaction:** Definitions - Infection, Invasion, Pathogen,  Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections. | | | | | | | |
| **Unit-II** | **Diagnostic and Therapeutical Microbiology:** Collections, transport & processing of clinical samples. **General methods of lab diagnosis**-cultural, biochemical, serological & molecular methods. Test for antimicrobial susceptibility. **Elements of chemotherapy-**Therapeutic drugs, Mode of action of Pencillin & sulphur drugs & their clinical use. Drug resistance. **Antiviral agents**- Interferon, Base analogues. **Preventive control of diseases-** active & passive  immunization. | | | | | | | |
| **Unit III** | **Medical Bacteriology:** Causative agent, symptoms, pathogenesis, treatment and prevention of the following diseases: **Air borne diseases**-Tuberculosis**. Food & water borne diseases**- Cholera, Typhoid. **Contact diseases**- Syphilis, Gonorrhoea. **Zoonotic diseases** - Anthrax.  General account of Nosocomial infections | | | | | | | |
| **Unit IV** | **Medical Virology and Parasitology:** Causative agent, symptoms, pathogenesis, treatment and prevention of the following diseases: **Air borne diseases**- Influenza**. Food &water borne diseases**- Hepatitis-A, Poliomyelitis, Amoebiosis. **Insect borne diseases**-Malaria, Filariasis,  Dengue fever. **Zoonotic diseases** -Rabies. **Blood borne diseases**- Serum hepatitis, AIDS. | | | | | | | |
| **Unit V** | **Antibacterial agents:** Mechanism of action of Penicillins, Tetracyclines, Cephalosporins, Macrolides. **Antifungal agents:** Mechanism of action of Amphotericin B, Griseofulvin, Nystatin. **Antiviral agents:** Mechanism of action of Amantadine, Acyclovir, Azidothymidine | | | | | | | |
| **Reference and Textbooks**:-(APA Format)   1. Ananthanarayan R. and Paniker C.K.J. (2009) *Textbook of Microbiology* (8thed.). University Press Publication 2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) *Jawetz, Melnick and Adelberg’s Medical Microbiology* (26thed.). McGraw Hill Publication 3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) *Mims’ Medical Microbiology*(4thed.). Elsevier 4. Willey JM, Sherwood LM, and Woolverton CJ.(2013) *Prescott, Harley and Klein’s Microbiology* (9thed.). McGraw Hill Higher Education 5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). *Brock Biology of Microorganisms*   (14thed.). Pearson International Edition   1. Pelczar M.J., Chan E.C.S. and Krieg N.R.(2002), *Microbiology*(5thed.).. McGraw Hill Book Company, New York 2. Samuel Baron (1996).*Medical Microbiology* (4thed.)., University of Texas medical branch at Galveston, Texas. | | | | | | | | |
| **Outcomes** | | * The student will be able to explain general and specific mechanisms by which an infectious agent causes disease. * The student will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted. | | | | | | |

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| **Semester – VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory II** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Microbial Physiology and Metabolism** | **4** | **-** | **-** | **4** | **4** |
| **Objectives** | * Build up a sufficient background to students about the growth of Microbes * Study the microbial metabolism and nutrition * Attain knowledge on mechanism of photosynthesis | | | | | | | |
| **Unit –I** | **Microbial Growth:** Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, synchronous growth, diauxic growth curve. **Microbial growth in response to environment** -Temperature, pH. **Microbial growth in response to nutrition and energy** – Autotroph, heterotrophy, Mixotrophs , Methylotrophs. **Survival at extreme environments** – starvation – adaptative mechanisms in  thermophilic, alkalophilic, osmophilic and psychrophilic. | | | | | | | |
| **Unit-II** | **Microbial Nutrition:** Microbial Nutrition – Nutritional Requirement, Uptake of nutrients by cell, Transport of nutrients: Passive and facilitated diffusion, Primary and secondary active transport (uniport, symport and antiport) Group translocation, Iron uptake.. | | | | | | | |
| **Unit III** | **Structure of photosynthetic pigments:** chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. **Mechanism of photosynthesis -** non-cyclic and cyclic electron transport. Photophosphorylation. Photosynthetic Apparatus in Prokaryotes. Outline of  oxygenic and Anoxygenic photosynthesis in bacteria | | | | | | | |
| **Unit IV** | **Aerobic Respiration:** Sugar degradation pathways (EMP, ED, Pentose phosphate pathway TCA cycle). Electron transport chain: components of respiratory chain,  comparison of mitochondrial and bacterial ETC, electron transport phosphorylation. Gluconeogenesis. | | | | | | | |
| **Unit V** | **Nitrogen Metabolism**: Introduction to biological nitrogen fixation, Ammonia  assimilation (glutamate dehydrogenase pathway), Assimilatory nitrate reduction, Dissimilatory nitrate reduction, Denitrification. | | | | | | | |
| **Reference and Textbooks**:-(APA Format)   1. Gottschalk, G. (1986). *Bacterial Metabolism*, Springer-Verlag, New-York. 2. Caldwell, D.R. (1995). *Microbial Physiology and Metabolism*, W.C. Brown Publications, Iowa, USA. 3. Moat, A.G. and Foster, J.W. (1995). *Microbial Physiology*, John-Wiley, New York. 4. White, D. (1995). *The Physiology and Biochemistry of Prokaryotes*, Oxford University Press, New York. Reddy, S.R. and Reddy, S.M. (2004). *Microbial Physiology,* Scientific Publishers, Jodhpur, India. 5. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). *Principles of Biochemistry*, (2nded.)., CBS Publishers and Distributors, New Delhi. 6. Elliot, W.H. and Elliot, D.C. (2001). *Biochemistry and Molecular Biology*, (2nded.)., Oxford University Press, U.S.A. 7. Nelson, D.L. and Cox, M.M. (2012). *Lehingers’s Principles of Biochemistry* (6th ed.)., Mac Millan worth Publishers, New Delhi. 8. Srivastava, M.L. (2008*). Microbial Biochemistry*. Narosa Publishing House, New Delhi. 9. Satyanarayana, U. and Chakrapani, U. (2013). *Biochemistry* (4th ed.)., Book and Allied Pvt. Ltd., Kolkata | | | | | | | | |
| **Outcomes** | | **After completion of the course, students are expected to be able to:**   * Know the various phases involved in the microbial growth * Understand the general concepts of pathways in microbial metabolism * Acquire a clear idea of the role of photosynthetic pigments and the mechanism of photosynthesis. | | | | | | |

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| **Semester –VI** | | | | | | | | |
| **CC/DSE/NME** | | | **Theory III** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Communicable and Non- Communicable Diseases** |  |  |  |  |  |
| **Objectives** | * Enable students to identify issues specifically related to infectious disease epidemiology. * Evaluate the contributions of various environmental factors to non-communicable diseases. * Impart knowledge on diseases transmitted through air, water, food, vectors and pollution sources as well as major components of health services. * Help the students to apply these understandings to infectious disease prevention and control | | | | | | | |
| **Unit -I** | **Diseases: -** Definition, causes of diseases, acute and chronic diseases. **Environmental factors that contribute to non-communicable diseases: -** Outdoor air pollution, household air pollution, impure water, toxic chemicals, radiation, mold and other natural  toxins. Differences between communicable and non-communicable diseases. | | | | | | | |
| **Unit-II** | **Communicable Diseases-** Causative agent, symptoms, preventive measures and treatment of Tuberculosis, Measels, COVID,Post COVID fungal infections, H1N1, Typoid,Rabies, Chikungunia and Respiratory tract Infections. Reservoirs of infection  agents, Chain of transmission in communicable disease. | | | | | | | |
| **Unit III** | **Non- Communicable Diseases-** Cardiovascular Diseases, Cancer, diabetes,  hypertension, obesity and stroke. | | | | | | | |
| **Unit IV** | **Chronic diseases transmitted through blood transfusions**- Viral disease- Dengue fever, Hepatitis and AIDS; Parasitic disease- Chagas disease, Malaria, Amoebiasis and  Leishmaniasis. | | | | | | | |
| **Unit V** | **Vaccine Preventable Diseases**: - Role of vaccine in global health maintenance. Specific vaccines of use in the developing world. Next generation of vaccine prevention, Types  of Vaccine. Hospital acquired infection (Nosocomial) | | | | | | | |
| **Reference and Textbooks**:-(APA Format)   1. Garrett, Laurie. (1994) *The Coming Plague: Newly Emerging Diseases in a World Out of Balance****.*** Penguin Books. 2. Park J. E. and Park K., (1989), “Text Book of Preventive and Social Medicine”, (10th ed). 3. Praful B Godkar and Darshan P Godkar, (2014). Textbook of Medical Laboratory Technology (3rd ed), Bhalani publishers. 4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt (2017). *Roitt’s Essential Immunology*, (13th ed). John Wiley & Sons, Ltd. 5. Abul, K. Abbas Andrew H. H. Lichtman& Shiv Pillai. (2015). Basic Immunology, Functions and Disorders of the Immune System (5th ed). Elsevier | | | | | | | | |
| **Outcomes** | | * The students are able to know the risk factors for the communicable and non- communicable diseases. * The students can take preventive measures to avoid severe diseases. * Understand the role of vaccines in the global health maintenance. | | | | | | |

**ALLIED SYLLABUS**

PROGRAMME STRUCTURE

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| **Sem.** | **Part** | **Course Code** | **Title of the Paper** | **Cr.** | **Hrs.**  **/**  **Wee k** | **Max. Marks** | | |
| **Int.** | **Ext.** | **Total** |
| I | I | T/OL | Tamil /Other Languages -I | 3 | 6 | 25 | 75 | 100 |
| II | E | Communicative English - I | 3 | 6 | 25 | 75 | 100 |
| II I | CC | Theory–I- **Cell Biology** | 5 | 5 | 25 | 75 | 100 |
| CC | Practical –I- **Lab in Cell**  **Biology** | 4 | 4 | 40 | 60 | 100 |
| Allied | Theory- IA- **Body Fluid**  **Analysis** | 3 | 3 | 25 | 75 | 100 |
| Allied | Practical-IA- **Lab in Body**  **Fluid Analysis** | 2 | 2 | 40 | 60 | 100 |
| IV | SEC -I | Value Education | 2 | 2 | 25 | 75 | 100 |
|  |  |  | Library |  | 2 |  |  |  |
|  |  |  | Total | **22** | **30** | **205** | **495** | **700** |
| II | I | T/OL | Tamil/Other Languages-II | 3 | 6 | 25 | 75 | 100 |
| II | E | Communicative English - II | 3 | 6 | 25 | 75 | 100 |
| II I | CC | Theory–II – **General**  **Microbiology** | 5 | 5 | 25 | 75 | 100 |
| CC | Practical-II – **Lab in General**  **Microbiology** | 4 | 4 | 40 | 60 | 100 |
| Allied | Theory – IB - **Blood Banking**  **Technology** | 3 | 3 | 25 | 75 | 100 |
| Allied | Practical-IB – **Lab in Blood**  **Banking Technology** | 2 | 2 | 40 | 60 | 100 |
| IV | SEC -II | Environmental Studies | 2 | 2 | 25 | 75 | 100 |
|  |  | Library |  | 2 |  |  |  |
|  |  | Total | **22** | **30** | 205 | 495 | **700** |
| III | I | T/OL | Tamil/Other Languages-II | 3 | 6 | 25 | 75 | 100 |
| II | E | English – III | 3 | 6 | 25 | 75 | 100 |
| II I | CC | Theory-III –**Human**  **Anatomy and Haematology** | 3 | 3 | 25 | 75 | 100 |
| CC | Theory-IV – **Clinical**  **Biochemistry** | 3 | 3 | 25 | 75 | 100 |
| CC | Practical-III – **Lab in**  **Haematology and Clinical Biochemistry** | 3 | 3 | 40 | 60 | 100 |
| Allied | Theory – IIA – **Hospital**  **Infection Control Measures** | 3 | 3 | 25 | 75 | 100 |
| Allied | Practical-IIA – **Lab in**  **Hospital Infection Control Measures** | 2 | 2 | 40 | 60 | 100 |
|  | SEC -III | Entrepreneurship | 2 | 2 | 25 | 75 | 100 |

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|  | I V | SEC - IV | NME- I  1.Adipadai Tamil 2.Advance Tamil  3.IT Skills for Employment/ MOOC’S | | 2 | 2 | | 25 | | 75 | 100 |
|  |  |  | **Total** | | **24** | **30** | | **255** | | **645** | **900** |
| IV | I | T/OL | Tamil /Other Languages -IV | | 3 | 6 | | 25 | | 75 | 100 |
| II | E | English – IV | | 3 | 6 | | 25 | | 75 | 100 |
| II I | CC | Theory–V - **Molecular**  **Biology and Microbial Genetics** | | 4 | 4 | | 25 | | 75 | 100 |
| CC | Theory-VI – **Clinical**  **Parasitology and Mycology** | | 4 | 4 | | 25 | | 75 | 100 |
| CC | Practical –IV – **Lab in**  **Molecular Biology, Clinical Parasitology and Mycology** | | 3 | 3 | | 40 | | 60 | 100 |
| Allied | Theory – IIB – **Microbial**  **Biotechnology** | | 3 | 3 | | 25 | | 75 | 100 |
| Allied | Practical-IIB – **Lab in**  **Microbial Biotechnology** | | 2 | 2 | | 40 | | 60 | 100 |
| IV | SEC -V | NME- II  1.Adipadai Tamil 2.Advance Tamil  3. Small Business Management / MOOC’S | | 2 | 2 | | 25 | | 75 | 100 |
|  |  | Total | | **24** | **30** | | **230** | | **570** | **800** |
| V | III | CC | | Theory-VII – **Systematic**  **Bacteriology and Virology** | 4 | | 4 | | 25 | 75 | 100 |
| CC | | Theory-VIII – **Clinical**  **Immunology** | 4 | | 4 | | 25 | 75 | 100 |
| CC | | Theory–IX – **Recombinant**  **DNA Technology and Molecular Diagnostics** | 4 | | 4 | | 25 | 75 | 100 |
| CC | | Theory-X – **Clinical**  **Bioinstrumentation and Diagnostics** | 4 | | 4 | | 25 | 75 | 100 |
| CC | | Practical-V- **Lab in**  **Bacteriology, Virology and Bioinstrumentation** | 4 | | 6 | | 40 | 60 | 100 |
| CC | | Practical-VI - **Lab in**  **Clinical Immunology and rDNA Technology** | 4 | | 6 | | 40 | 60 | 100 |
|  |  |  | | Career |  | | 2 | |  |  |  |

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|  |  |  | development/employability  skills |  |  |  |  |  | |
|  |  |  | Total | **24** | **30** | **180** | **420** | **600** | |
| VI | III | DSE | Internship | 24 | 30 | **150** | **250** | **400** | |
| **Or** | | | | | | |
| Theory I – **Basics of**  **Bioinformatics** | 6 | 6 | 25 | 75 | | 100 |
| Theory II – **Food and Dairy**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory III – **Agricultural**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory IV – **Environmental**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Library / Yoga etc |  | 2 |  |  | |  |
| Career development  /employability skills/Field trip | - | 4 | - | - | |  |
|  | 24 | 30 | **100** | **300** | | **400** |
| **Or** | | | | | | |
| Project | 6 | 10 | 25 | 75 | | 100 |
| Theory I – **Medical**  **Microbiology** | 6 | 6 | 25 | 75 | | 100 |
| Theory II – **Microbial**  **Physiology and Metabolism** | 6 | 6 | 25 | 75 | | 100 |
| Theory III –**Communicable**  **and Non-Communicable Diseases** | 6 | 6 | 25 | 75 | | 100 |
|  |  | others | Library / Yoga / Career development  /employability skills/Field trip etc |  | 2 |  |  | |  |
| **Total** | | | | **24** | **30** | **100** | **300** | | **400** |
| **Grand Total** | | | | **140** | **--** | **--** | **--** | | **4100** |

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| **Semester – I** | | | | | | | | |
| **CC/DSE/NME** | | | **Allied I A** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Body Fluid Analysis** |  |  |  |  |  |
| **Objectives** | * Acquire knowledge of body fluids and their functions. * Know about the Infection transmission process & its prevention * Make aware of standard norms, principles, classification, sources & hazards associated withbiomedical waste management. | | | | | | | |
| **Unit –I** | **Body fluids:-** Definition, **Types of body fluids**- blood and lymph, functions of body fluids. **Physical properties of body fluids:**- Body fluid compartments,  Solutes in body fluid, Clinical abnormalities of fluid volume regulation. | | | | | | | |
| **Unit-II** | **Amniotic fluid**:- Formation and function of amniotic fluid, Chemical composition, Collection, Testing – Alpha fetoprotein, Acetyl cholinesterase,  Neural tube defects, Chromosomal abnormalities, Haemolytic disease of newborn, Gestation age, Fetal maturation. | | | | | | | |
| **Unit III** | **Cerebrospinal fluid:-** Formation, Specimen collection, Causes of CSF pressure changes, Gross examination, Chemical analysis, Microbiologic examination, Immunologic tests, Cytological examination and clinical correlation and other  fluid such as Serous fluid, Synovial fluid. | | | | | | | |
| **Unit IV** | Components of the blood (Plasma and Cellular elements) and their functions, Mechanism of coagulation of blood, Coagulation system, Haemogram  ,Calculations of Anaemia using MCH, MCV & MCHC, Special Haematological tests: Osmotic fragility – Heinz body preparation, Blood parasites – Lupus Erythematosus (LE) | | | | | | | |
| **Unit V** | Laboratory that perform Low complexity tests: Principle, reporting – techniques, Laboratory that perform moderate complexity Tests: Principle, reporting – techniques, Laboratory that perform high complexity tests: Principle, reporting  techniques | | | | | | | |
| **Reference and Textbooks**   1. Praful.B. Godkar, et al., (1996). Textbook of Medical Laboratory Technology, 2nd edition, Bhalani Publication House 2. Kanai Mukherjee, (2000). Medical Laboratory Technology, volume – I, II, III, Tata McGraw Hill 3. Sambrook J and Russell DW, (2001). Molecular cloning – A laboratory manual, 3rd edition, Vol. I – III, ColdSpring Laboratory Press, New York. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Know the routes of infectious agents’ transmission and how to control the diseases. * Acquire knowledge on sterilization and disinfection. * Manage the biomedical waste. | | | | | | |

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| **Semester - I** | | | | | | | | |
| **CC/DSE/NME** | | | **Practical I A** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Body Fluid Analysis** |  |  |  |  |  |
| **Objectives** | * Determine the levels of body fluids and know their functions. * Know about the Infection transmission process & its prevention * Make aware of standard norms, principles, classification, sources & hazards associated withbiomedical waste management. | | | | | | | |
| 1. Standardization of distilled or deionized water. 2. Microscopic examination of total leukocyte count. 3. Determination of serum alkaline phosphatase by PNP method. 4. Determination of urine creatinine 5. Perform serological diagnosis of microbial diseases 6. Anti-streptolysin O (ASO) quantitative test 7. Perform C- reactive protein test (CRP) 8. Determination of blood hemoglobin by cyanomethemoglobin method 9. Reference ranges and normal values of RBC, Haemoglobin, WBC, Differential white cell count. 10. Hemorrhagic disorders related to platelet and capillary defects. | | | | | | | | |
| **Reference and Textbooks**   1. Praful.B. Godkar, et al., (1996). Textbook of Medical Laboratory Technology, 2nd edition, Bhalani Publication House 2. Grimaldi and Scopacasa (2000) 'Evaluation of the Abbott CELL-DYN 4000 Hematology Analyzer', American Journal of Clinical Pathology. 3. Kanai Mukherjee, (2000). Medical Laboratory Technology, volume – I, II, III, Tata McGraw Hill | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Determine the leukocyte count, urea creatinine and blood hemoglobin. * Identification of antigens by serological tests. * Acquire basic knowledge on the reference and normal values of RBC and WBC. | | | | | | |

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| **Semester - II** | | | | | | | | |
| **CC/DSE/NME** | | | **Allied I B** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Blood Banking Technology** |  |  |  |  |  |
| **Objectives** | To impart knowledge on   1. Basics of blood banking. . 2. The impression of the transfusion therapy. 3. The recent advances in the blood banking techniques. | | | | | | | |
| **Unit –I** | **Blood donation: -** Donor Motivation, Motivational Techniques, Social Marketing, Preparation of IEC Materials. **Donor recruitment & Retention**: Types of blood donors, Donor selection, medical interview and medical examination, screening for haemoglobin estimation, Managing rejected blood donors, technique for conversion of first time donor into regular voluntary donor, donor felicitation. Blood collection room equipment, their principles, and use, emergency medicines, Pre donation counselling, Bleeding of the donor, post donation care, post donation counseling. Screening of blood units for mandatory tests, Discarding  infected units, | | | | | | | |
| **Unit-II** | **Blood Banking- Blood Components: -** Selection of blood bags for component preparation, preparation of red cell concentrate, Fresh Frozen plasma, platelet concentrate, cryoprecipitate, washed red cells, Frozen red cells. Plasma Fractionation: Principles, manufacturing of different plasma derivatives- Component Testing, Labeling - Transportation and storage of  blood components. | | | | | | | |
| **Unit III** | **Transfusion Therapy-** Management of Blood Bank Issue Counter, Criteria for acceptance of requisition form, inspection of blood component prior to issue - Blood administration, transfusion filters, post transfusion care, Therapeutic plasma exchange - Judicious use of blood; management of different types of anemia, management of bleeding patient, Neonatal  transfusion, Transfusion practices in surgery, Transfusion therapy for oncology and trans plantation patents. | | | | | | | |
| **Unit IV** | **Quality Control Documentation and Legal Aspects of Blood Banking:-** Quality control of blood grouping reagents, QC of anti-human globulin reagent, bovine albumin, Normal saline- Quality control of blood bags -  Quality control of different blood bank Components, sterility test  on component - Organization of blood bank services, Blood Bank premises  and infrastructure, Regional blood transfusion centre and blood storage centres, | | | | | | | |
| **Unit V** | **Recent Advances In Blood Banking Techniques:-** Automation in  Blood Banking - Nucleic Acid Testing - Apheresis - Stem Cells. | | | | | | | |

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| **Reference and Textbooks**   1. Denise M Harmening. Modern Blood Banking and Transfusion practices by, (5th ed) 2. Transfusion Medicine technical manual-DGHS, 2003. Ministry of Health and Family Welfare, Govt. of India (2nd ed) 3. Mollison PL Dacie , J A and Lewis S M Blood transfusion in clinical medicine- Practical Hematology. 4. Abbas A K and Lichtman. A H. Basic Immunology, Saunders Elsevier. 5. Roitt, I. Essential Immunology. (8th ed), Blackwell scientific publications 6. David Latchman, 1997.Basic molecular and cell biology.. BMJ Publishing group. 7. Voluntary blood donation program NACO, 2007. Ministry of Health and Family Welfare, Govt. of India, New Delhi, 8. National guide book in blood donor motivation. NACO, Ministry of Health and Family Welfare, Govt. of India. 9. Standards for blood banks and blood transfusion services, NACO, 2007. Ministry of Health and Family Welfare, Govt. of India, New Delhi | |
| **Outcomes** | After completion of the course, students are expected to be able to:   * Acquire depth knowledge of selecting suitable blood donor and analysis of the bloodcomponents. * Know how to maintain the blood collection bags and preparation of blood fortransfusion. * Be able to access the recent advance in blood banking techniques. |

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| **Semester - II** | | | | | | | | |
| **CC/DSE/NME** | | | **Practical I B** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Blood Banking Technology** |  |  |  |  |  |
| **Objectives** | To impart knowledge on   1. Basics of blood banking. . 2. The impression of the transfusion therapy. 3. The recent advances in the blood banking techniques. | | | | | | | |
| 1. Qualitative test for ABO grouping with antisera and tube method 2. Cross reactivity 3. Coomb’s test- direct and indirect method 4. Confirmation of HIV 1 and 2 using ELISA 5. VDRL test for the confirmation of syphilis 6. Malaria test by dipstick method 7. Isolation of DNA from blood 8. Demonstration for the confirmation of Hepatitis B and C | | | | | | | | |
| **Reference and Textbooks**   1. Transfusion Medicine technical manual-DGHS, 2003. Ministry of Health and Family Welfare, Govt. of India (2nd ed) 2. Mollison PL Dacie , J A and Lewis S M Blood transfusion in clinical medicine- Practical Hematology. 3. David Latchman, 1997.Basic molecular and cell biology.. BMJ Publishing group. 4. Voluntary blood donation program NACO, 2007. Ministry of Health and Family Welfare, Govt. of India, New Delhi, 5. National guide book in blood donor motivation. NACO, Ministry of Health and Family Welfare, Govt. of India. 6. Standards for blood banks and blood transfusion services, NACO, 2007. Ministry of Health and Family Welfare, Govt. of India, New Delhi | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Acquire depth knowledge of selecting suitable blood donor and analysis of the bloodcomponents. * Know how to maintain the blood collection bags and preparation of blood fortransfusion. * Be able to access the recent advance in blood banking techniques. | | | | | | |

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| **Semester - III** | | | | | | | | |
| **CC/DSE/NME** | | | **Allied II A** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Hospital infection Control Practices** |  |  |  |  |  |
| **Objectives** | * Understand the healthcare-associated infections & infection control policies * Know about the Infection transmission process & its prevention * Make aware of standard norms, principles, classification, sources & hazards associated withbiomedical waste management. | | | | | | | |
| **Unit –I** | **Introduction of healthcare-associated infections & infection control program: -** Introduction, Role & responsibilities of ICN, Role of hospital administration in hospital infection control, Infection Protection for Healthcare Workers, Education and training of healthcare workers, patients, and families. | | | | | | | |
| **Unit-II** | **Infection transmission & its prevention:-** Introduction & various routes of transmission of infection, Standard / Universal precautions and its components, The significance of taking standard / Universal precautions, Isolation policies  and procedures and Infection Control measures to Control Transmission | | | | | | | |
| **Unit III** | **Sterilization and disinfection:-** Physical and chemical methods of sterilization  and disinfection, Cleaning & Disinfection of medical equipment, Disinfection of Hepatitis B virus, Hepatitis C virus, HIV or TB contaminated devices. | | | | | | | |
| **Unit IV** | **Personal protective equipment and standard precautions:** Introduction,  Types & Method of use of personal protective equipment (PPE): Gloves, Gown, mask, apron Protective eyewear (goggles), Boots or shoe cover & Cap or hair cover. **Hand hygiene practices**:- Introduction, typesof hand washing, Steps of  hand washing, The role of hand hygiene in control of hospital-acquired. | | | | | | | |
| **Unit V** | **Biomedical waste management:** Introduction, Standard norms for Biomedical waste, Principles of Waste Management, WHO Classification of BMWM,  Sources of Biomedical Waste, The problem associated with biomedical waste management, Hazards related to biomedical waste management, Treatment and disposal techniques of BMWM. | | | | | | | |
| **Reference and Textbooks**   1. Hospital Acquired Infections- Prevention and Control by Purva Mathur. Publisher: Lippincott Williams &Wilkins. 2. National, CDC, WHO guidelines on Hospital Infection Control. 3. Journals:    * Journal of Hospital Infection.    * Journal of patient safety and infection control.    * American Journal of Infection Control.    * Waste Management Journal Elsevier | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Know the routes of infectious agents’ transmission and how to control the diseases. * Acquire knowledge on sterilization and disinfection. * Manage the biomedical waste. | | | | | | |

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| **Semester - III** | | | | | | | | |
| **CC/DSE/NME** | | | **Practical II A** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Hospital Infection Control**  **Measures** |  |  |  |  |  |
| **Objectives** | * Know the basic techniques followed in the hospital for the prevention   of infections & diseases   * Acquire knowledge in the identification of infectious agents and laboratory first aid measures * Perform basic and serological tests for the disease diagnosis | | | | | | | |
| 1. Organization of infection control and surveillance of hospital acquired infections. 2. Study of Infection Control Precautions 3. Examination of Hand Hygiene 4. Laboratory first aid measures 5. Preparation of normal saline 6. Examination of decontamination of Hospital Environment 7. Prevention of Device Associated Infections 8. Preventive Strategies for Surgical Site Infections 9. Examination of morphology of blood cells 10. Determination of bleeding time 11. Determination of blood clotting time by capillary method and Lee- White method 12. Antiviral chemotherapy 13. Various culture media used for mycotic organisms | | | | | | | | |
| **Reference and Textbooks**   1. Anudita Bhargava, Atul Jindal, etc. (2019). Hospital infection Control Measures, All India Sciences of Medical Institute, Raipur. 2. Hospital Infection Control Manual, (2017). Sigma Hospital, India. 3. Praful.B. Godkar, et al., (1996). Textbook of Medical Laboratory Technology, 2nd edition, Bhalani Publication House 4. Kanai Mukherjee, (2000). Medical Laboratory Technology, volume – I, II, III, Tata McGraw Hill | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Do the first aid * Know how to prevent the environment and patients in the hospital from infections by applying various techniques learned through this course. * Acquire knowledge on basic tests followed in the hospital such as calculation of bleeding time and clotting time. | | | | | | |

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| **Semester - IV** | | | | | | | | |
| **CC/DSE/NME** | | | **Allied II B** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Microbial Biotechnology** |  |  |  |  |  |
| **Objectives** | * Provide the student with an understanding of the current views of microbial association invarious environments. * Evaluate the continuing roles played by microbes in the environment. * Recognition of microorganisms as indicators of alteration of an ecosystem. * Understand microbial processes aimed to solve environmental problems. | | | | | | | |
| **Unit –I** | **Brief history of fermentation;** Fermentation- general concepts, Applications of fermentation; Range of fermentation process- Microbial biomass, enzymes, metabolites, recombinant products, transformation process; Component parts of  a fermentation process. | | | | | | | |
| **Unit-II** | **Microbial biotechnology:** Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology, Use of prokaryotic and eukaryotic microorganisms in biotechnological applications , Genetically engineered microbes for industrial  applications: Bacteria and yeast | | | | | | | |
| **Unit III** | **Organic feedstock:** ethanol; Acetone; Ethanol Organic acids: Production of Citric acid; Acetic acid; Lactic acid; Gluconic acid; Kojic acid; itaconic acid; Amino acids: Use of amino acids in industry; methods of production; Production  of individual aminoacids (L-Glutamic acid; L Lysin;L-Tryptophan). | | | | | | | |
| **Unit IV** | **Enzymes:** commercial applications; production of Amylases; Glucose Isomerase; L Asparaginase Proteases Renin; Penicillin acylases; Lactases; Pectinases; Lipases; Structure and biosynthesis Nucleosides Nucleotides and  related compounds. | | | | | | | |
| **Unit V** | **Vitamins**- Vitamin B12; Riboflavin; B carotene; Antibiotics: beta-Lactam antibiotics; aminoacid and peptide antibiotics; Carbohydrate antibiotics; Tetracycline and antracyclines; Nucleoside antibiotics; Aromatic antibiotics;  bioplastics (PHB; PHA); biotransformation of steroids. | | | | | | | |
| **Reference and Textbooks**   1. Crueger Wand Crueger, A. Biotechnology. A Textbook of Industrial Microbiology, Sinauer AssociatesPublisher 2. Reed, G. *Industrial microbiology*, CBS publications 3. Demain L *Biology of Industrial microorganisms* ,Stanbury P.F.A 4. Vogel H C, Todaro C.L, Todaro C.C. *Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment*, Noyes Data Corporation/ Noyes Publications. 5. Scheper. T, *New Products and New Areas of Bioprocess Engineering* (Advances in Biochemical Engineering/Biotechnology, 68) Springer Verlag Publications | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Understand on soil characteristics and biogeochemical cycling * Be familiar with the microbial analysis of drinking water and Aeromicrobiology * Know the different aspects of waste management and sewage Treatment systems * Acquire knowledge on bioremediation and microbial leaching | | | | | | |

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| **Semester - IV** | | | | | | | | |
| **CC/DSE/NME** | | | **Practical II B** | **L** | **T** | **P** | **C** | **H/W** |
| **Course code:** | |  | **Lab in Microbial Biotechnology** |  |  |  |  |  |
| **Objectives** | * Highlight the roles and characteristics of microorganisms in field of Biotechnology * Impart knowledge on the basic concept of multiplication in microorganism * Know the metabolic pathways and products can be used in biotechnology. | | | | | | | |
| 1. Isolation of industrially important microorganism from different sources using specific substrates. 2. Design and Preparation of Media for Bioprocesses. 3. Growth curve of bacteria/Yeasts in batch culture and calculation of maximum specific growthrate. 4. To study the various methods of biomass measurement. 5. Production of ethanol from sucrose by yeast. 6. Determination of yield coefficient and Monod’s constant and metabolic quotient of E.coli culture onglucose. 7. Design of fermenter and its working. 8. Production of citric acid using sucrose and molasses. 9. Production of extracellular enzymes. 10. Ethanol production using immobilized yeast culture. | | | | | | | | |
| **Reference and Textbooks**   1. Atlas, R.M. and Bartha, R. 1992. *Microbial Ecology: Fundamentals and Applications*. (3rd ed) BenjaminCummings, Redwood City.CA. 2. Reed G, *Industrial microbiology*, CBS publications 3. Demain L *Biology of Industrial microorganisms* ,Stanbury P.F.A 4. Vogel H C, Todaro C.L, Todaro C.C. *Fermentation and Biochemical Engineering Handbook:Principles, Process Design, and Equipment*, Noyes Data Corporation/ Noyes Publications. 5. Scheper. T, *New Products and New Areas of Bioprocess Engineering* (Advances in Biochemical Engineering/Biotechnology, 68) Springer Verlag Publications. | | | | | | | | |
| **Outcomes** | | After completion of the course, students are expected to be able to:   * Know the principles involved in preparation of Beverage and industrial Alcohols andthe physical and chemical conditions influencing their production. * Understand the importance of microbial enzymes, their applications , productionprocess and relate biotransformation principles to biotransformation of steroids * Conceptualize the principles and production process of different types of Vaccines. | | | | | | |