**ANNAMALAI UNIVERSITY**

**(Affiliated Colleges)**

**211 –B. Sc. Biotechnology**

Programme Structure and Scheme of Examination (under CBCS)

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Part | Course Code | Study Components & Course Title | Credit | Hours/  Week | Maximum Marks | | |
| CIA | ESE | Total |
|  |  | SEMESTER – I |  |  |  |  |  |
| I | 23UTAML11/  23UHINL11/  23UFREL11 | Language– I:  nghJjkpo; - I  Hindi-I/  French-I | 3 | 6 | 25 | 75 | 100 |
| II | 23UENGL12 | General English - I | 3 | 6 | 25 | 75 | 100 |
| III | 23UBTHC13 | Core – I: Cell and Molecular Developmental Biology | 5 | 5 | 25 | 75 | 100 |
| 23UBTHP14 | Core – II: Practical – I: Cell and Molecular Developmental Biology Practical | 5 | 4 | 25 | 75 | 100 |
| 23UMICE15 | Elective – I  (General /Discipline Specific)  Fundamentals of Microbiology | 2 | 3 | 25 | 75 | 100 |
|  | 23UMICEP1 | Fundamentals of Microbiology Practical | 1 | 2 | 25 | 75 | 100 |
| IV | 23UTAMB16  23UTAMA16 | Skill Enhancement Course – I (NME-I) /\*  Basic Tamil – I /  Advanced Tamil - I | 2 | 2 | 25 | 75 | 100 |
| 23UBTHF17 | Foundation Course:  Microbial Diseases and Control | 2 | 2 | 25 | 75 | 100 |
|  |  | Total | 23 | 30 |  |  | 800 |
|  |  | SEMESTER – II |  |  |  |  |  |
| I | 23UTAML21  23UHINL21/  23UFREL21 | Language– II:  nghJ jkpo; - II  Hindi-II  French-II | 3 | 6 | 25 | 75 | 100 |
| II | 23UENCL22 | General English – II | 3 | 6 | 25 | 75 | 100 |
| III | 23UBTHC23 | Core – III: Genetics | 5 | 5 | 25 | 75 | 100 |
| 23UBTHP24 | Core – IV: Practical – II: Lab in Genetics | 5 | 4 | 25 | 75 | 100 |
| 23UMICE25 | Elective – I  (General /Discipline Specific)  Applied Microbiology | 2 | 3 | 25 | 75 | 100 |
|  | 23UMICEP2 | Applied Microbiology Practical | 1 | 2 | 25 | 75 | 100 |
| IV | 23UTAMB26  23UTAMA26 | Skill Enhancement Course – II (NME-II) /\*  Basic Tamil – II /  Advanced Tamil - II | 2 | 2 | 25 | 75 | 100 |
| 23USECG27 | Skill Enhancement Course – III  Internet and its Applications  (Common Paper) | 2 | 2 | 25 | 75 | 100 |
|  |  | Total | 23 | 30 |  |  | 800 |

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|  | Non-major (NME) Electives offered to other Departments | | | |  |  |  |
| IV | 23UBTHN16 | MUSHROOM TECHNOLOGY | 2 | 2 | 25 | 75 | 100 |
| 23UBTHN26 | ENVIRONMENTAL MANAGEMENT | 2 | 2 | 25 | 75 | 100 |

\* PART-IV: NME / Basic Tamil / Advanced Tamil (Any one)

Students who have not studied Tamil upto 12th Standardand have taken any Language other than Tamil in Part-I, must choose Basic Tamil-I in First Semester & Basic Tamil-II in Second Semester.

Students who have studied Tamil upto 10th & 12th Standardand have taken any Language other than Tamil in Part-I, must choose Advanced Tamil-I in First Semester and Advanced Tamil-II in Second Semester.

**FIRST YEAR - SEMESTER – I**

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| **SEMESTER: I**  **CORE-I**  **PART: III** | **23UBTHC13:**  **CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY** | **CREDIT: 5**  **HOURS: 5/W** |

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| **Learning Objective: On successful completion of the course, students will be able to** | | |
| LO1 | Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell | |
| LO2 | Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane. | |
| LO3 | Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication,Transcription and Translation and post translational modifications of proteins. | |
| LO4 | Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways. | |
| LO5 | Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell. | |
| **UNIT** | **Contents** | **No. of Hours** |
| I | Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells). | 10 |
| II | Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton. | 20 |
| III | Structure and functions of DNA and RNA -Central Dogma of the cell. DNA -Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation. | 15 |
| IV | Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways. | 15 |
| V | Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis. | 15 |
| **Total** | | **75** |

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| **Text Books** | |
| 1 | T. Devasena (2012), Cell Biology, Oxford University Press. |
| 2 | Gupta, Renu&Makhija, Seema&Toteja, Ravi. (2018). Cell Biology: Practical Manual. |
| 3 | Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA. |
| 4 | Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company. |
| 5 | James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers. |
| **Reference Books** | |
| 1 | Karp’s Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications. |
| 2 | James D. Watson, 7th Edition (2014), Molecular Biology of the Gene, Pearson Publications. |
| 3 | Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press. |
| 4 | LodishHarwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications. |
| 5 | Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press. |
| **Web Resources** | |
| 1 | <http://www.cellbiol.com/education.php> |
| 2 | <https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/> |
| 3 | <https://dnalc.cshl.edu/websites/> |
| 4 | <https://www.cellsignal.com/contents/science/cst-pathways/science-pathways> |
| 5 | <https://nptel.ac.in/courses/102/106/102106025/>11. |

**MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 2 | 1 | 3 | - | 3 | 3 | 2 | 3 |
| **CLO2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 2 | 3 |
| **CLO3** | 3 | 3 | 3 | 2 | - | 3 | 3 | 2 | 2 |
| **CLO4** | 3 | 2 | 3 | 2 | - | 3 | 3 | 2 | 3 |
| **CLO5** | 3 | 3 | 2 | 2 | - | 3 | 3 | 2 | 3 |
| **TOTAL** | **15** | **14** | **12** | **12** | **0** | **15** | **15** | **10** | **15** |
| **AVERAGE** | **3** | **2.8** | **2.4** | **2.4** | **0** | **3** | **3** | **2** | **3** |

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| **SEMESTER: I**  **CORE PRACTICAL: I**  **PART: III** | **23UBTHP14: CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY PRACTICAL** | **CREDIT: 5**  **HOURS: 4/W** |

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| **Learning Objective** | | | |
| LO1 | | Demonstrate the operation of Light Microscope | |
| LO2 | | Identify blood cells and its components | |
| LO3 | | Isolate and identify plant, and animal cells. | |
| LO4 | | Summarizes the concept of gametes | |
| LO5 | | Develop skill to perform cell fractionations. | |
| **UNIT** | | **Contents** | **No.of Hours** |
| I | | Components of a Compound / Light Microscope. | 9 |
| II | | Blood smear preparation and Identification of Blood cells  Buccal smear preparation and Identification of squamous epithelial cells. | 9 |
| III | | Isolation and Identification of plant cells. | 9 |
| IV | | Observation of sperm & Egg  Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.  Types of placenta in mammals. | 9 |
| V | | Cell fractionation and Identification of cell organelles (Demo) | 9 |
| **Total** | | | **45** |
| **Text Books** | | | |
| 1 | K.V. Chaitanya, (2013), *Cell and molecular biology*: Lab manual, PHI publishers,. ISBN 978-81-203-800-4 | | |

**MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 |
| **CLO2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO4** | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO5** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| **TOTAL** | **15** | **14** | **14** | **15** | **13** | **14** | **14** | **13** | **13** |
| **AVERAGE** | **3** | **2.8** | **2.8** | **3** | **2,6** | **2.8** | **2.8** | **2.6** | **2.6** |

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| **SEMESTER: I**  **CORE PRACTICAL: I**  **PART: III** | **Elective – I: 23UMICE15:**  **Fundamentals of Microbiology** | **CREDIT: 2**  **HOURS: 3/W** |

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| **Learning Objective** | | |
| LO1 | Understand the classification of Microorganisms and structure of bacteria | |
| LO2 | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | |
| LO3 | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes. | |
| LO4 | Exhibit knowledge in analyzing the importance ofBio insecticides, Bio fertilizersprebiotics and probiotics. | |
| LO5 | Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications. | |
| **UNIT** | **Contents** | **No.of Hours** |
| I | History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology. | 15 |
| II | Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram’s, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae. | 15 |
| III | Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL. | 15 |
| IV | Bioinsecticides - *Bacillus thuringiensis*, Baculoviruses- Biofertilizers -*Azospirillum* and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt). | 15 |
| V | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). | 15 |
| **Total** | | **75** |
| **Text Books** | | |
| 1 | Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York. | |
| 2 | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. | |
| 3 | Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013. | |
| 4 | Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. | |
| 5 | Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC | |
| **Reference Books** | | |
| 1 | Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017. | |
| 2 | Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012. | |
| 3 | Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby CollegePublishing, St Louis. | |
| 4 | Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson. | |
| 5 | Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York. | |

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| **Web Resources** | |
| 1 | Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB) |
| 2 | <http://www> ejb.org/content. |
| 3 | www. Biotech.kth.se Electronic Journal of biotechnology |
| 4 | https://www.cliffsnotes.com/study guides/biology/microbiology/introduction-to- microbiology/a-brief-history-of-microbiology |
| 5 | <https://bio.libretexts.org/@go/page/9188> |

**MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME**

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CLO2** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CLO3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** | **3** |
| **CLO4** | **3** | **3** | **3** | **2** | **3** | **2** | **3** | **3** | **2** |
| **CLO5** | **3** | **3** | **2** | **3** | **3** | **3** | **3** | **2** | **3** |
| **TOTAL** | **15** | **15** | **14** | **14** | **14** | **14** | **15** | **14** | **14** |
| **AVERAGE** | **3** | **3** | **2.8** | **2.8** | **2.8** | **2.8** | **3** | **2.8** | **2.8** |

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| **SEMESTER: I**  **ELECTIVE II:**  **PART: III** | **23UMICEP1: FUNDAMENTALS OF MICROBIOLOGY Practical** | **CREDIT: 1**  **HOURS: 2/W** |

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| **Learning Objective** | | | |
| LO1 | | Describe the general Laboratory safety & Sterilization Techniques | |
| LO2 | | Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques | |
| LO3 | | Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques. | |
| LO4 | | Perform the Motility of organisms. | |
| LO5 | | Able to characterize and identify bacteria using Biochemical tests. | |
| **UNIT** | | **Contents** | **No.of Hours** |
| I | | Sterilization techniques – Preparation of Media | 9 |
| II | | Inoculation techniques- Pour plate, spread plate  Isolation of bacteria from various sources and dilution techniques. | 9 |
| III | | Staining techniques: Simple, Gram’s, Capsule (Negative), Spores,  Preparation of temporary mounts- Lacto phenol cotton blue staining. | 9 |
| IV | | Motility tests: Hanging drop technique. | 9 |
| V | | Biochemical characterization - catalase, oxidase, IMVIC test and TSI.Antibiotic sensitivity test (demonstration). | 9 |
| **Total** | | | **45** |
| **Text Books** | | | |
| 1 | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. | | |
| 2 | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. | | |
| 3 | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. | | |
| 4 | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. | | |
| 5 | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. | | |
| **Reference Books** | | | |
| 1 | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. | | |
| 2 | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India. | | |
| 3 | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS. | | |
| 4 | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. | | |
| 5 | Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications. | | |
| **Web Resources** | | | |
| 1 | <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>. | | |
| 2 | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> | | |
| 3 | [https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry/files/essential_microbiology.pdf) | | |
| 4 | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> | | |

**MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOME**

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | **3** | **2** | **2** | **2** | **1** | **2** | **3** | **3** | **3** |
| **CLO2** | **3** | **2** | **2** | **2** | **1** | **1** | **3** | **3** | **3** |
| **CLO3** | **3** | **2** | **1** | **1** | **-** | **1** | **3** | **3** | **3** |
| **CLO4** | **3** | **2** | **1** | **2** | **3** | **2** | **3** | **3** | **2** |
| **CLO5** | **3** | **3** | **2** | **3** | **3** | **2** | **3** | **2** | **3** |
| **TOTAL** | **15** | **11** | **8** | **10** | **8** | **8** | **15** | **14** | **14** |
| **AVERAGE** | **3** | **2.2** | **1.6** | **2** | **1.6** | **1.6** | **3** | **2.8** | **2.8** |

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| **SEMESTER: I**  **Foundation Course:**  **PART: IV** | **23UBTHF17: Microbial Diseases and Control**  **(Foundation Course)** | **CREDIT: 2**  **HOURS: 2/W** |

**Learning Outcome:**

The paper imparts a thorough knowledge on the basics of concepts of microbial interactions and clinical manifestation and its control.

**Course outcomes**:

At the end of the Course, the Student will be able to:

|  |  |
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| CO-1 | Understand the microbial interactions and its prevention and control. |
| CO-2 | Knowledge about the Virus and clinical manifestation |
| CO-3 | Knowledge about the bacteria and clinical manifestation |
| CO-4 | Knowledge about the fungi and clinical manifestation |
| CO-5 | Knowledge about the Protozoa and clinical manifestation |

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| **SYLLABUS | Paper - 1 | MICROBIAL DISEASES AND CONTROL** | | | | |
| **Unit** | **Content** | **Hours** | **COs** | **Cognitive level** |
| **I** | Micro organisms - microbial interactions - pathogens.  General epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures. | 6 | CO1 | K1&k2 |
| **II** | Virus: (a) HIV, (b) Pox virus, and (c) Picorna virus - Epidemiology - pathogenesis - pathology – diagnostics procedure - clinical manifestation - prevention and control measures. | 7 | CO2 | K1,K2 & K3 |
| **III** | Bacteria: (a) Streptococcus (b) Staphylococcus and (c) Salmonella - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures | 7 | CO3 | K1,K2 & K3 |
| **IV** | Fungi: (a) Aspergillus, (b) Candida and (c) Microspora - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures. | 7 | CO4 | K1,K2 & K3 |
| **V** | Protozoa: (a) Entamoeba histolytica, (b) Plasmodium species and (c) Trypanosoma gambiense - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures - vectors. | 7 | CO5 | K1,K2 & K3 |
| **Reference books:**   1. Ananthanarayanan, R. and C.K., Jayaram Paniker, Textbook of Microbiology. Orient Longman, 5th Edition, (1994). 2. Jawetz, E., Melnic, J.L. and Adelberg E. A., Review of Medical Microbiology. Lange Medical publications, USA, 4th Edition, (1998). 3. Mackie and Mc Cartney, Medical Microbiology No 1 and II. Churchill Livingston, 14th Edition, (1994). 4. Chakraborty, P. A text book of microbiology, New central Book agency pvt Ltd. Calcutta, 2nd Edition, (1995). 5. Bailey and Scotts, Diagnostic Microbiology, Baron and Finegold CV Mosby publications, 9th Edition, (1994). | | | | |

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| **SEMESTER: I**  **Core-III:**  **PART: III** | **Core – III:**  **23UBTHC23: Genetics** | **CREDIT: 5**  **HOURS: 5/W** |

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| **Learning Objective** | | |
| LO1 | Learn about the classical genetics and transmission of characters from one generation to the next. | |
| LO2 | Obtain a strong foundation for the advanced genetics. | |
| LO3 | Explain the properties of genetic materials and storage and processing of genetic information. | |
| LO4 | Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human. | |
| LO5 | Categories Eugenics, Euphenics and Euthenicsand indepth Knowledge on population Genetics. | |
| **UNIT** | **Contents** | **No.of Hours** |
| 1 | Mendel’s experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel’s laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man. | 15 |
| II | Linkage - linkage in Drosophila- Morgan’s experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor inmice. Sex –Linked Inheritance and Sex- Determination in Man. | 15 |
| III | Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sexduction | 15 |
| IV | Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy) | 15 |
| V | Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics. | 15 |
| **Total** | | 75 |
| **Text Books** | | |
| 1 | Dr. Veer BalaRastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, KedarNath Ram | |
| 2 | NathPublications,Meerut,250001.www.knrnpublications.com, ISBN-978-81-907011-2-9 | |
| 3 | Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S.Chand& Co., New Delhi – 10055. | |
| 4 | Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S.Chand and Co., New Delhi, 110055. | |
| **Reference Books** | | |
| 1 | Gardener E.J. Simmons M.J. Slustad D. P. 2006. Principles of Genetics | |
| 2 | Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill. | |
| 3 | Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H.Freeman. New York. | |
| 4 | Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd | |
| 5 | Good enough U. 1985. Genetics. Hold Saunders international. | |
| **Web Resources** | | |
| 1 | <https://nptel.ac.in/courses/102/106/102106025/> | |
| 2 | [http://www.ocw.mit.edu](http://www.ocw.mit.edu/) | |
| 3 | [http://enjoy.m.wikipedia.org](http://enjoy.m.wikipedia.org/) | |
| 4 | [https://www.acpsd.net](https://www.acpsd.net/) | |

**MAPPING WITH PROGRAMME OUTCOMEAND PROGRAMME SPECIFIC OUTCOME**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** |
| **CLO1** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **2** | **2** |
| **CLO2** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **2** |
| **CLO3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CLO4** | **3** | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **3** |
| **CLO5** | **3** | **3** | **2** | **3** | **2** | **2** | **2** | **3** | **3** |
| **TOTAL** | **15** | **14** | **14** | **15** | **13** | **14** | **14** | **13** | **13** |
| **AVERAGE** | **3** | **2.8** | **2.8** | **3** | **2.6** | **2.8** | **2,8** | **2.6** | **2.6** |

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| **SEMESTER: I**  **CORE PRACTICAL:**  **PART: III** | **Core – IV: Practical – II:**  **23UBTHP24: Lab in Genetics** | **CREDIT: 5**  **HOURS: 4/W** |

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| **SYLLABUS | Core -4- Practical | GENETICS** |
| **Content** |
| 1 .Mitotic stages of onion (*Allium cepa*) root tip  2. Meiotic stages of cockroach testes/ Flower bud  3.Giant chromosomes from Chironomus larvae  4. Giant chromosomes from Drosophila salivary glands  5. Identification of Barr bodies from Buccal smear  6.Preparations of culture medium and culture of Drosophila – methods of maintenance  7. Identifications of mutants of Drosophila  8. Human karyotyping (Demo) |

**Elective II: APPLIED MICROBIOLOGY**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject Code** | | **L** | **T** | **P** | **S** | **Credits** | **Instructional Hours** | **Marks** | | |
| **CIA** | **External** | **Total** |
| **23UMICE25** | | **3** |  |  |  | **2** | **3** | **25** | **75** | **100** |
| **Course Outcomes** | | | | | | | | | | |
| CO1 | | Understand beneficial role of microorganisms in dairy and food products. | | | | | | | | |
| CO2 | | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | | | | | | | | |
| CO3 | | Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes. | | | | | | | | |
| CO4 | | Exhibit knowledge in analyzing the importance ofBio insecticides, Bio fertilizersprebiotics and probiotics. | | | | | | | | |
| CO5 | | Distinguish between normal flora and pathogens and describe the role of microbes in food intoxications. | | | | | | | | |
| **UNIT** | | **Contents** | | | | | | | | **No.of Hours** |
| I | | Microorganisms as food and feed: SCP, Mushroom-Oyster (Pleurotus) and Button (Agaricus) mushroom. Dairy products-cheese, yoghurt; Beverages-Beer and Wine. Probiotics. | | | | | | | | 15 |
| II | | Microorganisms in Agriculture: Bacterial Biofertilizers, Phosphate solubilizers, Vasicular Arbusucular Mycorrhizae, Algal Biofertilizers. | | | | | | | | 15 |
| III | | Biocontrol of microbial pathogens-Bio pesticide-Bactericide-*Bacillus thuringiensis*; Fungicide-*Trichoderma viridae-*Viral Biopesticides-CPV and NPV | | | | | | | | 15 |
| IV | | Microorganisms and Environment: liquid waste and solid waste-liquid waste management-water recycling- Industrial effluent treatment (sugar mill effluent, tannery effluent)- Solid waste management -Composting and vermicomposting. | | | | | | | | 15 |
| V | | Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). | | | | | | | | 15 |
| **Total** | | | | | | | | | | **75** |
| **Text Books** | | | | | | | | | | |
| 1 | | Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi | | | | | | | | |
| 2 | | Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. | | | | | | | | |
| 3 | | Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016. | | | | | | | | |
| **Reference Books** | | | | | | | | | | |
| 1 | | . Adams, M.R and M.O. Moss (2005). Food Microbiology. 1st edition. Reprinted, Published byNew Age International (P) Ltd, Publishers-New Delhi. | | | | | | | | |
| 2 | | Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012. | | | | | | | | |
| 3 | | Maier, R.M., Pepper, I.L. & Gerba, C.P. (2009). Environmental Microbiology. 2nd Ed. Academic Press. | | | | | | | | |
| 4 | | Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013. | | | | | | | | |
| **Web Resources** | | | | | | | | | | |
| 1 | <http://www> ejb.org/content. | | | | | | | | | |
| 2 | www. Biotech.kth.se Electronic Journal of biotechnology | | | | | | | | | |
| 3 | <https://bio.libretexts.org/@go/page/9188> | | | | | | | | | |

**MAPPING WITH PROGRAMME OUTCOMES**

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

**APPLIED MICROBIOLOGY PRACTICAL**

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| **Subject Code** | | **L** | **T** | **P** | **S** | **Credits** | **Instructional Hours** | **Marks** | | | |
| **CIA** | **External** | | **Total** |
| **23UMICEP2** | |  |  | **2** |  | **1** | **2** | **25** | **75** | | **100** |
| **Course Outcomes** | | | | | | | | | | | | |
| CO1 | Describe the techniques to estimate the quality of dairy products | | | | | | | | | | | |
| CO2 | Develop Skills in enzyme production | | | | | | | | | | | |
| CO3 | Microscopically analyze the morphological features of algae and root nodules bacteria | | | | | | | | | | | |
| CO4 | Learn the methods available to check the water quality | | | | | | | | | | | |
| CO5 | Understand the pathogenic bacteria in various sample | | | | | | | | | | | |
| **UNIT** | **Contents** | | | | | | | | | **No.of Hours** | | |
| I | Detection of bacteria in milk by SPC, Methylene Blue reduction test, Microscopic observation of curd | | | | | | | | | 9 | | |
| II | Demonstration of enzymes producing bacteria (lipase, amylase, protease) | | | | | | | | | 9 | | |
| III | Azolla- morphological study, Isolation of Rhizobium from root nodules, | | | | | | | | | 9 | | |
| IV | Enumeration of bacteria from water sample, test for coliforms by MPN method | | | | | | | | | 9 | | |
| V | Isolation of pathogenic bacteria from air, water, and food specimens | | | | | | | | | 9 | | |
| **Total** | | | | | | | | | | **45** | | |
| **Text Books** | | | | | | | | | | | | |
| 1 | | James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996. | | | | | | | | | |
| 2 | | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. | | | | | | | | | |
| 3 | | Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications. | | | | | | | | | |
| 4 | | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. | | | | | | | | | |
| 5. | | Rajan. S and Selvi Christy (2015). Experiments Procedure in Life Science, Anjanaa book House Publisers, Chennai | | | | | | | | | |
| 6 | | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | |
| 1 | | Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers. | | | | | | | | | |
| 2 | | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India. | | | | | | | | | |
| 3 | | Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS. | | | | | | | | | |
| 4 | | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. | | | | | | | | | |
| 5 | | Lim D. (1998). Microbiology, 2nd Edition, WCB McGraw Hill Publications. | | | | | | | | | |
| **Web Resources** | | | | | | | | | | | | |
| 1 | | <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>. | | | | | | | | | |
| 2 | | <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635> | | | | | | | | | |
| 3 | | [https://www.grsmu.by/files/file/university/cafedry//files/essential\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry/files/essential_microbiology.pdf) | | | | | | | | | |
| 4 | | <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology> | | | | | | | | | |

**MAPPING WITH PROGRAMME OUTCOMES**

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

**NME Courses offered to other Departments**

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| **SEMESTER: III**  **PART: IV** | **23UBTHN16:MUSHROOM TECHNOLOGY**  **(NME - I)** | **CREDIT:2**  **HOURS:2** |

**Unit I Basic concepts of Mushroom Technology Hours:05**

Mushroom Technology - Introduction, History and Scope. Edible and Poisonous Mushrooms. Importance and nutritive value of edible mushrooms. Mushroom research centers in India

**Unit II Types of mushroom and its cultivation Hours:05**

Cultivation of button mushroom (Agaricus bisporus), milky mushroom (Calocybeindica), oyster mushroom (Pleurotus sajorcaju) and paddy straw mushroom (Volvariella volvcea)

**Unit III Production, Harvest and Storage methods Hours:05**

Isolation and culture of spores, culture media preparation. Production of mother spawn, multiplication of spawn - Inoculation Technique

**Unit IV Cultivation technology Hours:05**

Substrates, composting technology, bed, polythene bag preparation, spawning - Cropping and its importance

**Unit V Mushroom production Hours:04**

Harvest -types and Storage methods and post marketing surveillance and types.

**Text Books**

1. Krishnamoorthy, A.S et al. 1991. Oyster Mushrooms. 2nd edition. TNAU Department of Plant Pathology. Tamil Nadu
2. Suman, B C, and Sharma V P. 2007. Mushroom Cultivation in India. 1st edition. Daya Publishing House. India

**References**

1. NIIR Board of Consultants and Engineers. 2011. Handbook on Mushroom Cultivation and Processing.1st edition. Asia Pacific Business Press Inc. India
2. Biswas S. 2012. Mushrooms: A Manual for Cultivation. 1st edition. PHI Learning Private Limited. New Delhi
3. Thapa, C.D et al. 2017. Mushroom Culture. 1st edition. Agrimoon.com.
4. Russel, S. 2018. Essential guide to Mushroom Cultivation. 2nd edition. Storey

Publishing, United States

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| **SEMESTER: IV**  **PART: IV** | **23UBTHN26: ENVIRONMENTAL MANAGEMENT**  **(NME II)** | **CREDIT:2**  **HOURS:2** |

**Unit I Ecology and Ecosystem Hours: 04**

Ecology - ecosystem and their types - definitions - environmental components and interrelationships - physical, chemical and biological characteristics of environment energy flow and materials cycling.

**Unit II Pollution Hours: 05**

Definition - source of pollution - types of pollution - air, water, soil, noise and radioactive pollution - environmental sanitation - environmental issues - global - national - regional and local

**Unit III Environmental Standards Hours: 05**

Prescribed environmental standards - WHO - Pollution Control Board – risk probability and hazards to humans - toxicology - chemical hazards – biological hazards: disease development and developing countries.

**Unit IV Pollution Control Methods Hours: 05**

Pollution control methods - physical, chemical and biological - waste water treatment - activated sludge process, oxidation ponds and trickling filter - anaerobic process.

**Unit V Environmental Management Hours: 04**

Tool for environment management - Environmental Impact Assessment – waste minimization techniques - environmental planning in urban development – natural resources and sustainable development - environmental ethics.

**Text Books**

1. Joseph, K. and Nagendra, R. 2004. Essentials of Environmental Studies. 2nd edition. Pearson Education. New Delhi
2. Tyler, M.J.R. 2004. Environmental Science. 2nd edition. Thomson Brooks/Cole Publishing. Singapore.

**References**

1. Dhamejam, S.K. 2005. Environmental Science and Engineering. 2nd edition. Kataria sons. Delhi
2. Dubey, R.C. 2006. Environmental Health Ecological Perspectives. 3rd edition. Jones and Bartlett Publishers. USA.