**UNIVERSITY OF RAJSHAHI**

**RAJSHAHI 6205, BANGLADESH**

**Outcome based Curriculum**

**of**

**BACHELOR OF SCIENCE (Honours) IN MICROBIOLOGY**

**Session: 2021-2022**

**Examination Schedule**

B. Sc. (Honours) 1st Year 1st Semester 2022

B. Sc. (Honours) 1st Year 2nd Semester 2022

B. Sc. (Honours) 2nd Year 3rd Semester 2023

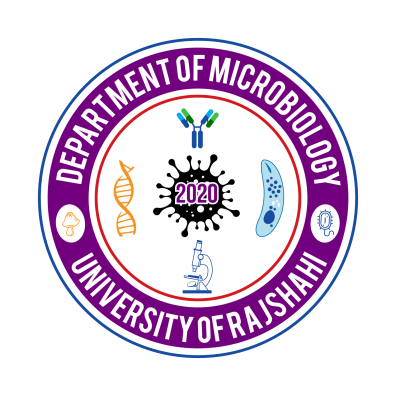
B. Sc. (Honours) 2nd Year 4th Semester 2023

B. Sc. (Honours) 3rd Year 5th Semester 2024

B. Sc. (Honours) 3rd Year 6th Semester 2024

B. Sc. (Honours) 4th Year 7th Semester 2025

B. Sc. (Honours) 4th Year 8th Semester 2025



**DEPARTMENT OF MICROBIOLOGY**

**FACULTY OF BIOLOGICAL SCIENCES**

**PART A**

1. **Title of the Academic Program:**

Bachelor of Science (Honours) in Microbiology

1. **Name of the University:**

University of Rajshahi

1. **Vision of the University:**

To pursue enlightenment and creativity for producing world class human resource to cater for the needs of changing time.

1. **Mission of the University:**

**M1:** To ensure a world-class curriculum with talented academicians and conducive academic and research environment for generation and dissemination of knowledge.

**M2:** To maintain international standards in education with focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state.

**M3:** To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations.

**Core Values:**

CV1: Upholding the spirit of war of liberation in all aspects of life

CV2: Maintaining honesty and integrity and showing mutual respect

CV3: Practicing openness, accountability, and transparency in all academic and administrative affairs

CV4: Ensuring justice for all irrespective of gender, caste, disability, belief and religion

CV5: Inspiring innovation and youth leadership.

1. **Name of the Program Offering Entity:**

Department ofMicrobiology

1. **Vision of the Program Offering Entity:**

The vision of the present program of the Department of Microbiology is to produce high-quality microbiologists with academic and scientific excellence to meet home and abroad demand in the manufacturing, research, service industries and medical sectors.

1. **Mission of the Program Offering Entity:**

**M1:** To prepare students with cutting-edge knowledge in the advance fields of microbiology in order to fulfill the requirements of global trades and to export skilled manpower.

**M2:** To equip students with front-line research facilities for advanced Microbial knowledge, as well as co- and extra-curricular activist and leadership development opportunities, in order to make them internationally standard competent.

**M3:** To train the graduates based on local and international requirements in order to promote innovation, capacity building, entrepreneurship, and the emergence of infectious diseases or the health of other environmental ecosystems.

**M= Mission of the Department**

1. **Objectives of the Program Offering Entity:**

**O1:** To be recognized as a national and international leader in the progression of microbiology education and research.

**O2:** To assist in establishing rational diagnoses of diseases to achieve better health outcomes

**O3:** To improve microbial practice for providing quality health services to the community members

**O4:** To contribute in drug discovery and development exploiting national resources to meet the needs of the twenty-first century challenges.

**O= Objectives of the Department**

1. **Name of the Degree:**

Bachelor of Science (Honours) in Microbiology

1. **Description of the Program:**

The Bachelor of Science (Honours) in Microbiology program offered by the Department ofMicrobiology at the University of Rajshahi is leading and prestigious B. Sc. degrees in Bangladesh. As a developing country, Bangladesh needs to maintain its progress in the public health and medical sectors for the human welfare. This program is designed with modern curriculum that can fulfill the global as well as our national demands in the Microbial fields. Microbiology is the study of the biology of microscopic small living organisms - archaea, bacteria, viruses, algae, fungi, slime molds, and protozoa. Generally this means living organisms that are too small to see without the use of a microscope. These life forms are called microorganisms or microbes. In this program students have to take various sophisticated courses of modern microbiology, which are furnished with theoretical and research tools. The program contains the basic and applied knowledge of general characteristics, isolation, identification and controlling of microorganisms. The program contains genetically engineering plants, animal and microbes for food production. Here, the program also describe the different tools and techniques using biomolecules for microbial ecology, mycology, phycology, cell biology, bacteriology, metabolism and medical microbiology for sustainable development of environment, agriculture, food, pharmaceutical and industrial production. The program also explores the skill developing procedures in English for communication, gathering knowledge of Bangladeshi history, culture and economic status. Apart from that, the students will learn some general education courses, which includes the modern ICT, computational applications for bioinformatics, diseases diagnostic, drug discovery lab safety and research methodology. Upon completion of this program the students will gain advanced knowledge of microbial, pharmaceutical and molecular biological techniques.

1. **Graduate Attributes:**

**GA1:** Comprehensive professional knowledge in the major fields of microbiology, involving agriculture, environment, industry, medical sectors, regulatory affairs, academia and research with the National Skills Framework of Microbiology Policy of the People’s Republic of Bangladesh.

**GA2:** Ability to learn modern microbiology-related information and technology through lifelong learning to improve professional skills.

**GA3:** Critical thinking ability to solve problems and effective planning to manage time and resources with special reference to the microbial and parasitic diseases common in Bangladesh.

**GA4:** Capability to analyse data, interpret scientific reports and perform research independently in the area of microbiology.

**GA5**: Ethical behaviour, including- honesty, sincerity, and integrity to serve as a professional microbiologist.

**GA6:** Leadership skills to apply positive impact and achieve effectively while working in a team of home and abroad.

**GA= Graduate Attributes**

1. **Program Educational Objectives (PEOs):**

The PEOs have been generated by the Department’s curriculum committee based on the vision and mission of the Department of Microbiology and the University of Rajshahi as well as the demand from relevant industrial and academic sectors. It reflects the requirement of the University and responds to the need of regional, national and international microbiology policy. The PEOs are documented in curriculum. PEOs of the Department are set as follows:

**PEO1:** To provide graduates with theoretical and practical knowledge to provide in various areas including microbial industry, agriculture, medical sectors, environment, ecology and research in an international environment.

**PEO2:** To produce skilled graduates by providing suitable training in all aspects required to meet the need of microbiology profession.

**PEO3:** To equip students with interdisciplinary knowledge for emerging capability in solving composite difficulties in the field of Microbial science.

**PEO4:** To offer an excellent academic and research environment that capable the graduates to obtain behavioural, decent and ethical attitudes required for comprehensive professional practice to serve in home and abroad.

**PEO = Program Educational Objective**

1. **Program Learning Outcomes (PLOs):**

The graduates from the Department of Microbiology, University of Rajshahi are expected to develop the following competencies upon completion of B. Sc. (Honours) degree in microbiology.

**PLO1:** Understand and grasp Microbial knowledge and effectively with the basic and advanced techniques of microbiology and communication networks.

**PLO2:** Demonstrate understanding of the methodology and address ethical, professional, global and social impact and humanistic problems in Microbial terms.

**PLO3:** Develop the ability/skill to investigate Microbial information databases thoroughly and uncover new knowledge using rigorous scientific reasoning.

**PLO4:** Acquire laboratory proficiency by honing and improving technical and analytical abilities.

**PLO5:** Be able to examine a wide range of Microbial work-related problems and difficulties, think critically, and conduct independent research studies.

**PLO6:** Capable of presenting academic text, scientific data, demonstration, review and evaluation of scientific paper and public scientific reports, and oral presentations.

**PLO7:** Effective communication, highly effective cooperation, and the essential leadership abilities to build entrepreneurship, including the capacity to assess and reflect on pertinent ethical concerns, transparency, responsibility, and intellectual property, are required.

**PLO8:** Develop observational, analytical and critical thinking skills to solve real-world problems.

**PLO = Program Learning Outcome**

1. **Mapping Mission of the University with PEOs:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Missions** | **M1** | **M2** | **M3** |
| **PEOs** |  |
| **PEO1** | | **3** | **3** | **1** |
| **PEO2** | | **3** | **2** | **2** |
| **PEO3** | | **3** | **3** | **3** |
| **PEO4** | | **3** | **2** | **1** |

**Level of Correlation: 3=High, 2=Medium, 1=Low**

1. **Mapping PLOs with the PEOs:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **PEOs** | **PEO1** | **PEO2** | **PEO3** | **PEO4** |
| **PLOs** |  |
| **PLO1** | | **×** | **×** | **×** |  |
| **PLO2** | |  | **×** | **×** | **×** |
| **PLO3** | | **×** |  | **×** | **×** |
| **PLO4** | | **×** |  | **×** |  |
| **PLO5** | | **×** | **×** | **×** |  |
| **PLO6** | | **×** | **×** | **×** |  |
| **PLO7** | | **×** | **×** | **×** | **×** |
| **PLO8** | | **×** |  | **×** | **×** |

**PLO = Program Learning Outcome, PEO = Program Educational Objective**

1. **Mapping** **Courses with the PLOs:**

**1st Year 1st Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 101 | Introductory Microbiology | **×** | **×** |  |  |  |  |  | **×** |
| BMIC 102 | Basic Techniques in Microbiology | **×** | **×** |  |  |  |  |  |  |
| BMIC 103 | Basic Genetics | **×** |  | **×** |  |  |  |  | **×** |
| BMIC 104 | Basic Plant Sciences | **×** | **×** |  |  |  |  |  |  |
| BMIC 105 | Basic Animal Sciences | **×** | **×** |  |  |  |  |  |  |
| BMIC 106 | Biochemistry and Biomolecules | **×** |  |  | **×** | **×** |  |  |  |
| BMIC 107 | Microbiology Practical I |  |  |  |  |  |  |  | **×** |
| BMIC 108 | Related Practical I |  |  |  |  |  |  |  | **×** |
| BMIC 109 | Field Report/ Excursion I |  |  |  |  |  |  |  | **×** |
| BMIC 110 | Functional English |  |  | **×** | **×** |  |  | **×** |  |
| BMIC 111 | Viva voce I |  |  |  |  |  |  |  | **×** |

**1st Year 2nd Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 201 | Basic Molecular Biology | **×** | **×** |  |  |  |  |  | **×** |
| BMIC 202 | Microbial Ecology | **×** | **×** |  |  |  | **×** |  |  |
| BMIC 203 | Basic Cell Biology |  |  |  |  | **×** |  |  |  |
| BMIC 204 | Human Anatomy and Physiology | **×** |  |  |  | **×** |  |  |  |
| BMIC 205 | ICT and Computer Applications |  |  | **×** |  |  |  | **×** |  |
| BMIC 206 | Basic Chemistry | **×** |  |  |  |  | **×** |  |  |
| BMIC 207 | Microbiology Practical II |  |  |  | **×** |  |  |  | **×** |
| BMIC 208 | Related Practical II |  |  |  |  | **×** |  |  | **×** |
| BMIC 209 | Field Report/ Excursion II |  | **×** |  |  |  |  |  | **×** |
| BMIC 210 | Bangladesh Studies |  |  | **×** | **×** |  |  | **×** | **×** |
| BMIC 211 | Viva voce II |  |  |  |  |  |  |  | **×** |

**2nd Year 3rd Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 301 | General Bacteriology | **×** | **×** |  |  |  | **×** |  | **×** |
| BMIC 302 | Microbial Physiology |  | **×** |  |  | **×** | **×** |  | **×** |
| BMIC 303 | Agricultural Microbiology |  |  |  |  |  | **×** |  |  |
| BMIC 304 | Microbial Genetics | **×** | **×** |  |  | **×** |  |  | **×** |
| BMIC 305 | Biosafety and Biosecurity | **×** |  |  |  |  | **×** |  |  |
| BMIC 306 | Cell and Tissue Engineering |  |  |  |  |  | **×** |  |  |
| BMIC 307 | Microbiology Practical III | **×** |  |  |  |  |  | **×** | **×** |
| BMIC 308 | Related Practical III | **×** |  |  |  | **×** |  | **×** | **×** |
| BMIC 309 | Field Report/ Excursion III | **×** |  |  |  |  |  | **×** |  |
| BMIC 310 | Viva voce III | **×** |  |  |  |  |  |  | **×** |

**2nd Year 4th Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 401 | General Mycology and Phycology |  | **×** |  |  |  | **×** |  | **×** |
| BMIC 402 | Advanced Molecular Biology |  | **×** |  | **×** |  | **×** |  | **×** |
| BMIC 403 | Environmental Microbiology | **×** | **×** |  |  |  | **×** |  | **×** |
| BMIC 404 | Microbial Biotechnology | **×** |  |  |  | **×** | **×** |  | **×** |
| BMIC 405 | Metabolism and Bioenergetics |  |  |  |  | **×** | **×** |  | **×** |
| BMIC 406 | Biostatistics |  |  | **×** |  |  |  | **×** |  |
| BMIC 407 | Microbiology Practical IV | **×** |  |  |  |  |  |  | **×** |
| BMIC 408 | Related Practical IV | **×** |  |  | **×** |  |  | **×** | **×** |
| BMIC 409 | Field Report/ Excursion IV | **×** |  |  |  |  |  |  |  |
| BMIC 410 | Viva voce IV | **×** |  |  |  | **×** |  |  | **×** |

**3rd Year 5th Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 501 | Introductory Virology | **×** |  |  |  |  |  |  |  |
| BMIC 502 | Molecular Cell Biology |  |  |  |  | **×** | **×** |  | **×** |
| BMIC 503 | Fermentation Technology |  | **×** |  |  |  | **×** |  | **×** |
| BMIC 504 | Food Microbiology |  | **×** |  | **×** |  | **×** |  | **×** |
| BMIC 505 | Epidemiology and Public Health | **×** |  |  | **×** |  |  |  | **×** |
| BMIC 506 | Fundamental Immunology |  | **×** |  | **×** |  | **×** |  | **×** |
| BMIC 507 | Microbiology Practical V | **×** |  |  |  | **×** |  | **×** | **×** |
| BMIC 508 | Field Report/ Excursion V | **×** |  |  |  |  |  | **×** | **×** |
| BMIC 509 | Viva voce V | **×** |  |  |  | **×** |  |  | **×** |

**3rd Year 6th Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 601 | Advanced Virology |  | **×** |  |  | **×** |  |  | **×** |
| BMIC 602 | Industrial Microbiology |  | **×** |  |  |  | **×** |  | **×** |
| BMIC 603 | Marine Microbiology | **×** |  |  | **×** |  | **×** |  | **×** |
| BMIC 604 | Advanced Immunology |  |  | **×** |  | **×** |  |  | **×** |
| BMIC 605 | Genetic Engineering |  |  |  |  | **×** |  |  | **×** |
| BMIC 606 | Research Methodology |  | **×** | **×** | **×** |  |  |  | **×** |
| BMIC 607 | Microbiology Practical VI | **×** |  |  |  |  | **×** | **×** | **×** |
| BMIC 608 | Field Report/ Excursion VI | **×** |  |  |  |  |  | **×** | **×** |
| BMIC 609 | Viva voce VI | **×** |  |  | **×** |  |  | **×** | **×** |

**4th Year 7th Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 701 | Medical Microbiology |  |  |  | **×** | **×** | **×** |  | **×** |
| BMIC 702 | Microbial Metabolism |  | **×** |  | **×** |  |  | **×** | **×** |
| BMIC 703 | Food and Beverage Quality Control | **×** |  | **×** | **×** |  | **×** |  |  |
| BMIC 704 | Environmental Pollution and Bioremediation | **×** |  | **×** | **×** |  | **×** |  | **×** |
| BMIC 705 | Enzymology | **×** |  |  |  | **×** | **×** |  | **×** |
| BMIC 706 | Bioinformatics |  |  | **×** |  |  |  | **×** | **×** |
| BMIC 707 | Microbiology Practical VII | **×** |  |  |  |  |  | **×** | **×** |
| BMIC 708 | Field Report/ Excursion VII | **×** |  |  |  | **×** |  | **×** | **×** |
| BMIC 709 | Viva voce VII | **×** |  |  |  |  |  | **×** | **×** |

**4th Year 8th Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Title** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| BMIC 801 | Diagnostic Microbiology | **×** | **×** |  | **×** | **×** | **×** |  | **×** |
| BMIC 802 | Analytical Microbiology |  |  |  |  | **×** |  | **×** |  |
| BMIC 803 | Pharmaceutical Microbiology | **×** |  | **×** | **×** | **×** | **×** |  | **×** |
| BMIC 804 | Nanobiotechnology |  |  |  | **×** | **×** | **×** |  | **×** |
| BMIC 805 | Genomics and Proteomics |  |  |  | **×** | **×** | **×** | **×** | **×** |
| BMIC 806 | Microbiology Practical VIII | **×** | **×** |  |  |  |  |  | **×** |
| BMIC 807 | Field Report/ Excursion VIII | **×** |  |  | **×** |  |  |  | **×** |
| BMIC 808 | Project/ + Internship | **×** |  | **×** |  |  |  |  | **×** |
| BMIC 809 | Viva voce VIII | **×** |  |  |  | **×** |  |  | **×** |

**PART B**

1. **Structure of the Curriculum**
2. **Duration of the program:** Years: Four (4), Semester: Eight (8) [2 semester in each year]
3. **Admission requirements:** As per rules of Rajshahi University Admission Committee.
4. **(i) Total minimum credit requirement to complete the program:** As per the Ordinance of the Faculty

**(ii) Available Credits:** 160

1. **Total class weeks in a semester:** As per the Ordinance of the Faculty
2. **Minimum CGPA requirements for graduation:** As per the Ordinance of the Faculty
3. **Maximum academic years of completion**: As per the Ordinance of the Faculty
4. **Category of Courses:**
5. **Honours Courses (Core courses)**
6. **Related courses (Minor courses)**
7. **Semester Wise Distribution of Courses:**

**(i)** B.Sc. (Honours) 1st Year 1st Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (including minor) | 300 | 3 | 12 |
| English (non-credit)1 | 50 | 0.5 | 00 |
| Practical | 100 | 1.0 | 4 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **475** | **4.75** | **19** |

**(ii)** B.Sc. (Honours) 1st Year 2nd Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (including minor) | 300 | 3 | 12 |
| Bangladesh Studies (non-credit)1 | 50 | 0.5 | 00 |
| Practical | 100 | 1.0 | 4 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **475** | **4.75** | **19** |

**(iii)** B.Sc. (Honours) 2nd Year 3rd Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (including minor) | 300 | 3 | 12 |
| Practical | 100 | 1.0 | 4 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **475** | **4.75** | **19** |

**(iv)** B.Sc. (Honours) 2nd Year 4th Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (including minor) | 300 | 3 | 12 |
| Practical | 150 | 1.5 | 6 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **525** | **5.25** | **21** |

**(v)** B.Sc. (Honours) 3rd Year 5th Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory | 300 | 13 | 12 |
| Practical | 100 | 1.0 | 4 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **475** | **4.75** | **19** |

**(vi)** B. Sc. (Honours) 3rd Year 6th Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory | 300 | 3 | 12 |
| Practical | 150 | 1.5 | 6 |
| Viva-voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **525** | **5.25** | **21** |

**(vii)** B.Sc. (Honours) 4th Year 7th Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory | 300 | 3 | 12 |
| Practical | 150 | 1.5 | 6 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| **Total (credit courses)** | **525** | **5.25** | **21** |

**(viii)** B. Sc. (Honours) 4th Year 8th Semester examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory | 250 | 2.5 | 10 |
| Practical | 150 | 1.5 | 6 |
| Viva voce | 50 | 0.5 | 2 |
| Field report/ Excursion | 25 | 0.25 | 1 |
| Project/+ lnternship2 | 50 | 0.5 | 2 |
| **Total (credit courses)** | **525** | **5.25** | **21** |

1A candidate shall not be allowed to continue the B.Sc. (Honours) program if he/she fails to obtain the letter grade (LG) “S” in the ‘Functional English’ and ‘Bangladesh Studies’ courses in 8 (eight) academic semester from the date of admission. The letter grade “S” corresponds to at least 40% marks.

2Theoretical course(s) may be offered instead, if a department desires.

**19. Administration:** Academic Committee of the respective Department shall design curriculum, allocate courses for teaching, constitute Examination Committee and the panel of examiners as per rules of the University.

**20. Academic Calendar:** The date of beginning and completion of course(s), date of examination, publication of results etc. shall have to be declared by the department concerned through an academic calendar at the beginning of the session. In preparing calendar the following points shall have to be considered as per the Ordinance of the Faculty.

**21. Examination Committee:** As per the Ordinance of the University of Rajshahi.

**22. Examinations:** As per the Ordinance of the Faculty

**26. Medium and Nature of Questions and Answers:** Question shall be made in English. The medium of answers in the examination of all courses shall be English.

**27. Theoretical Examination and Board of Viva voce:**

**27.1** A candidate absenting himself/ herself in a course in an examination, in which he/she ought to have been present, will be considered 'F' grade in that course.

**27.2** Members of the concerned Examination Committee shall be the members of the Board to conduct viva voce.

**28. Laboratory Examination:**

**28.1** The departmental Academic Committee will assign a teacher or a group of teachers to conduct a particular laboratory class or all the laboratory classes of a particular semester, as well as to conduct the laboratory assessment examination of that class during the scheduled course periods.

**28.2** One copy of the marks of the laboratory assessment examination will be sent to the Chairman of the concerned Examination Committee.

**29. Admission Requirements:**

**29.1** Subject to the conditions laid down and conditions as set by the admission committee, students passing Higher Secondary Certificate (HSC) examination or an equivalent examination (twelve class/ years education) of a recognized Board or equivalent institution may be admitted to the program of study leading to the degree of B.Sc. (Honours) on recommendation of the academic committee of the department concerned.

**29.2** To be eligible for admission to B.Sc. (Honours) program, as per rules of Rajshahi University Admission Committee.

**29.3**Admission of Foreign Students: Foreign Students will be admitted as per the ‘Ordinance for Admission of Foreign Students’ of the University of Rajshahi.

**30. Semester wise marks distribution (theory, practical, viva voce and field report/excursion courses) for the Department of Microbiology**:

**PART C**

**1st Year 1st Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subjects** | **Course Code** | **Course Title** | **Marks** | **Units** | **Credits** |
| **Honours** | BMIC 101 | Introductory Microbiology | 50 | 0.5 | 2 |
| BMIC 102 | Basic Techniques in Microbiology | 50 | 0.5 | 2 |
| BMIC 103 | Basic Genetics | 50 | 0.5 | 2 |
| **Related** | BMIC 104 | Basic Plant Sciences | 50 | 0.5 | 2 |
| BMIC 105 | Basic Animal Sciences | 50 | 0.5 | 2 |
| BMIC 106 | Biochemistry and Biomolecules | 50 | 0.5 | 2 |
|  | BMIC 107 | Microbiology Practical I | 50 | 0.5 | 2 |
| BMIC 108 | Related Practical I | 50 | 0.5 | 2 |
| BMIC 109 | Field report/ Excursion I | 25 | 0.25 | 1 |
| **Non-credit** | BMIC 110 | Functional English | **0.5** | **50** | **00** |
|  | BMIC 111 | Viva voce I | 50 | 0.5 | 2 |
| **Total** | | | **475** | **5.0** | **19** |

**1st Year 2nd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subjects** | **Course Code** | **Course Title** | **Marks** | **Units** | **Credits** |
| **Honours** | BMIC 201 | Basic Molecular Biology | 50 | 0.5 | 2 |
| BMIC 202 | Microbial Ecology | 50 | 0.5 | 2 |
| BMIC 203 | Basic Cell Biology | 50 | 0.5 | 2 |
| BMIC 204 | Human Anatomy and Physiology | 50 | 0.5 | 2 |
| **Related** | BMIC 205 | ICT and Computer Applications | 50 | 0.5 | 2 |
| BMIC 206 | Basic Chemistry | 50 | 0.5 | 2 |
|  | BMIC 207 | Microbiology Practical II | 50 | 0.5 | 2 |
| BMIC 208 | Related Practical II | 50 | 0.5 | 2 |
| BMIC 209 | Field report/ Excursion II | 25 | 0.25 | 1 |
| **Non-credit** | BMIC 210 | Bangladesh Studies | **0.5** | **50** | **00** |
|  | BMIC 211 | Viva voce II | 50 | 0.5 | 2 |
| **Total** | | | **475** | **5.0** | **19** |

**2nd Year 3rd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subjects** | **Course Code** | **Title** | **Marks** | **Units** | **Credits** |
| **Honours** | BMIC 301 | General Bacteriology | 50 | 0.5 | 2 |
| BMIC 302 | Microbial Physiology | 50 | 0.5 | 2 |
| BMIC 303 | Agricultural Microbiology | 50 | 0.5 | 2 |
| BMIC 304 | Microbial Genetics | 50 | 0.5 | 2 |
| **Related** | BMIC 305 | Biosafety and Biosecurity | 50 | 0.5 | 2 |
| BMIC 306 | Cell and Tissue Engineering | 50 | 0.5 | 2 |
|  | BMIC 307 | Microbiology Practical III | 50 | 0.50 | 2 |
| BMIC 308 | Related Practical III | 50 | 0.50 | 2 |
| BMIC 309 | Field Report/ Excursion III | 25 | 0.25 | 1 |
| BMIC 310 | Viva voce III | 50 | 0.5 | 2 |
| **Total** | | | **475** | **4.75** | **19** |

**2nd Year 4th Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subjects** | **Course Code** | **Title** | **Marks** | **Units** | **Credits** |
| **Honours** | BMIC 401 | General Mycology and Phycology | 50 | 0.5 | 2 |
| BMIC 402 | Advanced Molecular Biology | 50 | 0.5 | 2 |
| BMIC 403 | Environmental Microbiology | 50 | 0.5 | 2 |
| BMIC 404 | Microbial Biotechnology | 50 | 0.5 | 2 |
| **Related** | BMIC 405 | Metabolism and Bioenergetics | 50 | 0.5 | 2 |
| BMIC 406 | Biostatistics | 50 | 0.5 | 2 |
|  | BMIC 407 | Microbiology Practical IV | 100 | 1.0 | 4 |
| BMIC 408 | Related Practical IV | 50 | 0.5 | 2 |
| BMIC 409 | Field Report/ Excursion IV | 25 | 0.25 | 1 |
| BMIC 410 | Viva voce IV | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**3rd Year 5th Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subject** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Honours** | BMIC 501 | Introductory Virology | 50 | 0.5 | 2 |
| BMIC 502 | Molecular Cell Biology | 50 | 0.5 | 2 |
| BMIC 503 | Fermentation Technology | 50 | 0.5 | 2 |
| BMIC 504 | Food Microbiology | 50 | 0.5 | 2 |
| BMIC 505 | Epidemiology and Public Health | 50 | 0.5 | 2 |
| BMIC 506 | Fundamental Immunology | 50 | 0.5 | 2 |
| BMIC 507 | Microbiology Practical V | 100 | 1.0 | 4 |
| BMIC 508 | Field Report/ Excursion V | 25 | 0.25 | 1 |
| BMIC 509 | Viva voce V | 50 | 0.5 | 2 |
| **Total** | | | **475** | **4.75** | **19** |

**3rd Year 6th Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subject** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credit** |
| **Honours** | BMIC 601 | Advanced Virology | 50 | 0.5 | 2 |
| BMIC 602 | Industrial Microbiology | 50 | 0.5 | 2 |
| BMIC 603 | Marine Microbiology | 50 | 0.5 | 2 |
| BMIC 604 | Advanced Immunology | 50 | 0.5 | 2 |
| BMIC 605 | Genetic Engineering | 50 | 0.5 | 2 |
| BMIC 606 | Research Methodology | 50 | 0.5 | 2 |
| BMIC 607 | Microbiology Practical VI | 150 | 1.5 | 6 |
| BMIC 608 | Field report/ Excursion VI | 25 | 0.25 | 1 |
| BMIC 609 | Viva voce VI | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**4th Year 7th Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subject** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Honours** | BMIC 701 | Medical Microbiology | 50 | 0.5 | 2 |
| BMIC 702 | Microbial Metabolism | 50 | 0.5 | 2 |
| BMIC 703 | Food and Beverage Quality Control | 50 | 0.5 | 2 |
| BMIC 704 | Environmental Pollution and Bioremediation | 50 | 0.5 | 2 |
| BMIC 705 | Enzymology | 50 | 0.5 | 2 |
| BMIC 706 | Bioinformatics | 50 | 0.5 | 2 |
| BMIC 707 | Microbiology Practical VII | 150 | 1.5 | 6 |
| BMIC 708 | Field Report/ Excursion VII | 25 | 0.25 | 1 |
| BMIC 709 | Viva voce VII | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**4th Year 8th Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subject** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Honours** | BMIC 801 | Diagnostic Microbiology | 50 | 0.5 | 2 |
| BMIC 802 | Analytical Microbiology | 50 | 0.5 | 2 |
| BMIC 803 | Pharmaceutical Microbiology | 50 | 0.5 | 2 |
| BMIC 804 | Nanobiotechnology | 50 | 0.5 | 2 |
| BMIC 805 | Genomics and Proteomics | 50 | 0.5 | 2 |
| BMIC 806 | Microbiology Practical VIII | 150 | 1.5 | 6 |
| BMIC 807 | Field Report/ Excursion VIII | 25 | 0.25 | 1 |
| BMIC 808 | Project/ + Internship | 50 | 0.5 | 2 |
| BMIC 809 | Viva voce VIII | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |
| **Grand Total** | | | **4000** | **40.0** | **160** |
| **Non-Credit** | | | **100** | **1.0** | **4** |

**Outcome-Based Curriculum**

**PART C**

**31. Course Description**

**Course Code: BMIC 101**

**Course Title: Introductory Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2020-2021**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment10+Theory 35)

**Rational of the Course:**

Introductory microbiology is the fundamental course for learning on microbiology. This course teach the basic knowledge of microbes, bacteria, archaea, algae, fungi and protists. This course explores the basic knowledge of microorganism’s characteristics, microbiological fields and applications in biological sciences.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain basic knowledge on microbial scope, importance and interdisciplinary relation with life sciences.

**CLO2:** Evaluate organize the proper placement of bacteria in the living world and their modern classification.

**CLO3:** Know morphology, importance and major features of different forms of prokaryotes.

**CLO4:** Apply different types of media requirements of nutrition and physical factors for bacterial growth.

**CLO5:** Achieve a clear concept regarding contributions of microbes in several purposes related to our daily life.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introduction to Science of Microbiology:** Definition and objectives, history of microbiology. Branches of microbiology. Scope and career in microbiology. Definition and applications of microorganisms in human welfare. | Lecture & Assignment | Assignment, Class test & Semester final | **4** | **1 &2** |
| **2** | **Classifications:** Classification of microorganisms. Binomial nomenclature. Whittaker’s five kingdom and Carl Woese’s classification systems and utility. | Lecture & Assignment | Class test & Semester final | **4** | **2, 3** |
| **3** | **General Characteristics:** Prokaryots and eukaryots. Microorganisms’ distribution in nature, occurrence, characteristics, replication and economic importance. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | **3** | **1, 2 & 3** |
| **4** | **Microbial Cells:** Concepts of microbial cells. Morphological characterization, ultra-structure and composition of prokaryotic cells. | Lecture &Discussion | Tutorial & Semester final | **4** | **1, 2 & 3** |
| **5** | **Microbial Growth:** Microbial growth definition, mechanisms, growth phases, growth factors and nutrients. Concept of culture media for microbial growth. | Lecture & Discussion | Tutorial & Semester final | **4** | **1, 2 & 4** |
| **6** | **Microbial Control:** Principles of microbial control; the rate of microbial death; the action of microbial control agents. | Lecture & Assignment | Assignment & Semester final | **4** | **2 & 5** |
| **7** | **Antagonisms:** Definition and characteristic of an antagonist. Different types of antagonism. | Lecture &  Assignment | Assignment & Semester final | **3** | **1, 3 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

* + 1. Chung K, Liu J. Pioneers in Microbiology: The Human Side of Science. World Scientific Publishing. 2017.
    2. Madigan MT, Martinko JM, Parker J. Brock Biology of Microorganisms.12thedition. Pearson. 2009.
    3. Stanier RY, Ingraham JL, Wheelis ML, Painter PR. General Microbiology. McMillan. 2005.
    4. Tortora GJ, Funke BR, Case CL. Microbiology: An Introduction. Pearson Education. 2008.
    5. De A. Practical and Microbiology. The National Book Depot. 5th Edition. 2020.

**Course Code: BMIC 102**

**Course Title: Basic Techniques in Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment10+Theory 35)

**Rational of the Course:**

A general knowledge is needed to handle a microbiology laboratory. The course deals to learn the techniques of designing, good microbiological practices, waste management, and applications of microscope in a microbiology laboratory. The course explains the basic techniques of media preparation, cultivating microbes, microorganisms staining, sterilization, equipment handling, identification by molecular techniques and preservation.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain **k**nowledge on basic techniques of microorganism’s culture and management.

**CLO2:** Acquire the basic knowledge of microscopes and microscopy using and maintenance.

**CLO3:** Understand the principles of sterilization, disinfection and pasteurization of lab. equipment and materials.

**CLO4:** Know about microbial characteristics, importance, nutritional requirements and growth measurement.

**CLO5:** Apply the protocol for microorganism’s cultural, identification, staining and preservation.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Microbiology Laboratory:** Introduction of microbiology laboratory. Microbial practices and management. | Lecture & Discussion | Quiz, Assignment & Semester final | 3 | **1** |
| **2** | **Microscopy:** Principles, functions and applications of microscopes. Unit measurement-magnification, resolving power and numerical apparatus. Introducing different types of microscopy. | Lecture, Open discussion & Assignment | Quiz, Assignment, Tutorial & Semester final | 4 | **1** & **2** |
| **3** | **Sterilization Techniques:** Concept of sterilization, methods of sterilization, sterilization equipment’s, materials, inoculums and aseptic techniques. | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1**&**3** |
| **4** | **Media Preparation and Culture:** Media preparation, storage and applications. Culture techniques of aerobic and anaerobic microbes. | Lecture, Discussion&  Assignment | Assignment, Tutorial & Semester final | 4 | **1,2**&4 |
| **5** | **Measurement of Growth:** Direct microscopy. Standard plate count. Dilution plate, membrane filtration and turbidity metric method. | Lecture, discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &4** |
| **6** | **Microbe’s identification and Preservation:** Microorganisms isolation and identification by biochemical, serological, and molecular techniques. Principles, types and techniques of culture preservation. | Lecture &  Assignment | Assignment, Tutorial & Semester final | 4 | **1, 3**&5 |
| **7** | **Staining of microorganisms:** Preparation of microorganisms for microscopic observations. Chemical properties of staining. Different mechanisms of microbial staining. | Lecture& Discussion | Class test & Semester final | 3 | **1, 4**&5 |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Michael TM, John MM, Paul, David PC. Brock Biology of Microorganisms. Pearson Prentice Hall, 2012.
2. Michael JPJR, ChanECS, Noel RK. Microbiology: Concepts and Applications. McGraw Hill Inc. 1993.
3. Gerand JT, Berdell RF, Christine L. Microbiology: An Introduction. Boston, 2016.
4. Hans GS, Zaborosch C, Kogut M. General Microbiology. Cambridge University Press, 1993.
5. De A. Practical and Microbiology.The National Book Depot. 5th Edition. 2020.

**Course Code: BMIC 103**

**Course Title: Basic Genetics**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment10+Theory 35)

**Rational of the Course:**

This course is effective to know the role of genes in inheritance pattern. The course explores basic principles of Mendelian and non-Mendelian genetics and their interactions with environment. This course deals the genetics underlying traits, genetic variation and inheritance pattern and population’s genetics.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Explain the Mendel works, history and discovery of Mendel’s law.

**CLO2:** Acquire knowledge of gene interaction, types and expression.

**CLO3:** Understand the applications of inheritance, multiple allelism, lethal alleles and sex-linked transmission.

**CLO4:** Gather knowledge oncytoplasmic inheritance, chromosomal variation, and rearrangements.

**CLO5:** Evaluate the basic principles and research methods of genetics and are populations maintained.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Genetics and Mendel’s Laws:** Definition, background, branches and importance of genetics. Mendel’s law of segregation and independent assortment of alleles. Exception of Mendel’s law. | Lecture &Assignment | Tutorial &  Semester final | 4 | **1&2** |
| **2** | **Gene Interaction:** Types of gene and gene interaction. Explanation of dominance, recessive and lethal gene. | Lecture& Assignment | Assignment, Tutorial, &  Semester final | 4 | **1 & 2** |
| **3** | **Linkage and Crossing Over:** Definition of linkage and crossing over. Coupling and repulsion, hypothesis of linkage. | Lecture & Discussion | Assignment & Semester final | 4 | **1&3** |
| **4** | **Multiple Alleles:** Definition, types, expression of multiple alleles with examples. | Lecture &Quiz | Tutorial & Semester final | 3 | **1&3** |
| **5** | **Cytoplasmic Inheritance and Chromosome:** Definition and background of cytoplasmic inheritance. Cytoplasmic male sterility. Definition, structure and functions of chromosomes. Rearrangements, aneuploids and polyploids. | Lecture, Discussion & Assignment | Class test, Tutorial&, Semester final | 4 | **1&4** |
| **6** | **Population Genetics:** Definition, origins and applications of population genetics. Hardy-Winberg Law. Genetic equilibrium. | Lecture, Discussion& Quiz | Tutorial & Semester final | 3 | **1&5** |
| **7** | **Genetic Models of Evolution:** Changes of gene and genotype frequency. Selection, mutation, drift, migration and non-random mating. Population genetics and its critics. | Lecture& Assignment | Class test, &  Semester final | 4 | **3, 4 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Klung. Concepts of Genetics. Pearson. 12thEdition, 2018.
2. Sambamurty AVSS. Handbook of Genetics. Narosa Publishing House, New Delhi. 2005.
3. Singh BD. Fundamentals of Genetics. Kalyani Pub., New Delhi, 2014.
4. Snustad DP, Simmons MJ, Jenkins JB. Principles of Genetics. Wiely publishers.1st Edition. 1997.
5. Strickberger MW. Genetics. Pearson India; 3rdEdition, 2015.
6. VermaPS, Agarwal VK. Genetics. S. Chard and Company Ltd, New Delhi, 2009.
7. Singh P. Genetics. Kalyani Publishers, 3rd Edition.2016.

**Course Code: BMIC 104**

**Course Title: Basic Plant Sciences**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course basic plant sciences explains origin, biodiversity, external and internal morphology, reproduction, ecology and significance of plant kingdom. It also deals plants respond, adapt to the environment and consequences of the interactions in quality production. The course is essential to learn plants and pathogens relationship and their usefulness in human welfare.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the basic knowledge of plants importance, implication and present and future aspects of plant- based medicines for health care.

**CLO2:** Know about plant ecology, plant genetics and the interpretation of social networking and applications.

**CLO3:** Explain the plant life cycles and phase changes mechanisms.

**CLO4:** Apply the vegetative developmentprocess of plants.

**CLO5:** Evaluate the process of reproduction and death plants.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introductory Plant Sciences:** Definition and importance of plants. Plants uses as foods and other purposes. Present and future of plant-based medicines for health. | Lecture, Open discussion, Assignment | Quiz, Assignment, Class test & Semester final | 4 | **1** |
| **2** | **Plant Ecology:** Plant kingdom. Photosynthetic eukaryotes, cells assembled and multicellular plants. Scope and challenges of the terrestrial environment. | Lecture, Assignment | Assignment, Tutorial & Semester final | 3 | **1 &2** |
| **3** | **Social Networking of Plants:** Overview of Plant interactions, Plants-arthropods relationship. Plant–Plant interactions. | Lecture, Assignment | Tutorial & Semester final | 4 | **2** |
| **4** | **Life Cycles:** Concept of plant life cycle and it’s stages. Life cycle of *Arabidopsis thaliana* as model plant. | Lecture, & Discussion | Quiz & Semester final | 3 | **1**&**3** |
| **5** | **Concept of Phase Changes:** Juvenile phase, adult phase, and changes in meristem identity. | Lecture, Quiz & Assignment | Quiz, Tutorial, Presentation & Semester final | 4 | **2**&**3** |
| **6** | **Vegetative Development of Plants:** Leaf development, Shoot development and Root development. | Lecture, Quiz & Assignment | Quiz, Tutorial, Presentation & Semester final | 4 | **1**&**4** |
| **7** | **Reproductive Development and The End  of Plant:** Flower development. Senescence and cell death. | Lecture, Open discussion | Quiz, Tutorial, Presentation & Semester final | 4 | **1, 2 &5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Dube HC. A Textbook of fungi, Bacteria and Viruses. Vikas Pub. House. Pvt. Ltd. India, 3rd Edition, 2009.
2. Mukerjee SK. College Botany (Vol. III). New Central book Agency. 2016.
3. Odum EP. Fundamentals of Ecology.Oxford and IBH Pub. 2007.
4. Pandey BP. Plant Anatomy. S. Chand and Com Ltd. India. 2012.
5. Sammbanurty AVSS, Subrahmanyam NSS.A Textbook of Modern Economic Botany. CBS Publ. and Dis. 1998.
6. Shukla RS, Chandel PS. Plant Ecology and Soil Science. S. Chand and Com. Ltd. India.9th Edition. 2000.
7. Gillings M, Holmes A. Plant Microbiology.BIOS Scientific Publishers. 1st Edition. 2019.

**Course Code: BMIC 105**

**Course Title: Basic Animal Sciences**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Basic animal sciences provide the knowledge on introduction of important animals, model organisms in biological research, special care and diseases of animals, anatomy and reproductive organs of farm animals. It discloses the importance of biopesticide, biofertilizer, and biological méthode for Pest management. This knowledge is helpful for advanced study of microbes and diseases interactions.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain basic concepts of animal sciences, objectives, careers and economic importance of animal sciences.

**CLO2:** Explores knowledge of animal kingdom, classification, structure, functions, and relationships.

**CLO3:** Assure the applications of applied animal sciences, pest, pest management and microbes interactions.

**CLO4:** Introduce with special techniques and procedures involved in the field of animal care and diseases.

**CLO5:** Know about basic concept of animal developmental biology and anatomy.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Animal Science Concept:** Definition and objectives of animal sciences. Careers in animal science. Economic importance of animals. | Lecture &  Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Animal Kingdom:** Animal etymology, characteristics, reproduction and development. Ecology and diversity of animals. Classifications and features of animal kingdom. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**2** |
| **3** | **Animal Husbandry:** Definition and branches of animal husbandry. Animal feed, probiotics and prebiotics, animal breeding, and animal products. | Lecture & Discussion | Assignment & Semester final | 4 | **1, 2 & 3** |
| **4** | **Applied Animal Sciences:** Study of applied animal science. Potential careers. Comprise of applied animal nutrition, breeding and genetics, livestock, aquaculture and poultry management. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1,2**&  **3** |
| **5** | **Animals-Microbes Interactions:** Diseases caused by microorganisms in animals. Pests, diseases and disorders of animals. Factors associated with diseases in animals. Animal transmitted diseases. Pest and pest management. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **3** |
| **6** | **Developmental Biology:** Gametogenesis, spermatogenesis and oogenesis. Parthenogenesis in animal kingdom. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **5** |
| **7** | **Animal Anatomy:** Concept of animal anatomy. Introduction to cells, tissues and organs. | Lecture &  Assignment | Assignment& Semester final | 3 | **1 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Ganguly BB, Sinha AK, Adhikari S. Biology of Animals. Calcutta, India. 2011.
2. Grove AJ and Newell GE. Animal Biology. Universal Book Stall. New Delhi. 6th Edition.
3. Gullan PJ, Cranston PS. The Insects: An Outline of Entomology. Wiley-Blackwell. 5thEdi. 2014.
4. Kotpal RL. Modern Textbook of Zoology (Invertebrates).Rastogi Publications, India. 2012.
5. Kotpal RL. Modern Textbook of Zoology (Vertebrates).Rastogi Publications, India. 2010.
6. Verma PS, Srivastava PC. Advanced Practical Zoology. 2000.

**Course Code: BMIC 106**

**Course Title: Biochemistry and Biomolecules**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Biochemistry and biomolecules deals with chemical processes involving living system which will help to studies of microbiology and molecular biology. This course gives information about basic biochemical and bimolecular process of carbohydrates, amino acids, proteins, lipids water, vitamins and enzymes and their mechanism, metabolism, expression and transmission.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Know theconcept of biochemistry, scopes and prospects, relationship of biochemistry with microbiology.

**CLO2:** Learn the importance of carbohydrate, amino acids, protein, lipid, alkaloids and nucleic acids.

**CLO3:** Assure the applications of vitamins and hormones in the fields of biology.

**CLO4:** Know the basic concepts of water, structure, properties, pH indicator and buffer systems in human body.

**CLO5:** Accumulate, integrate and apply the vital biochemical information of enzymes.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Concepts of Biochemistry:** Scopes and prospects, relationship of biochemistry with biology, chemistry, medicine, agriculture, industry and diseases. | Lecture, Open discussion & Assignment | Assignment,  Class test & Semester final | 3 | **1** |
| **2** | **Carbohydrates and Glycobiology:** Nomenclature, classification and functions. Method of estimation. Natural sources. Reducing and non-reducing sugars and amino sugars. Ketogenic diets. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1**&**2** |
| **3** | **Proteins:** Introduction and classification. Natural sources. Amino acid, peptides and protein. Protein structure and functions. | Lecture & Discussion | Tutorial & Semester final | 4 | **1**&2 |
| **4** | **Lipids:** Nomenclature, classification and reactions of fatty acids. Sterols and methods of estimation. Structure and biological functions. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &2** |
| **5** | **Vitamins and Hormones:** Sources, classification and occurrence of vitamins. Deficiency symptoms and biological functions of vitamins.  Definition, types, chemistry, structures and synthesis of hormones. Biological functions and treatment of hormones. | Lecture, Quiz &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **6** | **Water:** Concepts, structure and properties. Effects of hydrogen bonding. Ion product of water, acid and base. Henderson-Hasselbach equation, pH and pH indicator. Buffer systems in our body. | Lecture, Quiz &  Assignment | Assignment, Class test & Semester final | 4 | 1 & 4 |
| **7** | **Enzymes:** Definition, nomenclature, classifications and characteristics of enzymes. | Lecture &  Assignment | Class test & Semester final | 3 | 1 &5 |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

* + 1. David LN, Michael MC. Lehninger Principles of Biochemistry. Macmillan Pub. 4th Edition. 2005.
    2. Robert KM, Daryl KG. Harper’s Biochemistry. McGraw Hill Books. 25th Edition. 1998.
    3. Jain JL, Sunjay J, Nitin J. Fundamentals of Biochemistry. S. Chand & Company. 2016.
    4. Harold V. Practical Clinical Biochemistry. CBS, New Delhi. 6th Edition. 2006.
    5. Ferrier DR. Biochemistry. Wolters Kluwer. 6th Edition. 2014.

**Course Code: BMIC 107**

**Course Title: Microbiology Practical** I

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the practical knowledge of basic microbiological techniques.

**CLO2:** Show the basic techniques using in a microbiology laboratory management for safe use.

**CLO3:** Explain the basic knowledge of gene, chromosome and genetic tools.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Introductory Microbiology):**  Identification and applications of major instruments  Collection, isolation, preservation and identification of bacteria and fungi from different samples.  Gram staining test | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **1** |
| **2** | **Unit B (Basic Techniques in Microbiology):**  Light microscopy: principles, parts & function, operation.  Microscopy of different microbes.  Preparation of microbial media.  Principle & operation of Lab. equipment.  Cotton blue staining | Continuous internal evaluation, viva voce & Semester final examination. | 5 | 2 |
| **3** | **Unit C (Basic Genetics):**  Chi- square test for Mendel’s law and modification, multiple alleles.  Changes of gene frequency for mutation, genetic drift, migration and selection.  Population selection and polymorphogenesis | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **3** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 108**

**Course Title: Related Practical** I

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the practical knowledge on basic plant science.

**CLO2:** Gain practical knowledge on basic animal sciences.

**CLO3:** Explain the basic techniques related to basic biochemistry.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Basic Plant Sciences):**  Identification of plants on plant biodiversity.  Plant collection and herbarium preparation.  Identification of plant diseases and inoculums preparation.  Identification of diseases, host and pathogen.  Plant development study | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Basic Animal Sciences):**  Collection and identification of different animals and organs  Mountings and slide preparation  General anatomy of selected parts of animals.  Collection and identification of insects and pest along with IPM  Visit of dairy, sheep, goat and buffalo farms of Bangladesh. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | 2 |
| **3** | **Unit C (Biochemistry and Biomolecules):**  Components isolation from plants and animals samples  Color reactions of carbohydrates  Identification of secondary metabolites, proteins and lipids from plant/animal source  Qualitative test for Carbohydrate, protein, DNA | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **3** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 109**

**Course Title: Field report/ Excursion I**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 110**

**Course Title: Functional English**

**Course Type: Non-credit**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Functional English deals with the efficiency of English grammar for pre-reading, writing and speaking activities for effective communication as well as oral presentation of a scientific paper. This course is also effectives for writing thesis paper, research article, and poster preparation following ethical issues.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the concept of functional English perquisites, uses and benefits of functional English.

**CLO2:** Introduce about the basic knowledge of English including grammar.

**CLO3:** Know the implication of English for scientific writing and reading.

**CLO4:** Understand listening and communicating with desired person.

**CLO5:** Apply scientific articles, project, thesis, paragraphs reports and writing ethical issues.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introduction:** Concept of functional English.  Perquisites of functional English. Uses of functional English. Benefits of functional English. | Lecture, discussion & Assignment | Assignment,  Class test & Semester final | 3 | **1** &**2** |
| **2** | **Grammar and Usage:** Noun, subject-verb, prepositions and tenses. Sentences simple, complex, fragments, run-ons, misplaced and dangling modifier. Mechanics capitalization, number style and punctuation. | Lecture, Open discussion & Assignment | Assignment,  Class test, Tutorial & Semester final | 4 | **1** &**2** |
| **3** | **Reading:** Textual reading. Making deductions and drawing logical conclusions from reading and reading for others. | Lecture& Open discussion | Assignment,  Tutorial & Semester final | 4 | **1**&**3** |
| **4** | **Writing:** Concept of writing, types of writing, comprehension and summary writing. Writing in newspaper, magazine, newsletters etc. | Lecture & Open discussion | Class test & Semester final | 4 | **1 & 3** |
| **5** | **Discourse:** Listening and understanding communications. Taking part in group discussion, reading and participating. | Lecture & Open discussion | Assignment,  Class test & Semester final | 4 | **4** |
| **6** | **English for Science:** Writing a project, thesis and research paper. Conceptual model, planning experiment, design, data recording, writing results, organizing and presenting information revising and editing. Preparation and presentation of oral and poster. | Lecture, Open discussion &  Assignment | Presentation, Assignment, Class test & Semester final | 4 | **1, 2**&**5** |
| **7** | **Ethical Issue:** Ethical issues of project, thesis and article writing. Plagiarism and similarity checking. | Lecture & Discussion | Tutorial & Semester final | 3 | **2 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Chowdhury MYA, Hossain MM. Advanced Learners Functional English. Adv. Publication. Dhaka, 2015.
2. Berry TE. The Most Common Mistakes in English Usage. Tata McGraw-Hill publishing company limited, New Delhi. Indian Edition.
3. Fitikedes TJ. Common Mistakes in English. Longman group limited, London. 200th Edition.
4. Jasim UM. Planning Research and Writing Research Papers. Bangla prokashoni. 2004.
5. Robert AD, Gastel B. How to Write and Publish a Scientific Paper. Greenwood. 7th Edition. 2011.
6. Cambridge IELTS series (1-14).Cambridge university press.

**Course Code: BMIC 111**

**Course Title: Viva voce I**

**Course Type: Core and related**

**Credits: 2**

**Year/ Semester: 1st Year 1st Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 101 to BMIC 106

**Course Code: BMIC 201**

**Course Title: Basic Molecular Biology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course plays an important role to know the basic of prokaryotic and eukaryotic concept, functions and importance of molecules. This course deals the basic structure and pathway of gene, genetic code, process of genetic manipulation, gene expression, regulations and anomalies of plant and animals cells.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about DNA, RNA and gene structure, functions and their regulatory elements.

**CLO2:** Know about the origin, history, properties, codon tables and genetic codes.

**CLO3:** Apply replication of DNA, mechanism of transcription and translation of tRNA, mRNA and rRNA.

**CLO4:** Understand the protocol of DNA extraction and gel docking.

**CLO5:** Achieve knowledge of PCR amplification procedures.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Genetic Elements:** DNA structure. Watson Crick Double helix model. Features of DNA helix, Chargaff’s rule. DNA supercoils. RNA structure, classification and functions. Structure of a gene, their promoters and regulatory elements. | Lecture, Assignment,&  Class test | Assignment,  Class test, Tutorial & Semester final | 4 | **1** |
| **2** | **Genetic Code:** Origin and history. Properties, standard codon tables, alternative genetic codes. | Lecture & Assignment | Tutorial & Semester final | 3 | **1 & 2** |
| **3** | **Replication:** Replication of DNA, mode of replication. Enzymes of DNA replication and its control in prokaryotic and eukaryotic system. | Lecture, Discussion &Assignment | Class test, Tutorial &  Semester final | 4 | **1 &3** |
| **4** | **Transcription:** Mechanism of transcription. Transcription initiation complex, inhibition and regulation. Mechanism of RNA splicing and RNA processing. Structure of rRNA and tRNA. | Lecture, Open discussion & Assignment | Assignment, Tutorial, &  Semester final | 4 | **1 &3** |
| **5** | **Translation:** Activation initiation, elongation and termination of protein biosynthesis. Functions of tRNA, post transcriptional modification of tRNA, mRNA and rRNA. | Lecture, Open discussion &Assignment | Assignment, Tutorial &  Semester final | 4 | **1 &3** |
| **6** | **DNA Extraction, Amplification and Gel Docking**: Preparation and extraction of total DNA from bacterial, plant and animal cells. Purification of DNA from living cells. | Lecture & Open discussion | Class test & Semester final | 3 | **2**&**4** |
| **7** | **PCR:** Selective amplification of genomic DNA and fragments concept. Principles, procedure, stages and optimization of PCR. Applications, advantages, limitations and variations of PCR and gel electrophoresis. | Lecture & Open discussion | Assignment, Class test & Semester final | 4 | **1,2**&5 |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Alberts B, Bray D, Lewis J. Molecular Biology of the Cell. Garland Publishing Inc. USA. 2007.
2. Berg JM, Tymoczko JL, Stryer L. Biochemistry. Palgrave MacMillan. 7th Edition. 2011.
3. Darnell J, Lodish H, Baltimore D. Molecular Cell Biology. Scientific Amer Inc. 2nd Edi. 1990.
4. Nelson DL, Cox MM. Lehninger. Principles of Biochemistry. W. H. Freeman and Company. USA. 6th Edition. 2012.
5. Voet D, Voet JG. Biochemistry.John Wiley and Sons.4th Edition. 2010.
6. Watson JD, Baker TA, Bell, Gann A, Levine M, Losick R. Molecular Biology of the Gene. Pearson. 7th Edition. 2013.

**Course Code: BMIC 202**

**Course Title: Microbial Ecology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Microbial ecology relates with public health, environment, soil quality, microorganisms infection and transmission patterns. It includes the basic study of genetic materials of various microorganisms, which are essentials for advance research in microbiology. This contents will be helpful to know the roles of microbes for sustainability of a global ecosystem.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain knowledge of evolution, diversification, microbial structures and behavior patterns of microbes.

**CLO2:** Introduce about the harnessing microbial ecology for public health.

**CLO3:** Know about climate change, environmental diversity, microbial habitats and nature of airborne microbes.

**CLO4:** Explain the elements of microbial communities and microbial interactions in global ecosystems.

**CLO5:** Understanding the implications of microbial adaptations and degradation in a microbial ecosystem.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Microbial Ecology Concept:** Scope of microbial ecology, historical overview, relation of microbial ecology to general ecology. Microbial ecology and role of microorganism in ecosystem. | Lecture, Discussion & Assignment | Assignment, Tutorial &Semester final | 3 | **1** |
| **2** | **Microbial Ecology and Public Health:** Harnessing microbial ecology for public health. Importance of understanding microbial ecology. Interaction of antibiotic and antimicrobial uses with microbial ecology. Unfolding the microbiome‘s potential. | Lecture, Open discussion & Assignment | Tutorial, Assignment & Semester final | 4 | **2** |
| **3** | **Microorganism’s Natural Habitats:** Climate change and microbial ecology. Diversity of microbes. Microbial habitats. Airborne microbes. | Lecture, Discussion & Assignment | Quiz, Assignment & Semester final | 4 | **1**&**3** |
| **4** | **Microbial Communities:** Definition and elements of microbial communities. Patterns and processes of microbial community assembly. | Lecture & Open discussion | Class test, Tutorial & Semester final | 3 | **1 & 4** |
| **5** | **Microbial Interactions:** Classes, regulations and applications of microbial interactions. Unique microbial interactions. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2 &** |
| **6** | **Microbial Adaptations:** Concept of microbial adaptations. Mechanisms and implications of microbial adaptation. Adaptation and preservation of ecological stability. | Lecture& Assignment | Tutorial &Semester final | 4 | **1**& **5** |
| **7** | **Microbial Degradations:** Definition, mechanisms and factors of microbial degradation. Applications and importance of microbial degradation. | Lecture, Open discussion & Assignment | Tutorial & Semester final | 4 | **1, 3 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Atlas RM,Bartha R. Microbial Ecology: Fundamentals & Applications. 4thedition. USA.2000.

2. Atlas RM. Microbiology: Fundamentals and Applications. 2ndEd. MacMillan Pub.Com. 1989.

3. Madigan MT, Martinko JM, Parker J. Brock Biology of Microorganisms. 12th edition.Pearson. 2009.

4. Campbell RE. Microbial Ecology.Blackwell Scientific Publication, Oxford, England. 1983.

5. Maier RM, Pepper IL, Gerba CP. Environmental Microbiology. Academic Press. 2009.

6. Lynch JM, Poole NJ. Microbial Ecology: A Conceptual Approach, John Wiley & Sons, 1979.

**Course Code: BMIC 203**

**Course Title: Basic Cell Biology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

This course introduces the cell concept, structure, functions and mechanisms underlying mitotic and meiotic cell divisions. It discusses cell organelles, protein sorting, vesicular trafficking, cytoskeletal components and chromosomal abnormalities. The course also discuss about intracellular trafficking, cell cycle, cell-cell adhesion in both somatic and germ cells which are important for molecular study of microbes.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Interpret the basic concepts of cell biology, cell theory, nature and structure of plant and animal cells.

**CLO2:** Introduces the basic knowledge of prokaryotic and eukaryotic cells characteristics and structure.

**CLO3:** Explain cell membrane structure and functions.

**CLO4:** Know about the different types of cell division, membrane transport, types and cellular processing.

**CLO5:** Understand the concepts and mechanisms of intracellular trafficking.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Concepts of Cell Biology:** Introduction of Cell biology. Definition and types of cell. The nature and function of cells. Discovery of cell and cell theory. Definition, structure and functions of plant and animal cells. | Lecture, Discussion & Assignment | Assignment,  Class test & Semester final | 4 | **1** |
| **2** | **Prokaryotic Cells:** Definition and characteristics of prokaryotic cells. Structure and functions of prokaryotic cells. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1** |
| **3** | **Eukaryotic Cells:** Definition and characteristics of eukaryotic cells. Structure and functions of eukaryotic cells. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **4** | **Membrane Structure:** Models of membrane structure, Membrane lipids, proteins and carbohydrates. Eukaryotic and prokaryotes cell membrane. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 3 | **1 &2** |
| **5** | **Cell Division:** Concept and history of prokaryotic and eukaryotic cells division. Phases of prokaryotic and eukaryotic cells division. Variants and degradation. Stages of mitosis and meiosis. Bacterial cell division. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&3 |
| **6** | **Membrane Transport:** Membrane transport. Types of transporters. Endocytosis. Organelles and transport across the membrane. | Lecture &  Assignment | Class test &Semester final | 4 | **1**&4 |
| **7** | **Intracellular Trafficking:** Concepts and causes of intracellular trafficking. Trafficking between the Golgi and Endosomes. The endocytic and secretory pathway. Intracellular trafficking and secretion of very low-density lipoprotein. | Lecture & Assignment | Assignment & Semester final | 3 | **2 &5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Karp G. Cell and Molecular Biology: Concepts and Experiments. 6thEdition.John Wiley & Sons.Inc. 2010.

2. De Robertis E.D.P, De Robertis, E.M.F. Cell and Molecular Biology.8th Edition. Philadelphia. 2006.

3. Hausman RE. The Cell: A Molecular Approach. VEdition.ASM Press & Sunderland.2009.

4. Becker WM, Kleinsmith LJ, Hardin. J, Bertoni GP. The World of the Cell. 7th Edition. San Francisco. 2009.

5. Bruce A, Alexander J, Julian L, David M, Peter W. Molecular Biology of the Cell. 6th edition. Garland Science. 2014.

**Course Code: BMIC 204**

**Course Title: Human Anatomy and Physiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course Human Anatomy and Physiology gives comprehensive coverage of human physiological systems, structure and functions. As a course, it connects science, medicine, and health, and creates a framework for understanding how the human body adapts to stresses, physical activity and microbial infection. The course builds from knowledge of function at the cellular level of major body systems at level of the whole organism.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the human anatomy and physiology and its implication for human welfare.

**CLO2:** Understand functions, working techniques, factors, and prevention of circulatory system problems.

**CLO3:** Know the components of human digestive system, functions and clinical significance.

**CLO4:** Explain the respiratory, and urinary systems and their interaction.

**CLO5:** Understanding the endocrine, reproductive and nervous systems of human body.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Human Anatomy:** Human body and anatomy. Fast facts on anatomy. History and importance of human anatomy. Ways to explore human anatomy. Anatomy of different organs and systems. | Lecture & Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Human Physiology:** Introduction, fast facts, history and importance of human physiology. Biological systems and branches of physiology. Physical therapy. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1**& **2** |
| **3** | **Digestive System:** Introduction, components and functions of human digestive system. Development and clinical significance of digestive system. | Lecture & Assignment | Assignment Tutorial & Semester final | 4 | **1**& **3** |
| **4** | **Respiratory and Urinary System**: Urinary system. Organs and functions of urinary system. Control of the urinary system. Mechanics of ventilation. Interaction of respiratory and urinary systems. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**& **4** |
| **5** | **Endocrine System:** Study of endocrine hormones signals throughout the organism, helping it to respond in concert. The principal endocrine glands–the pituitary, thyroid, adrenals, pancreas, parathyroids, gonads and endocrine hormones. | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1**& **5** |
| **6** | **Reproductive Systems:**  Reproductive organs development. Male and female reproductive system. Androgen production and physiological effects in males. Synthesis, secretion and effects of estrogen. | Lecture, Discussion & Assignment | Tutorial & Semester final | 4 | **1, 2**&**5** |
| **7** | **Nervous System:** Prenatal and postnatal development of the human nervous system. The central nervous and peripheral nervous system. | Lecture & Discussion | Tutorial & Semester final | 3 | **5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Chatterjee CC. Human Anatomy and Physiology. Central Book Agency, India 2018.
2. Chaurasia BD. Human Anatomy. CBS Publishers.7th Edition, 2018.
3. Drake RL, Vogl W, Mitchell AWM and Gray HC. Gray's anatomy for students. Elsevier. 2010.
4. Ganong WF. Review of Medical Physiology. McGraw Hill Companies. 26th Edition.
5. Marieb EN. Human Anatomy and physiology Benjamin. Scientific publishing, California. 9th Edition. 2012.
6. Smith E, Pateson CR, Scratecherd T, Read NW. Text Book of physiology. Hongkong. 2011.

**Course Code: BMIC 205**

**Course Title: ICT and Computer Applications**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 30**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

ICT and computer applications need to develop methods and software tools for understanding biological data analysis and interpret. Computer programming helps to better understanding the genetic basis of disease, unique adaptations, desirable properties, or differences between populations. Moreover, computer application consists of introduction, uses and application of computer software in biology for daily life.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the components, models of access and impact of information and communication technology.

**CLO2:** Know the concepts of computers, computer software and operating systems.

**CLO3:** Understand the internet security, database, information retrieval, alignment, and searching methodology.

**CLO4:** Learn the techniques of sequence alignment methods, scoring matrices and heuristic database searching.

**CLO5:** Apply phylogenetic tree, construction of algorithms and phylogenetic models data for research.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Information and Communication Technology (ICT):** Etymology. Components of an ICT system. Models of access to ICT. Impact of ICT in biology. | Lecture & Assignment | Assignment,  Class test & Semester final | 4 | **1** |
| **2** | **Concept of Computers:** Basic concept of computers and microcomputer system. Computers applications and its impacts in biological sciences. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1 & 2** |
| **3** | **Computer Software and Operating Systems:** Different types of operating systems and applications. Basic of software, package programmes and programming language. Referencing software. Application of MS Word, Excel, PowerPoint, Photoshop and usable program. | Lecture & Open discussion | Class test & Semester final | 4 | **1 & 2** |
| **4** | **Internet Application and Security:** Information security learning. Internet basics, applications, digital signature, antivirus software, troubleshooting and maintenance. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &3** |
| **5** | **Database Concepts:** Basic concepts of database, database software, database structure, database management system and its merits-demerits. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **1**&**3** |
| **6** | **Sequence Alignment and Analysis:** Sequence alignment, alignment methods, scoring matrices and heuristic database searching. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **4** |
| **7** | **Phylogenetic Analysis:** Phylogenetic tree basics and construction algorithms. Elements of phylogenetic models. Data analysis. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Gillings M R, Hilbert M, Kemp D J. Information in the Biosphere: Biological and Digital Worlds. Trends in Ecology & Evolution. 2016.
2. Rahman M L, Hossain MA. Computer Fundamentals. Systech, Dhaka 2011.
3. Murrill PW, Smith CL. Introduction to Computer Science. Harper and Row, New York 1973.
4. Pradeep KS, Priti S. Computer Fundamentals. BPB Publications, New Delhi, 2016.
5. Anita G. Computer fundamentals. Pearson New Delhi 2014.
6. Akash S, Sunil C, Kratika G. Fundamentals of computer. Laxmi Publications, 2008.

**Course Code: BMIC 206**

**Course Title: Basic Chemistry**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course basic chemistry explores the fundamental particles, modern periodic table, periodic law, periodic system, ionization potential, atomic and transition elements. The course teach us the knowledge of sigma and bonds, polar molecules and electron affinity. The course also discuss the concept of gases, laws of gases, pH, acid, buffer, solubility products and common ion effect.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Know the fundamental particles, discovery of electron, proton and neutron, charge and mass.

**CLO2:** Gain theconcepts of periodic table, ionization, electron affinity, atomic and transition elements.

**CLO3:** Learn about polar molecules, pH, acids and buffer, osmosis, electrolytes, and common ion effect.

**CLO4:** Explores the concept of gases, laws, kinetic energy of gases, solubility of gases in liquid and gas constant.

**CLO5:** Apply buffer, types of solutions, vapor pressure, solubility product, and common ion effects.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Atomic Structure:** Fundamental particles, discovery of electron, proton, neutron, and charge. Isotope, wave nature of electrons, electron configuration of atom. | Lecture, Open discussion& Assignment | Assignment,  Class test, Tutorial & Semester final | 4 | **1** |
| **2** | **Periodic Classification of Elements:** Modern periodic table. Types of elements in the periodic table, atomic and transition elements. | Lecture & Assignment | Assignment, Tutorial & Semester final | 4 | **1,** &**2** |
| **3** | **Chemical Bonds:** Electronic, valance bonds, molecular orbital theory. Sigma and bonds and polar molecules, electro negativity and electron affinity. | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1**&**3** |
| **4** | **Gases:** Concept of gases, free energy, direction of chemical and biochemical process, energetic of biochemical reaction. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &4** |
| **5** | **Thermodynamics:** Laws of gases, kinetic energy of gases, solubility of gases in liquid and gas constant. | Lecture & Discussion | Assignment, Class test & Semester final | 3 | **1,2**&**4** |
| **6** | **Acids, Bases and Buffers:** Concepts of pH, acids and buffer, indicators. Solubility products applications. Measurement of pH, solution and concentration units. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1,2**&5 |
| **7** | **Properties of Aqueous Solution:** Vapor pressure, osmosis, solubility and, solutions of electrolytes. | Lecture & Discussion | Class test & Semester final | 3 | **1,3&5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Ebbing DD. General Chemistry.11th Edition, 2021.

2. Price NC, Dwek R. A Principles and problems in Physical Chemistry for Biochemists. 3rd Edition. 2002.

3. Bahl. B.S, Bahl A. Advanced organic Chemistry. 2012.

4. Bahl A. Bahl. BS, Tuli GD. Essential of Physical Chemistry. Revised Edition. 2009.

5. Madan RD. Modern Inorganic Chemistry, 4th Edition, 2014.

**Course Code: BMIC 207**

**Course Title: Microbiology Practical** II

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain practical knowledge on basictechniques of molecular biology.

**CLO2:** Achieve practical knowledge of role and interaction of microbes in ecology.

**CLO3:** Apply the basic techniques of cell isolation, cell division and chromosomal abnormalities study.

**CLO4:** Learn some practical experience on human anatomy and physiological system.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Basic Molecular Biology):**  Isolation DNA, RNA and plasmid  Agarose gel electrophoresis  Study of primers designing  Study of PCR, RT-PCR | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Microbial Ecology):**  Collection and isolation of microbes from ecosystems  Study of BOD in different water samples.  Study of microbial degradations. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **2** |
| **3** | **Unit C (Basic Cell Biology):**  Separation of nucleic acid bases  Study of structure of chromosomes and cell organelles  Isolation of chromosomal DNA from bacteria  Study of mitosis and meiosis | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **3** |
| **4** | **Unit C (Human Anatomy and Physiology):**  Collection and identification of different organs  Dissection of different system in mammals and birds  Measurement of Blood glucose level, temperature, oxygen and pressure of human. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **4** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 208**

**Course Title: Related Practical** II

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain practical knowledge on ICT and computer applications in biological fields.

**CLO2:** Acquire some practical knowledge on basic chemistry related to microbiology.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (ICT and Computer Applications):**  Microsoft office (MS word, excels, MS PowerPoint)  Introduction to referencing software (eg. EndNote, Zotero)  Computational Language for Expressing Computation  Data base search, alignment and phylogenic tree.  Spreadsheet handing, working with worksheets, creating a spreadsheet, tables and graphs. | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **1** |
| **2** | **Unit B (Basic Chemistry):**  Determination of the molar mass of carbon tetrachloride  Determination of enthalpy and neutralization of acid calorimetrically  Determination of partition coefficient  Effect of reactant concentrations rate  Determination of the melting point of the organic compounds | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **2** |

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**Course Code: BMIC 209**

**Course Title: Field report/ Excursion II**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 210**

**Course Title: Bangladesh Studies**

**Course Type: Non-credit**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Bangladesh Studies deals with etymology of Bengal, ancient periods of Bangladesh, history of Bengali language movement, independence movement, and formal declaration of independence of Bangladesh. The graduates will be able to learn about the constitution, early democracy, socialism, religion and their activities, Bengali cultures, national days and sustainable development of Bangladesh.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Achieve information regarding etymology of Bengal and ancient periods of Bangladesh

**CLO2:** Explain the history of Pakistan movement and Pakistan period.

**CLO3:** Learnabout the history of Bengali language and independence movements.

**CLO4:** Introduce with the constitution, democracy, government and declaration of independence of Bangladesh.

**CLO5:** Explores the history of different religion, Bengali cultures, national days, present activities and sustainable development of Bangladesh.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introduction:** Etymology of Bengal, ancient Bengal, Nawabs of Bengal, company and British rule. | Lecture & Discussion | Assignment, Class test & Semester final | 3 | **1** |
| **2** | **Pakistan Movement and Pakistan Period:** Bengali language movement and 21 February 1952. Address of 7th March 1971. Massacre of 25th March 1971. Independence movement. | Lecture, Open discussion &  Assignment | Assignment, Tutorial & Semester final | 4 | 1&2 |
| **3** | **Birth of People’s Republic of Bangladesh:** Declaration of independence. Mujibnagar Government and Liberation war. Surrender and aftermath. Atrocities and international reactions. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **3** |
| **4** | **Independent Bangladesh:** Sheikh Mujib administration. Military coups and presidential regimes. Parliamentary republic. | Lecture & Discussion  Assignment | Assignment, Class test & Semester final | 4 | **2**&**3** |
| **5** | **Constitution:** Constitution of People's Republic of Bangladesh. Early democracy and socialism. | Lecture & Open discussion | Quiz, Tutorial & Semester final | 3 | **2, 3**&**4** |
| **6** | **Religions and Cultures:** Different religions and activities. Religious pluralism. Bengali cultures and national days. Small ethnic groups of Bangladesh and cultures. | Lecture & Open discussion | Quiz, Tutorial & Semester final | 4 | **5** |
| **7** | **Present Activities of Bangladesh:** Developments in different sectors. Structure and change of economy from 1971 in Bangladesh. World leadership and others. Future aspect of Bangladesh. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Ahmed HU. History. Banglapedia: National Encyclopedia of Bangladesh. 2nd Edition. Asiatic Society of Bangladesh. 2012.
2. Library of Congress A Country Study: Bangladesh, 1988.
3. Hussain A. History of Bangladesh, 1704–1971. Vol. 1. Asiatic Society of Bangladesh, 1997.
4. Raghavan S. 1971: A Global History of the Creation of Bangladesh. Harvard Univ. Press; 2014.
5. Van Schendel W. A History of Bangladesh. Cambridge University Press, 2009.
6. Chakrabarti DK. Ancient Bangladesh: A Study of the Archaeological Sources, Delhi Press. 1992.

**Course Code: BMIC 211**

**Course Title: Viva voce II**

**Course Type: Core and related**

**Credits: 2**

**Year/ Semester: 1st Year 2nd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 201 to BMIC 206

**Course Code: BMIC 301**

**Course Title: General Bacteriology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Bacteriology is helpful to know about morphology, ecology, genetics and biochemistry of bacteria. This course explores the identification, classification, and characterization of bacterial species. Because of the similarity of thinking and working with microorganisms other than bacteria, such as protozoa, fungi, and viruses, there has been a tendency for the field of bacteriology.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the identification, classification, and characterization of bacterial species.

**CLO2:** Explain the growth nutrition, culture media, morphology and biochemistry of bacteria.

**CLO3:** Gain knowledge about cytoplasm and endospore structure and formation stages.

**CLO4:** Introduce with the asexual reproduction, logarithmic representation and generation time of bacteria.

**CLO5:** Explores the archaebacterial, purple bacterial and eubacterial characteristics, metabolism and importance.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Bacterial Systematic:** Composition of bacteria. Concept of species, taxa and strains. Molecular approaches to polyphasic bacterial taxonomy and evolutionary chronometers. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2** |
| **2** | **Bacterial Growth:** Bacterial multiplication, generation time; mathematical expression, phases, and synchronous growth.Batch, fed-batch and continuous culture. | Lecture, Open discussion & Assignment | Tutorial, Assignment & Semester final | 4 | **1 &2** |
| **3** | **Cytoplasm:** Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. | Lecture & Discussion | Assignment, Class test & Semester final | 3 | **1 &3** |
| **4** | **Endospore:** Structure, formation, stages of sporulation. | Lecture, Discussion | Class test, Semester final | 3 | **1**&**3** |
| **5** | **Bacterial Reproduction:** Asexual reproduction. Logarithmic representation of bacterial populations, calculation of generation time and rate. | Lecture, discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 & 4** |
| **6** | **Archaebacteria and Eubacteria:** General characteristics. Morphology and metabolism. Ecological and economic importance. | Lecture, Quiz &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**5** |
| **7** | **Purple Bacteria and Relatives:** Classes and unique features of proteobacteria phylum. Life cycle of Chlamydia. | Lecture &  Assignment | Assignment, Class test & Semester final | 4 | **5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Gottschalk. Bacterial metabolism. Springer US. 1979.
2. Moat A G, Foster JF. Microbial physiology. 4thEdition. 1995.
3. Byung HK, Geoferry MG. Bacterial physiology and metabolism. Cambridge Univ. Press, 2008.
4. Johnsbor O, Eldholm V, Håvarstein LS. Natural genetic transformation: prevalence, mechanisms and function. Res. Microbiol. 2007.
5. Schulz H, Jorgensen B. Big bacteria. Annu Rev Microbiol. 2001.
6. Shapiro JA. Thinking about bacterial populations as multicellular organisms. Annu. Rev. Microbiol. 1998.

**Course Code: BMIC 302**

**Course Title: Microbial Physiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course introduces nutritional classification of microorganisms, metabolite transport, describes microbial growth rates, measurement of microbial growth techniques and the environmental effects on microbial growth. The course also teach about the chemolithotrophic metabolism and phototrophic metabolism techniques as well as CO2 fixation process and applications by the microbial organisms.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn an introduction to physiological characteristics of microbes.

**CLO2:** Apply metabolite transport techniques of microorganisms.

**CLO3:** Know the different types of microbial growth techniques and the effects of environmental factors.

**CLO4:** Understand the microecological foundations, chemolithotrophic and phototrophic metabolism techniques.

**CLO5:** Explores the concept of CO2 fixation, Calvin and reductive TCA cycle process.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introduction of Microbial Physiology:** Concept of microbial physiology. Nutritional classification of microorganisms. Primary nutritional groups. Important of microbial physiology. | Lecture, Discussion and Assignment | Class test & Semester final | 4 | **1** |
| **2** | **Metabolite Transport:** Types of transport across membranes. Endo and exocytosis. Fueling reactions. Group translocation. Iron uptake. | Lecture, Discussion,  Assignment | Assignment, Class test & Semester final | 4 | **1**&**2** |
| **3** | **Microbial Growth:** Growth, growth curve, batch and continuous culture. Measurement of colonies numbers, morphology, cell mass and metabolic activity. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **4** | **Environmental Effects on Microbial Growth:** Temperature and pH ranges and adaptations, solutes, water activity, oxygen concentration, radiation and pressure. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2**&**3** |
| **5** | **Chemolithotrophic Metabolism:** Physiological groups of aerobic and anaerobic chemo-lithotrophs. Hydrogen-oxidizing bacteria and methanogens. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **1,2**&**4** |
| **6** | **Phototrophic Metabolism:** Photoautotrophism and photoheterotroph. Diversity of phototrophic bacteria. Photosynthetic pigments. Physiology of bacterial photosynthesis. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2**&**4** |
| **7** | **CO2 Fixation:** Concept of CO2 fixation**.** Calvin and reductive TCA cycle process. | Lecture & Discussion | Class test & Semester final | 3 | **5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Moat AG, Foster JF. Microbial physiology. 4th Edi. 2002.
2. Byung HK, GeoferryMG.Bacterial physiology and metabolism. Cambridge University Press. 2008.
3. Gräber P, MilazzoG.Bioenergetics. Birkhäuser. 1997.
4. Bryant, Frigaard. Prokaryotic photosynthesis and phototrophy illuminated. Trends Microbiol. 2006.
5. McFadden G. Endosymbiosis and evolution of the plant cell. CurrOpin Plant Biol. 1999.
6. Cabello P, Roldán MD, Moreno C. Nitrate reduction and the nitrogen cycle in archaea. Microbiology. 2004.

**Course Code: BMIC 303**

**Course Title: Agricultural Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Credit Value: 2**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

This course interprets microbial disease formation process, plant immune responses, signal integration, and manage agriculture related organisms diseases. The course explores the knowledge of crops plants and microbial symbionts and plants and pathogens relationship and their effects in crops production as well as agricultural microbiology. The course provides the basic intensive knowledge on biofertilizers and biopesticide production and uses in agricultural crops with a specific focus on ecofriendly environment.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain basic knowledge of microbes and agricultural, major groups of microorganisms in soil

**CLO2:** Learn about plants and microbial symbionts, plant nutrition, rhizosphere and rhizoplane in microflora.

**CLO3:** Analyze the plant pathogens and disease, disease diagnosis, microbial fertilizers and controlling diseases

**CLO4:** Evaluate the knowledge of the different types of crops processing and preservation.

**CLO5:** Explain the production process and importance of bio-fertilizer and bio-pesticides in agriculture.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Concept and importance of microbiology in agriculture. Good agricultural practices. | Lecture &  Assignment | Tutorial & Semester final | 3 | **1** |
| **2** | **Soil and Microorganisms:** Major groups of microorganisms in soil. Role of microbes in soil fertility and plant nutrition. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **3** | **Crops and Microbial Symbionts:** Plants and mycorrhizal fungi. Role of rhizosphere microflora on crops. Microorganisms as fertilizers and nitrogen fixation. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**2** |
| **4** | **Plants and Pathogens:** Disease formation process. The disease triangle, strategies of pathogenicity and plant immune responses. Plant responses to necrotrophic, and viruses. Strategies to prevent and manage plant diseases. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1,2**&**3** |
| **5** | **Microbes in Agriculture as Good Scenes:** Useful microbes for agriculture. Pathogenicity and resistance. Genetic engineering for disease resistance in plants. Genetically modified crops. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **2**&**3** |
| **6** | **Microorganism in Agro-processing:** Preservation and storage of forage crops. Curing of tea, cocoa and coffee. Processing of tobacco. | Lecture, Discussion&  Assignment | Assignment, Class test & Semester final | 4 | **1**&**4** |
| **7** | **Biofertilizer and Biopesticides:** Biofertilizer and biopesticides concept. Production technology and importance. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Mukherjee, Ghosh T. Agricultural Microbiology.2nd Edition. Kalyani Publishers, 2020.
2. Rao S. Soil Microbiology. 4th edition. Enfield: Science Publishers, 1999.
3. Vieira. Bacterial colonization of minerals in grassland soils is selective and highly dynamic. Environmental Microbiology. 2020.
4. Falkowski PG, Fenchel T, Delong EF. The Microbial Engines That Drive Earth's Biogeochemical Cycles. Science. 2008.
5. Sylvia DM, Jeffry J, Fuhrmann PG, David AZ. Principles and Applications of Soil Microbiology. Upper Saddle River: Prentice Hall, 1998.

**Course Code BMIC 304**

**Course Title: Microbial Genetics**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Credit Value: 2**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Microbial genetics studies genetically implications and role in bacteria, virus, fungi, bacteriophages, protozoa and archaea. The course is helpful for studies of microorganisms involve in genotype, gene expression, genetic engineering in microbial genetics. Microbial genetics also has applications to study processes and pathways of drug metabolism and antagonisms activities.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Explores knowledge of microbial genetics and genomic organization in prokaryotes.

**CLO2:** Acquire knowledge of genetic transformation, characteristics and mechanisms of microbial genetics.

**CLO3:** Learn about molecular characteristics, bacterial genetics, phase genetics and genetic exchange.

**CLO4:** Analyze the effects and prevention of antibiotics and antimicrobial resistance mechanisms.

**CLO5:** Apply microbial genetics in the fields of applied genetics, medicine, agriculture and industry.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Genomic Organization of Microbes:** Concept of microbial genetics. Genomic organization in prokaryotes. Multigene and pseudogenes family. | Lecture, Open discussion,  Assignment | Presentation & Semester final | 4 | **1** |
| **2** | **Recombination in Living Cells:** Transformation of bacterial cells and selection of recombinants. Phage DNA induce into bacterial cell and selection of recombinant phage. Transformation of non-bacterial cells. | Lecture, Quiz & Assignment | Tutorial & Semester final | 5 | **1**&**2** |
| **3** | **Bacterial Genetics Exchange:** Genetic exchange mechanismin bacteria. Mutant phenotypes. Genetic techniques to detect mutations in bacteria. Transformation, transduction and conjugation of bacteria. | Lecture, Open discussion &  Assignment | Quiz, & Semester final | 3 | **1**&**3** |
| **4** | **Phase Genetics:** Define phasing. Phasing with data from one parent or other family members. Statistical phasing, genetic genealogy companies and phasing tools. | Lecture, Discussion &  Assignment | Assignments& Semester final | 4 | **2 &3** |
| **5** | **Antibiotics Resistance:** Concept of antibiotics resistance. Scope of the problems. Causes of the antibiotic resistance crisis. The clinical and economic burden of antibiotic resistance. Prevention and control. | Lecture & Open discussion | Assignment, Class test & Semester final | 3 | **2**&**4** |
| **6** | **Antimicrobials Resistance:** Concept of antimicrobial resistance. Mechanisms of bacterial, fungal, viral and parasitic drug resistance. Impact of microbial natural products on antimicrobial drug discovery. Antimicrobial discovery: problems and possibilities. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2**&**4** |
| **7** | **Applications of Microbial Genetics:** Concept and uses of microbial genetics. Applied genetics. Medicine. Agriculture and animal husbandry. Industry. Epigenomes biochemistry. | Lecture & Open discussion | Assignment, Class test & Semester final | 4 | **1**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

2. Klug, Cummings. Concept of Genetics.6thedition. 2018.

4. Robert J B. Genetics: Analysis and Principles.7thEdition. 2021.

5. Drost H, Sanchez D. Becoming a selfish clan: recombination associated to reverse-transcription in LTR retrotransposons. Genome Biology and Evolution. 2019.

6. John ES. Biotechnology.5th edition, University of Strathclyde, 2009.

8. Prichard RK. Antimicrobial Drug Resistance: Mechanisms of Drug Resistance. Mc Gill University, 2017.

9. Gualerzi CO, Brandi L, Fabbretti A, Pon CL. Antibiotics: targets, mechanisms and resistance. Wiley. 2013.

**Course Code: BMIC 305**

**Course Title: Biosafety and Biosecurity**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Credit Value: 2**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course provides an overview of biosafety, biosecurity and bioethics on laboratory. These are very important issues for ensuring safety, security and responsible behavior in biological research laboratories. This course describes the safe and secure handling of transgenic organisms and dangerous pathogens in a laboratory setting. This course also incorporates ethical questions that are at the heart of medicine, law, biology and public policy.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn how to assess risks for biohazards in the laboratory setting and the strategies.

**CLO2:** Gain knowledge about the proper use of PPE, first aid, and biological containment to safely research.

**CLO3:** Adequate knowledge of equipment uses, maintenance, and trouble shooting for lab. members and visitors.

**CLO4:** Understand the role of the biosafety professionals and practice in microbiology research laboratories.

**CLO5:** Apply the national and international bioethics standards, and guidelines for GMOs research.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Management and Employees Key Elements:** Establish and maintain adequate standard, policies, procedures, work practices and maintenance of buildings and equipment to ensure a safe working environment. Orient and train staff in safe work practices. | Lecture, Open discussion & Assignment | Class test & Semester final | 4 |  |
| **2** | **Health Care in Lab.:** Designate hand wash sinks in areas close to exits. Disposable gloves and handling specimens. Washing hands and laboratory coats. Remove lab coat prior to exiting the work area. Health review and screened for infectious diseases. | Lecture, Assignment & Open discussion | Assignment, Tutorial & Semester final | 4 | **1**&**2** |
| **3** | **First Aid:** Concept of first aid. Requirements for first aid training and availability of a first aid kit depend on legal requirements. | Lecture, Quiz &  Tutorials | Tutorial, Assignment & Semester final | 3 | **2** |
| **4** | **Equipment Safety:** Adequate knowledge of equipment uses, maintenance and initial trouble shooting. Modified or repaired equipment shall be checked for safety. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **1**&**3** |
| **5** | **Visitors Safety:** Anyone inspecting or being shown a hazardous laboratory area people concerned must be aware of safety precaution. | Lecture, Quiz &  Assignments | Assignment,  Tutorial & Semester final | 3 | **1**&**3** |
| **6** | **Biosafety Practices:** Laboratory safeguards and procedures. Biological safety cabinets. Decontamination and sterilization. Emergency procedures. Waste disposal procedures. | Lecture, Open discussion & Assignment | Tutorial, Presentation & Semester final | 4 | **1** &**4** |
| **7** | **Bioethics:** Principles of bioethics, ethical dilemma. Ethical considerations in microbial research in the area of agriculture, plants, animals, medical sciences. | Lecture, Open discussion & Assignment | Tutorial, Presentation & Semester final | 4 | **1**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Asadulghani. Biosafety and Biosecurity in Biotechnology. Biosafety and BSL3 Laboratory, icddr,b. 2021.
2. Bethesda MD. Guidance for Enhancing Personnel Reliability and Strengthening the Culture of Responsibility, National Science Advisory Board for Biosecurity. 2011.
3. Michael JS. Gain-of-Function Research: Ethical Analysis, SciEng Ethics. 2016.
4. Miller JM, Astles R, Baszler T, Chapin K,WiedbraukD. Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories, Recommendations of a CDC-convened, Biosafety Blue Ribbon Panel. 2012.
5. [Ned-Sykes R](https://www.ncbi.nlm.nih.gov/pubmed/?term=Ned-Sykes%20R%5BAuthor%5D&cauthor=true&cauthor_uid=25974716), [Pollock A](https://www.ncbi.nlm.nih.gov/pubmed/?term=Pollock%20A%5BAuthor%5D&cauthor=true&cauthor_uid=25974716), [DeBoy JM](https://www.ncbi.nlm.nih.gov/pubmed/?term=DeBoy%20JM%5BAuthor%5D&cauthor=true&cauthor_uid=25974716). Competency Guidelines for Public Health Laboratory Professionals. 2015.
6. Farida K. Enhancing Responsible Science Research. National Science Advisory Board for Biosecurity. 2013.

**Course Code: BMIC 306**

**Course Title: Cell and Tissue Engineering**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Credit Value: 2**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

This course will enlighten the students with plant and animal cell-tissue culture techniques, plant improvement techniques and transgenesis plant and animals development. The course will be helpful to research on transgenic plants and animals with their application in different areas.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Conceptualize general knowledge of plant and animal cell culture and tissue engineering.

**CLO2:** Acquire general knowledge on cell and tissue culture media preparation and culture techniques for improvement through gene transfer methods.

**CLO3:** Use genetic engineering and production of transgenic plant and animal production and improvement.

**CLO4:** Understand the techniques of cloning vectors preparation, gene cloning, gene transfer and expression of induced genes.

**CLO5:** Apply the national and international bioethics standards, and guidelines for GMOs research.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Concept of plant and animal cell and tissue engineering. Importance and scope of cell and tissue engineering. | Lecture, Discussion & Assignment | Quiz, Tutorial & Semester final | 3 | **1** |
| **2** | **Plant Cell and Tissue Culture:** Media preparation. Cell and tissue culture techniques. Cellular differentiation. Problems and remedies. | Lecture & Open discussion | Tutorial, Semester final | 4 | **1**& **2** |
| **3** | **Plant Improvement Techniques:** Embryo rescue and culture. In vitro selection of mutants–tolerance for disease, and herbicide. Meristem culture and virus elimination. | Lecture, Open discussion & Assignment | Tutorial, Presentation &Semester final | 4 | **2**&3 |
| **4** | **Transgenesis in Plants:** Gene transformation and transfer methods in plants. Advantage and disadvantages of gene transfer. CRISPR-Cas9 gene transfer. | Lecture &Assignment | Class test & Semester final | 4 | **3**&4 |
| **5** | **Animal Cell and Tissue Culture:** Animal cell and tissue culture media preparation. Techniques of animal cell and tissue culture. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**&**2** |
| **6** | **Gene Transfer in Animals:** Gene cloning vectors, gene cloning, gene transfer and expression of induced genes. | Lecture, Quiz & Assignment | Tutorial & Semester final | 3 | **2**&**4** |
| **7** | **Transgenic Animal Development:** Development of transgenic animal, microinjection technique, embryo transfer and in vitro fertilization. Transgenic animal production. | Lecture & Quiz | Tutorial & Semester final | 4 | **1,2**& **5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Adrian S, Niger S, Mark F. Plant Biotechnology.2ndEdition, 2008.
2. Joshi P. Genetic Engineering with its application. Agrobios Publications, India.2nd Edition, 2004
3. Purohit U. Agricultural Biotechnology. Updesh Purohit, 2003
4. SantSB, Prem K D. Plant Tissue Culture: An Introductory Text. Springer, India, 2013.
5. Mason C, Dunnill, P. A brief definition of regenerative medicine. Regenerative Medicine. 2008.
6. Mahla RS. Stem cells application in regenerative medicine and disease therapeutics. Int. J. Cell Biol. 2016.

**Course Code: BMIC 307**

**Course Title: Microbiology Practical** III

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Adopt practical knowledge onbacteria culture, isolation and identification techniques.

**CLO2:** Learn the physiological activities of microbes.

**CLO3:** Achieve practical knowledge on microbial effects on agriculture.

**CLO4:** Apply the genetic tools and techniques in microbes.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (General Bacteriology):**  Different Gram staining test  Collection, identification and preservation of bacteria  Biochemical test for bacteria identification  Infection process and pathogenicity test of bacteria | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **1** |
| **2** | **Unit B (Microbial Physiology):**  Microbial growth factors study  Measurement of microbial growth and development  Detection of environmental effects on microbial growth  Isolation of microbial metabolites | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **2** |
| **3** | **Unit C (Agricultural Microbiology):**  Study of microflora of soil, rhizosphere and rhizoplane  Denitrification, ammonification and nitrogen fixation test  Identification of plant pathogens  Effect of microbes in crops | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **3** |
| **4** | **Unit D (Microbial Genetics):**  Isolation of genetic materials from microbes  Preparing glycerol stock  Colony counting, bacterial cell density.  Bacterial degradation of various carcinogens by growing cell | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **4** |

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**Course Code: BMIC 308**

**Course Title: Microbiology Practical** III

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the basic rules and regulation for laboretory safety and security.

**CLO2:** Apply the techniques of plant and animal cell culture.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A(Biosafety and Biosecurity):**  Assessing biological hazards in Laboratory  Study of laboratory safeguards and procedures  Decontamination, sterilization and waste disposing  Guidelines for using laboratory equipment | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **1** |
| **2** | **Unit B (Cell and Tissue Engineering):**  Preparation of different media for plant tissue culture  Development of virus free plants through meristem culture  Isolation, purification and culture of protoplast  Preparation of single cell suspension  Animal cell culture media preparation and culture | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **2** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 309**

**Course Title: Field report/ Excursion III**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation.

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 310**

**Course Title: Viva voce III**

**Course Type: Core and related**

**Credits: 2**

**Year/ Semester: 2nd Year 3rd Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 301 to BMIC 306

**Course Code: BMIC 401**

**Course Title: General Mycology and Phycology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 30**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

This course emphasizing the diagnosis and treatment practices for algae and fungi diseases in human body. To combat such worst situation of various pathogens, this course has been designed to offer students with modern knowledge of human pathogens, diseases and their medical measures. The content includes in-depth knowledge of algae and fungal basis concept, characteristics, and their applications as well as infectious diseases.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Explain the basic principles of fungi and algae, dealing with characteristics, infectious pathogens, host-pathogen interaction and diagnosis.

**CLO2:** Achieve in-depth knowledge about the biology and life cycle of fungi and algae infectious diseases.

**CLO3:** Understanding the basic molecular characteristics and diagnostics of fungi and algae.

**CLO4:** Explore antigen detection DNA probes and applications of PCR technology in fungi and algae.

**CLO5:** Evaluate implications of fungi and algae in agriculture, industry, environment, foods and fuel production.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction of Fungi:** Definition and background of fungi. General characteristics and classification of fungi. Lactophenol cotton blue staining principle and procedure. | Lecture & Open discussion | Assignment,  Tutorial & Semester final | 3 | **1 &3** |
| **2** | **Life Cycle of Fungi:** Reproduction, occurrence, somatic structure and life cycles of different fungi. | Lecture & Open discussion | Assignment & Semester final | 3 | **1**&2 |
| **3** | **Molecular Mycology:** Current approaches to fungal pathogenesis. Molecular diagnostics. Challenges to molecular-based diagnostic mycology. Antigen detection. DNA probes and applications of PCR technology. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1, 3** & 4 |
| **4** | **Applications of Fungi:** Economic importance of fungi with examples. Drug development. Antifungal screening. Psychotropic effects. Vitamin D2 production. Mycotoxins. | Lecture, Open discussion &  Assignment | Assignment, Tutorial & Semester final | 4 | **1** &**5** |
| **5** | **Introduction of Algae:** Definition and history of phycology. Classification and characteristics. Pigments and types of algae chloroplasts. | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1 & 3** |
| **6** | **Life Cycle of Algae:** Reproduction, occurrence and life cycles of algae. Characteristics of blue-green algae. Molecular characterization and diagnosis. | Lecture& Assignment | Quiz & Semester final | 4 | **1,** 2 & 3 |
| **7** | **Applications of Algae:** Applications of algae in agriculture, industry, environment and foods. Culture and farming of algae. Algae as a source of energy, fuel and rich oils. Paleophycology. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1** & 5 |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Kumar HD. Introductory Phycology. 2nd edition. Affiliated East Western Press. 1990.

2. Kumar HD. The Text Book on Algae.4th edition.Affiliated East Western Press. 1995.

3. Sharma OP. Textbook of Algae. Tata McGraw Hill Publishing Co. Ltd. 2005.

4. Vashishta BR. Algae. 3rd edition. S. Chand and Company Ltd., New Delhi. 2005.

5. Alexopoulos CJ. Introductory Mycology.4th edition. John Wiley and Sons, Inc. 1996.

7. VashishtaBR,Sinha AK. Fungi. S. Chand and Company Ltd. 2008.

**Course Code: BMIC 402**

**Course Title: Advanced Molecular Biology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2020-2021**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course includes lectures and smaller group discussions as well as seminar, writing and data analysis exercises. The course emphasizes enhancing critical thinking and communication skills in the context of understanding research methodology, experimental design and the scientific process as applied to the field of Molecular Biology. This course is based upon the collaborative student learning model and will therefore endorse active student participation.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Understand the current trends of molecular biology and applications.

**CLO2:** Analyze the techniques of RNA extraction and expression.

**CLO3:** Acquire DNA manipulative enzymes, recombination and gene manipulation in biotechnology.

**CLO4:** Explore the techniques of mutation concept, mutagenic agents, mutagenicity and molecular mutagenesis.

**CLO5:** Apply the different methods of DNA sequencing, repairing and transposable genetic elements.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **RNA Extraction and Expression Analysis:** Current trends, and applications of advanced molecular biology. Preparation of total RNA from bacterial, plant and animal cells. Purification of RNA from living cells. cDNA synthesis,RT-PCR and qRT-PCR analysis and its applications. Microarray and RNA seq analysis. | Lecture, Open discussion, Quiz, Assignment | Class test, Tutorial & Semester final | 3 | **1** |
| **2** | **DNA Manipulative Enzymes:** Designing primers. Restriction modification enzymes. Plasmid cloning vector production. Ligation. Transferring recombinant plasmid and electroporation. Plasmid DNA extraction, purification and restriction digestion products. Competent cells preparation. Topoisomerases and ligation systems. Use of linkers and adaptors. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1 &2** |
| **3** | **Recombination and Gene Manipulation:** General recombination and interactions of complementary strands of DNA molecules. Biology of plasmids and vectors. Gene cloning strategies, gene transfer and genetic manipulation of animals and plants. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **4** | **Mutation:** Mutation definition, types and rate. Mutagenic agents. Screening chemicals for mutagenicity. Molecular basis of mutagenesis. Mutation induced by chemical and physical agents. Effects of mutation on multicellular organisms and microorganisms. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1**&3 |
| **5** | **Repairing:** DNA repair mechanisms, nature of DNA damage, and reversal of UV damage in prokaryotes. Mismatch repair; post replication, mismatch, SOS, and error prone repair. Ultimate match of DNA-RNA. | Lecture, Quiz & Assignment | Quiz, Tutorial & Semester final | 3 | **2**&**4** |
| **6** | **Transposable Genetic Elements:** Definitions, types and general features of transposons. Typical transposons. Model for transposition, transposons in eukaryotes. Transposable elements, composite transposons, tn3 elements, retroviruses and retrotransposons. | Lecture & Assignment | Tutorial & Semester final | 4 | **1,2**&4 |
| **7** | **Sequencing of DNA:** Sanger-Coulson, Maxam-Gilbert methods. Study of First, second and third generation sequencing. Advantages and limitations of sequencing. Technology and criteria for choosing sequencing technology. | Lecture & Assignment | Tutorial & Semester final | 4 | **3 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Alberts B, Raff M, Walter P. Molecular Biology of the Cell. Garland Publishing.Inc. 6th Edition. 2019.
2. Brown TA. Gene cloning and DNA analysis: an introduction. Blackwell Science, 7th Edition. 2016
3. Darnell J, Lodish H, Baltimore. Molecular Cell Biology. D.W.H. Freeman and Company. 5th Edition.
4. Gurthew S, Richard S. Molecular Genetics-An Introduction Narrative.2nd Edition.2020.
5. Karp G. Cell and Molecular Biology-Concepts and Experiments. 6th Edition, 2018
6. Srivastava S, Srivastava PS, Tiwary BN. Molecular Biology and Biotechnology. 2012.
7. Khalid ZM, Sameena ML, Rovidha SR. Advanced Methods in Molecular Biology and Biotechnology. Elsevier Inc. 2021.

**Course Code: BMIC 403**

**Course Title: Environmental Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course focuses on the utilization of microbial processes in waste and water treatment, microbial removal, degradation of organics, phytoremediation of soil, water contaminated with toxic metals. It also deals with microbial waste utilization, microbial degradation of heavy metals, bio deterioration, environmental pollution and role of genetically engineered organisms for controlling environmental pollution.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain basic knowledge on historical perspective, and modern environmental microbiology.

**CLO2:** Identify the global environmental problems and solving for sustainable development.

**CLO3:** Understand themicroorganisms-animals-plant interactionsin sustainable development.

**CLO4:** Explain the biogeochemical cycle, ecology and participation of microorganisms in environments.

**CLO5:** Evaluate the emerging concerns of waste water and sewage treatments.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Concept and historical perspective. Modern environmental microbiology. Environmental microbiology groups. Microbial factors and environmental pollution. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 3 | **1** |
| **2** | **Global Environmental Problems:** Greenhouse effect, acid rain, El nino, ozone depletion, deforestation, desertification and salination. Chemical, radiation hazards and arsenic effects | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&2 |
| **3** | **Sustainable Development:** Concept of sustainable development. Important of sustainable development for the environment. Role of microbes in sustainable development. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**2** |
| **4** | **Microorganisms and Animals-plants Interactions:** Predation on microorganisms by animals and plant, commensal and mutualistic intestinal symbionts, ethanotrophic microorganisms and other symbiotic relationship. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **5** | **Biogeochemical Cycling:** Biogeochemical cycle overview and history. Reservoirs, box models and compartments. Fast, slow and deep cycles with some examples. | Lecture, Discussion &  Assignment | Class test &Semester final | 4 | **1,2**&**4** |
| **6** | **Quantitative Ecology:** Microbial populations and pollutants detection. Phenotypicdetection and lipid profile analysis. Detecting non-cultural bacteria and microbial biomass. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **2**&**4** |
| **7** | **Water and Sewage Treatment:** Water and wastewater and sewages treatment systems. Sanitation and public health microbiology reference to Bangladesh. Removal of cynobacteria and cyanotoxins in waters. | Lecture, Discussion&  Assignment | Assignment, Class test & Semester final | 4 | **3**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Atlas RM,Bartha R. Microbial Ecology: Fundamentals. Benjamin-Cummings Pub Co. 3rdEdition, 1993.
2. Bitton G. Wastewater Microbiology. Wiley-Blackwell, 4thEdition, 2011.
3. Glazer AN, Nikaido H. Microbial Biotechnology. Cambridge University Press, 2ndEdition, 2007.
4. Lynch JM, Poole NJ. Microbial ecology- A conceptual approach. Wiley, 1979.
5. Mitchell R,Ji-Dong. Environmental Microbiology.Wiley-Blackwell, 2ndEdition, 2009.

**Course Code: BMIC 404**

**Course Title: Microbial Biotechnology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course microbial biotechnology explores of knowledge on features of microbial biotechnology, applications of microorganisms in agriculture, food, pharmaceuticals, environment, industry, health and medicine in the context of Bangladesh. It shows the techniques of ultimate energy source, conversion of biomass to energy, ethanol and methane, biofuel and other bio-electrochemical devices. Microbial leaching and microbes useful in metal recovery, biopolymers, and biodegradation of materials also describe to purification of product.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the features of microbial biotechnology and relationship of microorganisms and biotechnology.

**CLO2:** Understand the options for the production of energy, biofuel, organic acid and amino acid from biomass.

**CLO3:** Explain the microbial leaching and microbes useful in metal recovery and bioprocess engineering.

**CLO4:** Learn the direct and indirect methods of downstream processing and purification of products.

**CLO5:** Apply the knowledge of biotechnology and biosafety guidelines, rules and regulations.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Microbes and Biotechnology:** Development, and essential features of microbial biotechnology. Microbial biotechnology and food. Microbial biotechnology and life sciences. Microbes and biotechnology: a crucial scientific revolutions. | Lecture & Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Biological Fuels Generation:** The ultimate energy source. Conversion of energy from biomass. Biofuel and other bio-electrochemical devices. | Lecture Discussion & Assignment | Assignment, Class test& Semester final | 4 | **1**& **2** |
| **3** | **Chemistry and Microbiology:** Current developments production of solvents, organic acid and amino acid from biomass. | Lecture Discussion & Assignment | Assignment, Class test& Semester final | 4 | **1**& **3** |
| **4** | **Materials and Microbiology:** Microbial leaching and microbes useful in metal recovery. Mechanism of metal recovery. Biopolymers. | Lecture & Assignment | Class test, Tutorial & Semester final | 3 | **1**& **3** |
| **5** | **Bioprocess Engineering:** Bioprocess engineering. Real time monitoring of cell and biomass concentration. Direct and indirect methods. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**& **4** |
| **6** | **Downstream Processing:** Downstream processing separation and disintegration of cells. Separation, concentration and purification of product. | Lecture & Open discussion | Assignment& Semester final | 4 | **3**& **4** |
| **7** | **Biotechnology and Biosafety:** ICGEB, hazards mitigation by environmental engineering. Biosafe-transproduction, biomarkers for GMOS. Biosafety guidelines, general agreements on tariffs and trade. Patenting of microbial live forms and significance of patents in our countries. | Lecture & Assignment | Tutorial & Semester final | 4 | **4**& **5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Chatterjee CC. Human Anatomy and Physiology. Central Book Agency, India 2018.
2. Chaurasia BD. Human Anatomy. CBS Publishers.7th Edition, 2018.
3. Drake RL, Vogl W, Mitchell AWM and Gray HC. Gray's anatomy for students.Elsevier. 2010.
4. Ganong WF. Review of Medical Physiology. McGraw Hill Companies. 26th Edition.
5. Marieb EN. Human Anatomy and physiology Benjamin. Scientific publishing, 9th Edition. 2012.
6. Smith E, Pateson CR, Scratecherd T, Read NW. Text Book of physiology.Hongkong. 2011.

**Course Code: BMIC 405**

**Course Title: Metabolism and Bioenergetics**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course deals with the applied aspects of biotechnology for study of amino acid metabolism, nucleotide metabolism, bioenergetics and metabolism, bioenergetics and thermodynamics, biological oxidation-reduction reaction, oxidative phosphorylation and photosynthesis. It will teach how to perform standard molecular biology techniques for the isolation, manipulation and analysis of DNA as well as the roles of pathways for development, homeostasis and diseases.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain knowledge about amino acid and nucleotide metabolism, functions and synthesis.

**CLO2:** Explain the techniques of bioenergetics metabolisms, thermodynamics and energy conservation.

**CLO3:** Understand the biological oxidation-reduction, flow of electron and relationship of reduction potentials.

**CLO4:** Explore the salient feature of oxidative phosphorylation, electron transport and chemiosmotic hypothesis.

**CLO5:** Learn the concept, types of reactions and examples of major bioenergetic processes.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Amino acid Metabolism:** Glucogenic and ketogenic amino acids. Oxidative degradation of amino acids. Amino acid biosynthesis. Regulation of amino acid and folic acid metabolism. | Lecture, Open discussion & Assignment | Quiz, Tutorial & Semester final | 3 | **1,2**&**3** |
| **2** | **Nucleotide Metabolism:** Functions of nucleotide. Synthesis of purine and pyrimidine. Regulation, degradation and biosynthesis of nucleotide co-enzymes. Nucleotide metabolizing enzymes functions. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**& **2** |
| **3** | **Bioenergetics and Metabolism:** Cycling of carbondioxide and oxygen between autotroph and heterotrophs. Cycling of nitrogen in the biosphere. Energy relationship in catabolic and anabolic pathways. | Lecture, Open discussion & Quiz, Assignment | Quiz, Tutorial &Semester final | 4 | **1**& **2** |
| **4** | **Bioenergetics and Thermodynamics:** Principles of bioenergetics. Laws of thermodynamics in bioenergetics. Energy conservation and conversion in mitochondria. | Lecture & Assignment | Class test & Semester final | 4 | **2**& **3** |
| **5** | **Biological Oxidation-Reduction Reaction:** Flow of electron and biological work, oxidation-reduction reaction. Measurement and relationship of standard reduction potentials. | Lecture & Open discussion | Class test, Tutorial & Semester final | 4 | **2** |
| **6** | **Oxidative Phosphorylation:** Salient feature of oxidative phosphorylation, electron transport chain and chemiosmotic hypothesis. Generation of proton gradient, mechanism for ATP synthesis and respiratory control. | Lecture, Quiz & Assignment | Tutorial & Semester final | 4 | **2**&**3** |
| **7** | **Bioenergetics:** Concept and overview. Types of reactions. Examples of major bioenergetic processes. Cotransport. Chemiosmotic theory. Energy balance. | Lecture, Quiz | Class test & Semester final | 3 | **1,2**& **3** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Albert L, David L. Nelson, Michael M. Cox. Principles of Biochemistry.3rd Edi. 2001.

2. Thomas M.D. Text Book of Biochemistry.7th Edi. 2010.

3. Nelson DL, Cox, Michael ML. Principles of Biochemistry. Freeman and Company, 2013.

4. Green DE, Zande HD. Universal energy principle of biological systems and the unity of bioenergetics. USA. 1981.

5. Ferrick DA, Beeson C. Advances in measuring cellular bioenergetics using extracellular flux. Drug Discovery. 2008.

**Course Code: BMIC 406**

**Course Title: Biostatistics**

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Biostatistics deals with the calculative and mathematical quantitative analytical knowledge of the data of bioscience and application systems to collect, arrange, present and analyses the numerical biological data in health and agricultural sciences. In biostatistics, it may be bound to explain the significance tests relate the correlation and regression analysis of the variables and construct the perdition for every biological research.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain knowledge about the basic concepts and statistical approach in every sector of biosciences.

**CLO2:** Apply probability, distributions, experimental design and relate the correlation regression of the variables**.**

**CLO3:** Learn about sample surveys, analysis of variance and experimental design for biological research.

**CLO4:** Know the descriptive statistics to collect, arrange, present and analyses the numerical biological data.

**CLO5:** Apply computer for biological data collection, arrangement, processing and presentation.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Statistics and Descriptive Statistics:** Basic concepts of biostatistics. Data processing and presentation. Measures of central tendency, dispersion moments skewness and kurtosis. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **2** | **Probability and Distributions:** Basic concept of probability. The binomial, poisson and normal distribution. Study of normal, χ2and t-distribution. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 3 | **1**&**2** |
| **3** | **Hypothesis and Non-parametric Test:** Idea of null and alternative hypothesis. Types of errors and, level of significance. Test of single proportion, mean, variance, regression and correlation coefficients. Definition. Study of the sign test. Run test and rank sum test. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1**&**2** |
| **4** | **Analysis of Variance and Experimental Design:** Properties, assumptions and significance of F-test. One-way and two-way analysis and F-test. Least significant difference and critical difference. Complete randomized design. Randomized complete block design, Latin square design and Split-plot design. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1,** &**2** |
| **5** | **Sample Surveys:** Concept of surveys. Preparation of questionnaire, probability and non-probability sampling, sampling with and without replacement, sampling technique. Study of simple, stratified, systematic and cluster sampling. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **6** | **Survival Analysis:** Basic designs follow-up, cross-sectional and case-control studies. Survival and hazard function. Product limit estimate of survival function. | Lecture, Quiz &Assignment | Assignment, Class test & Semester final | 4 | **1**&4 |
| **7** | **Computer Applications in Biostatistics:** Data presentation and analysis by using computer software. Application of online platforms for quantitative data. | Lecture, Quiz &Assignment | Assignment, Class test & Semester final | 3 | **2**& **5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Cochran WG. Sampling Techniques, 4th Edition., Wiley, NY. 2002.
2. Gupta SC. Fundamentals of Applied Statistics. New Delhi, 2001.
3. Kendall M.G, Stuart A. Advanced Theory of Statistics. Edward Arnold, NY. 2004.
4. Lehmann EL. Testing of Statistical Hypothesis 4th Edition., Wiley, NY. 2000.
5. Montgomery DC. Designs and Analysis of Experiments. 6thEdition, Wiley, NY. 2005.

**Course Code: BMIC 407**

**Course Title: Microbiology Practical** **IV**

**Course Type: Core**

**Credits: 4**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 100**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Acquire knowledge on fungi and algae culture, isolation and identification techniques.

**CLO2:** Explain the techniques of primers designing, PCR amplification and **electrophoresis** microbial molecules.

**CLO3:** Analysis of microbes grow in an environment and their control

**CLO4:** Evaluate the techniques of cell immobilization and effect of substrates in microbial growth.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (General Mycology and Phycology):**  Collection and identification of different fungi.  Study of *Volvox, Vaucheria, Polysiphonia, Navicula* and *Nostoc* for slide preparation  Preparation of media for fungi culture.  Study of *Mucor, Saccharomyces, Penicillium* and *Agaricus.*  Isolation, culture and characteristics of different algae. | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **1** |
| **2** | **Unit B (Advanced Molecular Biology):**  Study of primers designing  Mutation analysis  Study of restriction digestions and ligations  Transformation and electrophoresis  Study of sequencing system | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **2** |
| **3** | **Unit C (Environmental Microbiology**):  Identification and characterization of pollutants.  Isolation, and identification of waterborne pathogens.  Observation of metal-microbes interactions.  Sewage treatment for safe environment.  Heavy metals isolation and detection | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **3** |
| **4** | **Unit D (Microbial Biotechnology):**  Whole cell immobilization by Ca-alginate.  Determination of specific growth rate substrate  State batch culture.  Pesticide degradation by bacterial dehalogenase. | Continuous internal evaluation, viva voce & Semester final examination. | 5 | **4** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 408**

**Course Title: Related Practical** IV

**Course Type: Related**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Apply the different techniques of metabolism and bioenergetics of microorganisms.

**CLO2:** Analyze the different statistical test on biological data.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Metabolism and Bioenergetics):**  Isolation and identification of common fungi from oil seeds.  Calvin cycle, dark and light reaction.  C4 pathway of tropical plants.  Detection of antigen/antibody by ELISA  Quantization estimation of proteins and reducing sugar. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Biostatistics):**  Techniques of random sampling  T-test and F-test  Correlation and regression analysis and their interpretations  Layout and perform CRD, RCBD,  Latin square design, Factorial experiment and test least significance differences  Data base and computation using compute | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **2** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 409**

**Course Title: Field report/ Excursion IV**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 410**

**Course Title: Viva voce IV**

**Course Type: Core and related**

**Credits: 2**

**Year/ Semester: 2nd Year 4th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 401 to BMIC 406

**Course Code: BMIC 501**

**Course Title: Introductory Virology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course deals with fundamental concept of viruses, submicroscopic, parasitic particles of genetic material contained in a protein coat and virus-like agents. It focuses on the following aspects of viruses: their structure, classification and evolution, their ways to infect. It exploits host cells for reproduction, with host organism physiology, immunity and discloses the diseases causing techniques.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Explores theconcepts of viroids, virusoids, satellite viruses and prions with their economic important.

**CLO2:** Learn about classification and nomenclature of different groups of viruses.

**CLO3:** Gain knowledgeabout structures of helical, icosahedral, capsid, enveloped and non-enveloped viruses.

**CLO4:** Explain the general characteristics of replication, phage growth and modes of virus transmission

**CLO5:** Identify viral diseases in plants, animal and human for designing vaccines and antiviral drugs**.**

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Virus Features:** Concept of viroids, virusoids, satellite viruses and prions. Components, sizes and shapes of different viruses. Host range and specificity. Economic important. | Lecture & Open discussion | Assignment, Tutorial & Semester final | 3 | **1**& **2** |
| **2** | **Viral Taxonomy:** Classification and nomenclature of different groups of viruses. ICTV and Baltimore classification. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**& **2** |
| **3** | **Structure of Viruses:** Structures of helical, icosahedral, prolate, capsid symmetry, enveloped and non-enveloped and complex viruses. | Lecture & Assignment | Class test & Semester final | 4 | **3** |
| **4** | **Viral Replication:** General characteristics of replication. Replication of T4 phage. Phage growth and the estimation of phage numbers. Lytic and lysogenic life cycle of bacteriophage lambda. | Lecture, Open discussion, Quiz & Assignment | Tutorial & Semester final | 4 | **1,2**&4 |
| **5** | **Virus Transmission:** Modes of virus transmission and entry. Barriers to virus infection. Infection and transmission of SARS- CoV-2. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1, 3, & 4** |
| **6** | **Viral Diseases:** Study of plant virology, animal virology and human or medical virology. Detecting viruses. | Lecture & Assignment | Class test& Semester final | 4 | **3 &5** |
| **7** | **Prevention and Control:** Vaccines. Antiviral drugs. Tamiflu-resistant pandemic influenza H1N1 virus selected by prophylaxis. | Lecture, Open discussion, & Quiz | Tutorial & Semester final | 3 | **1 &5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Edward KW. Basic virology. Malden, MA; Oxford: Blackwell Publications, 2008.
2. Jawetz M, Adelberg’s. Medical Microbiology. 26thEdition. 2013.
3. Pelezar MJ. Microbiology. Mcgraw-Hill College. 5thedition. 1985.
4. Thomas DB, Michael TM, John MM. Biology of microorganism. Prentice Hall. 1994.
5. Jeffrey W. The Fundamentals of Human Virology. Department of Microbiology, Immunology and Pathology, Colorado State University, Fort Collins. 2005.
6. Nicholas HA. Fundamentals of Molecular Virology, 2ndEdition. 2011.

**Course Code: BMIC 502**

**Course Title: Molecular Cell Biology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Molecular cell biology has a goal to explanation of life processes at the cellular and molecular level. Molecular biology provides powerful techniques in the pharmaceutical, health, agricultural industries that are being used to isolate, separate, and probe synthesis for specific proteins, nucleic acids, chemical signaling, and apoptosis of cell, stem cell transplantation, and recombination of DNA mechanisms.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the fundamentals of cell processes, genetic materials and the mechanisms of gene regulations.

**CLO2:** Show the phases of eukaryotic cell cycle phase, cell cycle control and cell-cell adhesion system.

**CLO3:** Gain knowledgeabout the chemical signaling between cells, and apoptosis of cells.

**CLO4:** Explain the proteasome, chaperon, protein degradation and posttranslational processing of proteins. **CLO5:** Apply stem cell transplantation and recombination of DNA into living cells in biological sciences.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Cellular Processes:** Replication. DNA repair. Growth and metabolism. Protein synthesis. Motility. | Lecture & Open discussion | Assignment & Semester final | 4 | **1** |
| **2** | **Cell Cycle:** Phases of eukaryotic cell cycle: G1, S, G2 and M phase cell cycle control system. | Lecture &  Assignment | Class test & Semester final | 3 | **2** |
| **3** | **Cell-cell Adhesion:** Extracellular matrix, intercellular recognition and cell adhesion, cell junctions. | Lecture &  Assignment | Class test & Semester final | 4 | **1**&2 |
| **4** | **Chemical Signaling Between Cells:** Strategies of chemical signaling, local chemical mediators, hormones and neurotransmitters. Intracellular receptors and cell surfaces signaling. Involvement of G-proteins in signal transduction. Target cell adaptation. Role of extracellular vesicles (EVs). | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1**&3 |
| **5** | **Apoptosis:** Etymology. Activation mechanisms. Negative regulators of apoptosis. Proteolyticcaspase cascade: killing the cell. Methods for distinguishing apoptotic from necrotic cells. Programmed cell death in plants. Excessive and insufficient apoptosis. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 4 | **1,2**&**3** |
| **6** | **Protein Turn Over:** Proteasome, chaperon; protein degradation and ubiquitination. Posttranslational processing of proteins. | Lecture, Quiz & Assignment | Tutorial & Semester final | 4 | **2**&**4** |
| **7** | **Stem Cell:** Embryonic and adult stem cells. Enipotency and pluripotency. Stem cell isolation and expansion. Stem cell transplantation. | Lecture, Quiz & Assignment | Assignment & Semester final | 3 | **1 &5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Turner PC, Mclennan AG, White M.R.H. Instant Notes Molecular Biology.4th edition. 2005.

3. Bruce A,Bray D, Lewis J, Raff M, Roberts K, WatsonJ.D.Molecular Biology of Cell. New York: 2002.

4. Jeremy MB, John LT,Lubert S. Biochemistry. 5thedition, New York: W H Freeman; 2002.

5. Darnell J,Loddis H, Baltimore D. Molecular cell biology. Scientific American Books, WH Freeman, 1986.

6. Felfly H, Haddad GG.Hematopoietic stem cells: potential new applications for translational medicine. J. Stem Cells. 2014.

**Course Code: BMIC 503**

**Course Title: Fermentation Technology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The field of modern microbiology belongs with fermentation technology that processes, bioreactor types, carbon sources, regulators to media, oxygen requirements and solid state fermentations. It describes the tropics of inoculums preparation for bacterial, yeast and fungal processes with suitable process of medium, fermenter, feed and continuous culture processes.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about basic knowledge of fermentation as well as their function.

**CLO2:** Explain the different types of bioreactor design, configuration, associated of instrument and services.

**CLO3:** Apply the processing of energy and carbon sources, inoculums preparation and sterilization.

**CLO4:** Analyze the role of microbial growth kinetics in fermentation and monitoring bioreactors.

**CLO5:** Apply the isolation and strain improvement of potential microbes and marketing locally and globally.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction to Fermentation:** Concept, process and components of fermentation. Chronological development of the fermentation industry. | Lecture & Assignment | Quiz, Tutorial &Semester final | 3 | **1** |
| **2** | **Bioreactor Design:** Bioreactor types and configuration. Impeller designs and baffles agitation and aeration. Fermentor associated instrument and services. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**& **2** |
| **3** | **Media and Inoculums Development:** Energy and carbon sources. Precursors and metabolic regulators to media. Oxygen requirements, antifoams, medium optimization; submerged, surface and solid state fermentations. Inoculums preparation and scale up for microbial processes. | Lecture, Open discussion, Quiz & Assignment | Quiz, Tutorial, Presentation& Semester final | 4 | **1**& **3** |
| **4** | **Sterilization of Fermenter and Media:** Medium sterilization, sterilization processes. Sterilization of the fermenter; feed and air. | Lecture & Assignment | Class test & Semester final | 3 | **1,2**& **3** |
| **5** | **Microbial Growth Kinetics:** Rate equations for cell growth, substrate utilization and product formation. Comparison of batch, fed-batch and continuous culture. | Lecture & Open discussion | Tutorial & Semester final | 4 | **2**&**3** |
| **6** | **Instrumentation and Control:** Agitation and aeration, foam sensing, measurement. Control of dissolved oxygen. Monitoring bioreactors. | Lecture, Quiz & Assignment | Tutorial &Semester final | 4 | **2**&**4** |
| **7** | **Fermentation Economics:** Isolation and strain improvement of potential microbes. Market potential, legislation, water usage and recycling, effluent treatment. | Lecture & Quiz | Tutorial & Semester final | 4 | **1,2**& **5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Stanbury PF. Whitaker, Hall SJ. Principle of Fermentation Technology. New Delhi, 3rd Edi. 2020.

2. EI-Mansi EMT, Bryce CFA, Demain A. Fermentation Microbiology and Biotechnology. London. 2012.

3. Okafor N. Modern Industrial Microbiology and Biotechnology. 2ndEdi.CBC Press, 2004.

4. McNeil B, Harvey L. Practical Fermentation Technology. Wiley, 2008.

5. Srivashava ML. Fermentation Technology. Alpha Science Intl Ltd. 2008.

**Course Code: BMIC 504**

**Course Title: Food Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Main objectives of this course design to production and applications of food, food products, food ingredients, fruit processing, spoilage of food, food processing and preservation, dairy products, bakery and confectionary food product, genetically modified foods, and canned foods following the foods rules and regulations in Bangladesh. After completion of this course graduates would be able to create the employment opportunities in order to achieve the SDG goal of Bangladesh.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Conceptualized food and food microbiology and survival factors of microbes in foods.

**CLO2:** Learn aboutprevent food spoilage and ensure the process of food preservation.

**CLO3:** Apply dairy foods production, starter cultures, fermented products and probiotics in home and industry.

**CLO4:** Evaluate microbe’s intoxications, food-borne diseases, food contaminants, sanitation and prevention.

**CLO5:** Ensure the implement of foods law and regulations for food safety and security.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Foods and Microbes:** Concept of food and food microbiology. Growth and survival factors of microbes in foods. Microbes and heavy metals in foods. | Lecture, Open discussion &Assignment | Quiz, Tutorial & Semester final | 3 | **1** |
| **2** | **Spoilage of Foods:** Spoilage of vegetables, fruits, meat, eggs, milk, butter, bread and canned foods. | Lecture & Open discussion | Tutorial & Semester final | 3 | **1**& **2** |
| **3** | **Food Preservation:** Principles of food preservation. Methods of food preservation. Microwave processing and aseptic packaging. Effect of freezing/thawing of foods. | Lecture, Open discussion & Quiz | Quiz, Tutorial, Presentation& Semester final | 5 | **1** & **2** |
| **4** | **Dairy Foods:** Dairy foods production. Dairy starter cultures. Fermented products and probiotics. | Lecture & Assignment | Class test & Semester final | 3 | **2**& **3** |
| **5** | **Food Borne Diseases:** Concept of food borne diseases**.** Food and microbes intoxications. Microorganisms associated with food-borne diseases and effects. | Lecture, Open discussion& Assignment | Assignment, Tutorial & Semester final | 4 | **2**&**4** |
| **6** | **Food Sanitation and Control:** Types of food contaminants, sanitation, management and prevention. HACCP in sanitation. Quality assurance for sanitation. | Lecture & Assignment | Tutorial & Semester final | 4 | **3**&4 |
| **7** | **Foods Laws and Regulations:** Foods standards, codex alimentary, FDA, WHO, BSTI. Laws and regulations in international trade. Recent Concerns in food safety of emerging diseases, and genetically modified food. New trends in food packaging and technology. | Lecture, Quiz& Assignment | Assignment& Semester final | 4 | **1 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. James MJ. Modern food microbiology. 7th Edi. 2021.
2. Roberts S. Food microbiology: Advances and prospects. 1993.
3. Frazier WC. Food microbiology. McGraw-Hill. 3rd edition, 1978.
4. Reed GP, Dunns. Industrial Microbiology. 4th Edi. 1983.
5. Adams MR, Moss MO. Food microbiology. 3rd Edi. 2007.

**Course Code: BMIC 505**

**Course Title: Epidemiology and Public Health**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course is helpful to explain the basic information on epidemiology uses, and core epidemiologic functions, concepts of disease occurrence, epidemic disease occurrence and investigating on disease outbreak. The course is design to achieve the millennium development goal implementing community involvement in health, public health surveillance, data interpretations and improving surveillance. The course makes the students awareness to bioethics debates, autonomy, non-malfeasance, beneficence and justice.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Know the basic information on epidemiology, infection chain and core epidemiologic functions.

**CLO2:** Learn about the steps of a disease outbreak and surveillance system to control disease outbreak.

**CLO3:** Explain the study design of epidemiology, field and community trials and measures of potential impact.

**CLO4:** Understand the awareness of health in development in millennium development goal.

**CLO5:** Know about health care and health information technology for improving health surveillance.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Epidemiology Introduction:** Definition, intrinsic and extrinsic determinants and core epidemiologic functions. Epidemiologic approaches, counts and rates. Concepts of infection chain and epidemic disease occurrence. | Lecture, Open discussion & Assignment | Assignment,  Class test, Tutorial & Semester final | 4 | **1** |
| **2** | **Disease Outbreak:** Define endemic, epidemic and pandemic. Steps of an outbreak investigation. Quantitative and qualitative data collection procedure. Surveillance system to control disease outbreak. | Lecture & Discussion | Tutorial & Semester final | 4 | **1**&**2** |
| **3** | **Epidemiological Study Design:** Intervention or experimental studies. Randomized, non-randomized, controlled clinical, field and community trials. | Lecture & Open discussion | Assignment, Tutorial &Semester final | 4 | **1 & 3** |
| **4** | **Statistical Methods:** Basic incidence measures. Prevalence, morbidity, mortality and natality (birth) frequency measures. Measures of association, public health impact, risk ratio, and potential impact. | Lecture, Quiz & Assignment | Assignment, Class test & Semester final | 3 | **1 & 3** |
| **5** | **Health Development:** Health and family planning. Role of health in development, and millennium development goal. | Lecture, &  Assignment | Class test, presentation & Semester final | 3 | **1**&**4** |
| **6** | **Health Care and Service:** Health professionals care. Home and community care. Health services. Health information technology. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2**&**5** |
| **7** | **Public Health Surveillance:** Purpose and characteristics of public health surveillance. Identifying health problems, data collection and evaluation. Improving health surveillance. | Lecture, Open discussion &  Assignment | Assignment, Tutorial, & Semester final | 4 | **1 & 5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Aschengrau A, Seage GR. Essentials of Epidemiology in Public Health. Massachusetts. 4th Edi. 2021.
2. Goldsteen L, Goldsteen K, Dwelle T. Introduction to Public Health. New York, 2nd Edi. 2021.
3. Dicker R, Coronado F, Parrish R.G. Principles of Epidemiology in Public Health Practice. 3rd Edi. 2006.
4. Willing SH, Stoker JR. Good Manufacturing practices for Pharmaceuticals. Dekker Inc. 2022

**Course Code: BMIC 506**

**Course Title: Fundamentals of Immunology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 30**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The field of modern medical science mostly depends on the knowledge of immunity, immunodeficiency and immunization. This course deals with the facts for diseases, preventions, immunoglobulin, MHC, hypersensitivity reaction, immunization, vaccines and genetic disorders for insure healthy life. Knowledge of immunology provided powerful techniques to diagnostics, pharmaceutical and health sector.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the basic concept of immunity and immunity system development in organisms.

**CLO2:** Realize the autoimmunity with diseases, diagnostic, components of the innate and adaptive immunity.

**CLO3:** Explain the involvement of cells, tissues and organs in immune response and measures of potential impact.

**CLO4:** Gain knowledge on basic concept of antigens and antibodies.

**CLO5:** Follow and explain the regulation of immune response, influence of genetic factors, effects of diet, exercise, trauma and age on immunity.

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| **SI No.** | **Course Content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Introduction to Immunology:** Definition of immunology, immunity, immune systems. Historical development of immunology. | Lecture, Discussion & Assignment | Quiz, Tutorial & Semester final | 3 | **1** |
| **2** | **Autoimmune Diseases:** Association of autoimmunity with diseases. Diagnostic and prognostic value of autoimmune diseases. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 3 | **1**&**2** |
| **3** | **Innate and Adaptive Immunity:** Components of the innate and adaptive immunity. Types of adaptive immune response, active and passive immunity. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**&**2** |
| **4** | **Cells of the Immune Systems:** Basic of lymphoid progenitor- B-lymphocytes and T-lymphocytes. Natural killer cells. Dendritic cells. Myeloid progenitor. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **2**&**3** |
| **5** | **Organs of the Immune Systems:** Classification, hematopoiesis and maturation stages of lymphoid organs. Tonsils and adenoids. Thymus. Spleen. Bone marrow. | Lecture, Open discussion &Assignment | Quiz, Tutorial & Semester final |  | **2**&3 |
| **6** | **Antigens and Antibodies:** Definition determinants and binding of antigen. Definition, classification and functions of antibody. Antibody diversification and receptors. | Lecture, Quiz & Assignment | Class test & Semester final | 4 | **1**& **4** |
| **7** | **Immune Regulations:** Regulation of immune response. Idiotypic regulation on immune response. Influence of genetic factors, effects of diet, exercise trauma and age on immunity. | Lecture, Quiz & Assignment | Class test & Semester final | 4 | **1 & 5** |

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**Books, Reference Book, Online Resources and Other):**

1. Mir MA. Basics and fundamentals of immunology. Nova Science Publishers, Inc. 2020.
2. Ivan R, David M,Johathan B. Immunology. 4th Edition. Mosby 1996.
3. Ivan R. Roitt's Essential Immunology. 9th Edition.  John Wiley & Sons. 1997.
4. Ivan M Roitt and Peter J D. Roitt's Essential Immunology. Blackwell 2006.
5. David M, Brian C, Anne C, Michael O. Advanced Immunology. Williams & Wilkins, 1991.
6. Tizar IR. Immunology. An introduction. Saunders College Publication. 1995
7. Abul KA, Andrew HL. Basic Immunology. 2ndEdition. Saunders 2006.

**Course Code: BMIC 507**

**Course Title: Microbiology Practical** V

**Course Type: Core**

**Credits: 4**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 100**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Apply the introduction and characterizations of viruses.

**CLO2:** Analyze the techniques of isolation, identification, counting of apoptosis cells and gene transfer in ccells.

**CLO3:** Evaluate the techniques of inoculums preparation, handling fermentor and industrial production.

**CLO4:** Gain the knowledge of microbes involve in food production, processing and preservation

**CLO5:** Explain the epidemiologic diseases effects on health surveillance systems and control.

**CLO6:** Acquire knowledge on immune system, immunity power boosting and immunity related diseases.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Introductory Virology):**  Collection and identification of viral disease samples  Cultivation, enumeration and isolation of bacteriophages from raw sewage  ELISA test for virus identification  Detection of HBsAg from patients serum by serological methods  Isolation of TMV virus and infecting plants. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Molecular Cell Biology):**  Isolation, identification and counting of apoptosis cells  Gene transfer in living cells  Stem cells isolation  Cell –cell interaction | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **2** |
| **3** | **Unit C (Fermentation Technology):**  Demonstration of a typical fermenter  Demonstration of fermentation techniques  Inoculums preparation  Production of cell mass  Production of industrial alcohol | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **3** |
| **4** | **Unit D (Food Microbiology):**  Sampling procedures, individual sample, composite sample and preservation of samples.  Detection of adulteration in milk.  Laboratory pasteurization, homogenization and bottling of milk.  Microscopic count (DMC) in milk product.  Isolation and detection of microbes from dahi, cheese, ghee, butter, ice-cream  Methods of preservation of meat | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **4** |
| **5** | **Unit E (Epidemiology and Public Health):**  Quantitative and qualitative data collection procedure Demonstration and data analysis on epidemiologic diseases  Study of health surveillance systems  Evaluation of personal hygiene in food and health care  Demonstration on bioethics in public health | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **5** |
| **6** | **Unit F (Fundamentals of Immunology):**  Preparation of bacterial whole cell extract.  Preparation of outer membrane protein  Collection of serum and plasma  Separation of blood leucocytes  Test for cell viability.  Determination of human blood groups | Continuous internal evaluation, viva voce & Semester final examination. | 3 |  |

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**Course Code: BMIC 508**

**Course Title: Field report/ Excursion V**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 509**

**Course Title: Viva voce V**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 5th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 501 to BMIC 506

**Course Code: BMIC 601**

**Course Title: Advanced Virology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Advanced virology deals on it exploit host cells for reproduction, interaction with host organism physiology and immunity, diseases causing, the techniques to isolate and culture them, and their use in research and therapy. The course also describes the prevention and control techniques of virus causing diseases.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn about the basic concept of viral infections to common diseases.

**CLO3:** Explain the genome organization, transmission, diagnosis, treatment strategy and vaccine approaches.

**CLO4:** Gain knowledge on genome structure, replication, and oncogenic transformation of viruses.

**CLO5:** Explain the use of antiviral compounds, interferon and vaccines for prevention and treatment.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Respiratory System and Gastrointestinal Tract:** Viral Infections to the common cold, influenza, measles, mumps, rubella, chicken pox, shingles and viral diarrhoea. | Lecture Quiz & Assignment | Quiz, Tutorial &Semester final | 4 | **1** |
| **2** | **Arthropod-Borne Diseases:** Diseases causing Japanese encephalitis virus and yellow fever virus. | Lecture & Open discussion | Tutorial & Semester final | 3 | **1** |
| **3** | **Herpes and Hepatitis Viruses:** General properties, pathogenesis and transmission of herpes viruses. Detail of genome organization, replication, pathogenesis, molecular variants transmission and prevention of hepatitis viruses. | Lecture & Assignment | Class test& Semester final | 4 | **1**& **2** |
| **4** | **Non-oncogenic Retroviruses- HIV:** Structure, genome organization, transmission, epidemiology, disease, pathogenicity, diagnosis and control, treatment strategy and vaccine approaches. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1,2&3** |
| **5** | **Cellular Oncogenes and Oncogenic Viruses:** General features and classification; retroviridae genome structure; replication of HTLV; DNA tumour viruses. Mechanism of oncogenic transformation. | Lecture, Quiz & Assignment | Tutorial & Semester final | 5 | **1, 2** & **4** |
| **6** | **Human Papilloma and Influenza Viruses:** General properties and replication; antigenic shift and drift; pathogenesis epidemiology and vaccine approaches. | Lecture, Quiz& Assignment | Tutorial &Semester final | 4 | **2,3**&4 |
| **7** | **Prevention and Treatment:** Antiviral compounds, interferon and viral vaccines. Gene therapy and phage display. | Lecture, Quiz& Assignment | Tutorial & Semester final | 3 | **2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Edward K W. Basic virology. Malden, MA; Oxford: Blackwell Publications, 2008.
2. Jawetz M, Adelberg’s. Medical Microbiology. 26th Edition. 2013.
3. Pelezar MJ. Microbiology. Mcgraw-Hill College. 5th Edition. 1985.
4. Thomas DB, Michael TM, John MM. Biology of microorganism. Prentice Hall. 1994.
5. Jeffrey W. The Fundamentals of Human Virology. Fort Collins. 2005.
6. Nicholas HA. Fundamentals of Molecular Virology, 2nd Edition. 2011.

**Course Code: BMIC 602**

**Course Title: Industrial Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Industrial microbiology is importance for manufacture of bio products, bio-energy, generate electricity, transport fuels, chemicals, pulp and paper, treating industrial waste water and reduce the adverse environmental impacts. The course also explores microbial metabolites, industrial foods and beverages.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Adoptscreening, strain development and processing of industrial fermentation for bio products.

**CLO2:** Apply the techniques of*Taq* polymerase, DNA ligase, metabolites and recombinant DNAproduction.

**CLO3:** Produce antibiotics, vitamins, steroids, insulin and industrial food and beverages using microbes.

**CLO4:** Explore the chemical applications for synthesis and production of organic solvents.

**CLO5:** Explain contribution of microbes to economic growth, and industrial produces marketing globally.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Industrial Microbes:** Primary and secondary screening, strain development, preservation and maintenance. | Lecture & Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Industrial Fermentation:** Crude and synthetic media. Production of molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. | Lecture & Open discussion | Tutorial &Semester final | 4 | **1** |
| **3** | **Microbial Molecule Products:** Production of Taq polymerase, restriction enzymes, DNA ligase and primary and secondary metabolites. Recombinant products. | Lecture & Open discussion | Tutorial& Semester final | 4 | **1,** &**2** |
| **4** | **Health Care Products:** Industrial production of antibiotics, vitamins, essential amino acids, enzymes and steroids. Insulin production. Metabolites ientification. | Lecture, Quiz & Assignment | Tutorial & Semester final | 4 | **1,2**&**3** |
| **5** | **Food and Beverage Fermentations:** Dairy foods- cheese, yogurt and butter. Food additives and supplements- flavours, food colors and natural food preservatives.Production of wine, beer alcohol, acid vinegar. Manufacture of baker’s yeast. Single cell protein production. Edible fungi and algae production. | Lecture, open discussion & Quiz | Tutorial & Semester final | 4 | **1**& **3** |
| **6** | **Chemical Applications:** Synthesis of L-Methionine, L-Lysine, L-Tryptophan, non-essential amino acid and L-Glutamic acid. Production of acetone, butanol, and isopropanol organic solvents. | Lecture, group discussion & Quiz | Assignment & Semester final | 4 | **1 &4** |
| **7** | **Global Economy:** Contribution of industrial microbiology to economic growth. Contribution of microbial biotechnology to employment creation. Industrial microbiology market. | Lecture, Assignment & Quiz | Assignment & Semester final | 3 | **1 & 5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

## Norman NP, Joseph HH.Food Science.5th Edition. 1995.

## Gordon FB. Immobilization of enzymes and cells.1997.

## Weetall HH. Immobilization of enzymes, antigen, antibody and peptides: Preparation and characterization.Springer, 1993.

## Vyan SP, DixitVK.Pharmaceutical Biotechnology. CBS Publishers Pvt. Ltd., 2010.

## Ian FR. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7th Edt., Wiley, 2016.

## Vandamme EJ. Production of vitamins, coenzymes and related biochemical by biotechnological processes.J.Chemical Technology and Biotechnology.1992.

**Course Code: BMIC 603**

**Course Title: Marine Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Marine Microbiology programs to improve marine resources, aquaculture technology, environmentally sustainable fisheries and successful stock restoration strategies. Marine microbiology involves in the research of fish reproductive endocrinology, pathology, virology, vaccine development, and environmentally sustainable marine aquaculture and microbiology.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Understand about marine microorganisms, marine environment and their application for human welfare.

**CLO2:** Acquire extensive knowledge in aquaculture, fisheries, transgenic animal production.

**CLO3:** Evaluate the professional methodologies for identification of marine resources and microbes.

**CLO4:** Explore the knowledge of marine diversity and their role in marine ecology.

**CLO5:** Apply the identification techniques marine microbes, diseases diagnose and management of marine environment for human society.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Aquaculture and marine microbiology applications. Microbes into the wild, marine pollution and biological control. | Lecture, Discussion & Assignment | Assignment, Tutorial & Semester final | 3 | **1** |
| **2** | **Aquaculture Microbiology:** Fish and aquaculture microbiome. Importance of microbial communities in diversified and sustainable aquaculture. | Lecture & Assignment | Tutorial & Semester final | 3 | **1**&**2** |
| **3** | **Marine Resources:** Marine phytoplanctons, algae and plants. Marine invertebrates, vertebrates and reptile. Biomedical and health products. Importance marine resource in economic growth, biotechnology, industrial products and marketing globally. | Lecture & Open discussion | Assignment, Tutorial & Semester final | 4 | **1**&**2** |
| **4** | **Marine Microbes:** Marine viruses, bacteria, archaea, protists, fungi. Marine micro-animals. Marine micro-plankton. Marine sediments and microfossils. Marine micro-benthos. | Lecture & Quiz | Tutorial & Semester final | 4 | **2**&**3** |
| **5** | **Marine Diversity:** Marine microbenthos. Marine microbiomes. Marine food web. Niche communities. Microbial diversity. | Lecture, Open discussion & Quiz | Quiz, Tutorial & Semester final | 4 | **1**&**3** |
| **6** | **Diseases and Control:** Effects of microbes on blue-green algae. Development and regulation of algal blooms. Protozoan, parasite and microbial diseases of fish and shellfish and control method. | Lecture, Open discussion & Assignment | Tutorial & Semester final | 4 | **2**&**4** |
| **7** | **Marine Microbiology and Human Society:** Beneficial and detrimental effects. Marine pollutants. Microbiology of fish and seafood products. Micro-plastics effects. | Lecture, Open discussion & Assignment | Tutorial & Semester final | 4 | **2,3**& 5 |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Ananth PN. Marine Fisheries Extension. Discovery Publishing Pvt Ltd, 2010.
2. Munn C. Marine Microbiology: Ecology and Applications. Garland Science, 2011.
3. Beaumont A, Hoare K. Biotechnology and Genetics in Fisheries and Aquaculture. 2nd Edition, 2010.
4. Gall G, Chen H. Genetics in Aquaculture IV. Elsiver Science, 1st Edition, 1993.
5. Ransa MM, Shammi J. Fish Biotechnology. Agrobios, 2002.

**Course Code: BMIC 604**

**Course Title: Advanced Immunology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The main objectives of advanced immunology is to explore immunity and immune-system and immunoglobulin, MHC, hypersensitivity reaction, immunization, immunological techniques and genetic disorders for insure healthy life. It also apply microbial study in the area of immunology, developing vaccines for specific epidemic diseases, ontogeny immune system, immunological tolerance, hypersensitivity reactions, transplantation immunology and vaccination for healthy life.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the ontogeny of immune system and immunological tolerance procedure.

**CLO2:** Explain the different types of hypersensitivity reactions.

**CLO3:** Gain knowledge in transplantation immunology, histocompatibility complex and vaccination process.

**CLO4:** Apply the techniques of immunology of tumors and administration of vaccines in human population.

**CLO5:** Learn about antibody-mediated autoimmune diseases and management systems.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Ontogeny of Immune System:** Origin of hematopoietic stem cells. Immunological status of the newborn. Ontogeny of T and B cell. | Lecture, Discussion & Assignment | Quiz, Tutorial & Semester final | 3 | **1** |
| **2** | **Immunological Tolerance:** Mechanisms of tolerance. Thymic tolerance of self-antigens; B cell tolerance, artificially induced tolerance. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 3 | **1** |
| **3** | **Hypersensitivity Reactions:** Hypersensitivity type I, II, III and IV reactions. | Lecture &Assignment | Tutorial & Semester final | 4 | **2** |
| **4** | **Transplantation Immunology:** Barriers of transplantation. Law of transplantation. Role of T lymphocytes in rejection and prevention of rejection. | Lecture, Quiz & Assignment | Class test & Semester final | 4 | **1** &**23** |
| **5** | **Histocompatibility Complex:** Discovery of MHC molecules, general features of MHC genes and binding of peptides to MHC molecules. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**&**3** |
| **6** | **Immunology of Tumors:** Surface markers of tumor cells. Immune response to tumor cells. Lymphoproliferative disorders due to tumor growth. Cancer immunotherapy. | Lecture, Quiz& Assignment | Tutorial & Semester final | 4 | **2**&**4** |
| **7** | **Antibody-mediated Autoimmune Diseases:** Systemic lupus erythematosus (SLE). Waste disposal hypothesis and SLE. Autoimmune Bullous Skin Diseases – Pemphigus. | Lecture, Quiz& Assignment | Tutorial & Semester final | 4 | **2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. David MJB. David I. Immunology. 8thEdition. Saunders, 2012.
2. Ivan R. Roitt's Essential Immunology. 9thEdition. John Wiley & Sons, 1997.
3. Ivan MR, Peter JR. Essential Immunology. 13thedition Delves .Wiley-Blackwel, 2016.
4. David M, Brian C, Anne C, Michael O. Lippincott Advanced Immunology. Williams & Wilkins, 1991.
5. Barrett T J. Textbook of Immunology. Mosby, 1978.
6. Tizar I R. Immunology. An introduction. Saunders College Publication, 1995.
7. Abbas AK, Andrew HL. Basic Immunology. 4thEdition. Saunders, 2012.

**Course Code: BMIC 605**

**Course Title: Genetic Engineering**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Genetic engineering refers to the genetic modification, genetic makeup of cells and novel organism’s production. Benefiting human beings it combine various technologies to living cells, agriculture, industry, medicine and nutrition. Genetic tools used in biotechnology to modify genetic structure of improve plants and animals products. Molecular basis of epigenetic, chromatin remodeling in gene regulation and diseases are important part of this course which are apply to modification of different organisms.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Know about different tools of genetic engineering and DNA manipulating.

**CLO2:** Explain the features of a cloning vectors, analysis and expression of a cloned gene.

**CLO3:** Apply the techniques of linkage, chromosomes, mapping and RFLP, AFLP, SSR, RAPD and SNP.

**CLO4:** Acquire knowledge of epigenetic for inheritance patterns of life and applications in microbiology.

**CLO5:** Analyze metagenomics to know transmission of tropical diseases and applications in human welfare.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Molecular Tools:** Recombinant DNA production. Amplification of recombinant DNA. Molecular analysis of DNA, RNA and protein. | Lecture & Assignment | Tutorial, & Semester final | 2 | **1** |
| **2** | **Cloning Vector:** Features of a cloning vector-cloning site, selectable marker, reporter gene and elements for expression. Types of cloning vectors- plasmid, bacteriophage and cosmid. Bacterial, yeast and human artificial chromosome. Screening of blue white. | Lecture & Assignment | Class test, Presentation & Semester final | 4 | **1 &2** |
| **3** | **Analysis of Cloned Gene:** Use of recombinant DNA technology to identify human genes and diagnose human diseases. Human gene therapy. DNA profiling. Production of eukaryotic proteins in bacteria. Transgenic animal and plant production. Reverse genetics. Dissecting biological processes by inhibiting gene expression. | Lecture, Open discussion & Assignment | Class test & Semester final | 4 | **1 & 2** |
| **4** | **Gene Expression and Function Analysis:** Transcription of cloned gene. Identifying protein binding sites on a DNA molecule. Identifying the translation product of a cloned gene. Hybrid- release translation and hybrid-arrest translation. Analysis of protein by in vitro mutagenesis. Studying protein-protein interaction, phage display and yeast to hybrid system. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **1**&**2** |
| **5** | **Gene Linkage and DNA Markers:** Gene linkage, chromosomes and gene mapping of human. Applications of RFLP, AFLP, SSR, RAPD and SNP. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **1, 2**&**3** |
| **6** | **Epigenetic:** Definitions, molecular basis, mechanisms, functions and consequences. Epigenetic and health. | Lecture & discussion | Tutorial & Semester final | 4 | **1,2**&**4** |
| **7** | **Metagenomics:** Definition, types and importance of metagenomics. Tools and programs for genomic and metagenomics study. Basic linux commands, Anaconda, programs installation and maintenance, programs repository. SARSCoV-2, Chikungunya, Dengue and Monkey pox. | Lecture & Group discussion | Assignment, Class test & Semester final | 4 | **1, 3**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Old RW, Primrose SB. Principle of Gene Manipulation. University of California Press, 2012.

2. Watson JD, Baker TA. Molecular Biology of the Gene SP. Harrison; Pearson, Boston.2009.

3. Peter SD, Simmons MJ. Principles of Genetics –Wiley, New Jersey. 2011.

4. Brown TA. Gene Cloning: An Introduction –Wiley Blackwell. 2020.

5. Sambrook J. Russell D.W. Molecular Cloning: a laboratory manual, NY. 2008.

6. Ausubel FM, Brent R, Smith JA. Current Protocol in Molecular Biology. John Wiley and Sons. 2019.

**Course Code: BMIC 606**

**Course Title: Research Methodology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The knowledge of research methodology provides a basic knowledge of good design concept, development of research plan, sampling strategy, simulation, interpretation of primary data, and selection of appropriate data. The course also discloses the rules of quotation and bibliography, scientific reports, reviews, short communication, and publication research articles in scientific journals.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn a basic knowledge of research objectives, importance, types and limitations.

**CLO2:** Know basic concept of research plan, sampling strategy, methodology and types of design.

**CLO3:** Gain knowledge on data collection, simulation, methods of primary data analysis and graph designing.

**CLO4:** Apply the methods of participation, questionnaire preparation, handling data and research funds.

**CLO5:** Acquire knowledge of research ethics and research article publication ethics.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Concepts and Approaches:** Definition, objectives, importance and types of research. Methodology and limitation of research. | Lecture, Open discussion & Assignment | Tutorial, Presentation& Semester final | 4 | **1** |
| **2** | **Research Design:** Features of good design and development of research plan sampling design, sampling strategy. Types of programme design, survey and census. | Lecture & Assignment | Class test & Semester final | 4 | **1**&**2** |
| **3** | **Methods of Data Collection Processing and Analysis:** Primary data collection and selection of appropriate data. Data analysis, simulation, replication and interpretation. Problems, type’s statistics, interpretation of results, graphical representation and tabulation. | Lecture & Assignment | Tutorial & Semester final | 4 | **1, 2** & **3** |
| **4** | **Guidelines for Communication:** General principles and methods in people’s participation. Questionnaire and schedule. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **1**&4 |
| **5** | **Ethics of Fund and Data Management:** Data handling. Managing public research funds. | Lecture, Quiz &  Assignments | Tutorial **&** Semester final | 3 | **2**&**4** |
| **6** | **Research Ethics:** Research misconduct. Rules for collaborative Research | Lecture, Quiz &  Assignments | Tutorial & Semester final | 3 | **1**&**5** |
| **7** | **Publication Ethics:** Authorship. Plagiarism. Rules of quotation and bibliography. Ethical issues on scientific reports, reviews, short communication, case studies, web page, booklet and leaflet writing. | Lecture, Open discussion | Tutorial, Semester final | 4 | **2**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Niglas K. The Multidimensional Model of Research Methodology: An Integrated Set of Continua. SAGE Publications, Inc., pp. 215–236, 2010.

2. Bright EW. Jr.An Introduction to Scientific Research.Dover Publications. 1991.

3. Petter L. Research Methodology in the Medical and Biological Sciences. Elsevier. 2007.

4. Thomas K. The Structure of Scientific Revolutions.University of Chicago Press. 1962.

5. Ranjit K. Research Methodology: A step-by-step Guide for Beginners. Sage Pub.Ltd. 2012.

**Course Code: BMIC 607**

**Course Title: Microbiology Practical** **VI**

**Course Type: Core**

**Credits: 6**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 150**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Analyze the viruses detection, laboratory diagnosis, prevention and treatment of viral infection

**CLO2:** Apply the techniques of protein, brewing yeast, alcohol and cheese production.

**CLO3:** Evaluate of marine microbes identification, biofilm observation and microalgae identification.

**CLO4:** Analyze antigen and antibody detection, SDS-PAGE and immunoblotting of bacterial protein.

**CLO5:** Evaluate the bacterial transformation, DNA digestion and restriction mapping.

**CLO6:** Acquire knowledge on research planning, data collection, data analysis, and scientific article writing.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Advanced Virology):**  Viruses detection by ELISA  PCR amplification of HBV core and surface genes  Laboratory diagnosis of virus infection  Prevention and treatment of viral infection  Viral infection and tumors | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Industrial Microbiology):**  Production of single cell protein from fungal and algal source  Isolation of brewing yeast and alcohol production  Isolation of baking yeast and production of bread  Isolation of milk coagulating bacteria from milk and yogurt.  Production of cheese by milk coagulating isolates. | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **2** |
| **3** | **Unit C (Marine Microbiology):**  Identification of marine microbes and fish parasites  Internal anatomy of different aquatic animals.  Study of different internal organ of fishes  Observation of marine biofilm and macro algae.  Identification of economically viable marine microalgae. | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **3** |
| **4** | **Unit D** (**Advanced** **Immunology):**  Detection of antigen and antibody  SDS-PAGE and immunoblotting of bacterial protein.  Complement fixation tests.  HLA typing. | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **4** |
| **5** | **Unit E (Genetic Engineering):**  Bacterial transformation and transformation efficiency study.  Methods of DNA and RNA isolation.  Preparation of c-DNA and reverse transcriptase PCR.  DNA digestion by restriction enzymes.  Restriction mapping and orientation of a ligated insert.  Ligation of DNA to appropriate vector | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **5** |
| **6** | **Unit F (Research Methodology):**  Research planning, questionnaire and schedule designing.  Data processing, collection and analysis  Guidelines for communication  Manuscript preparation, editions and submission | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **6** |

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**Course Code: BMIC 608**

**Course Title: Field report/ Excursion VI**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 609**

**Course Title: Viva voce VI**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 6th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 601 to BMIC 606

**Course Code: BMIC 701**

**Course Title: Medical Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Medical microbiology focuses on the nature and causes of diseases in human, emphasizing the diagnosis and treatment practices for pathogenic diseases in human body. Due to the change of environment microbes are evolving that make difficulties for clinical diagnosis and medical measures for infectious diseases. To combat such worst situation of various pathogens, this course offer modern knowledge of pathogens, diseases and their medical measures for infectious diseases in human health.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Achieve in-depth knowledge of various human pathogens and host-pathogen interactions.

**CLO2:** Acquire knowledge of disease samples collection, transport, culturing, and diagnostic tests**.**

**CLO3:** Learn about clinical manifestation, pathogenesis and applications of antimicrobial therapy.

**CLO4:** Explain the human microbiome project, microbes related to human body and diseases.

**CLO5:** Gain knowledge of basic regenerative medicine, IPS cells and methods of gene therapy.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Microbial-Human Interactions:** Normal microbial population of healthy human body-skin, mouth, upper respiratory, intestinal, urino-genital tract and eye. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **2** | **Host-Pathogen Interaction:** Pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **3** | **Collection, Transport and Diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 4 | **1&2** |
| **4** | **Microbes and Diseases:** Clinical manifestation, pathogenesis, virulence factors, and control of diseases causing microbes. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **2**&**3** |
| **5** | **Antimicrobial Therapy:** General properties of antimicrobial agents. Selective toxicity, spectrum of activity, modes of action, side effects and resistance of microorganisms. | Lecture, Quiz &  Assignment | Assignment, Class test & Semester final | 4 | **1**&**3** |
| **6** | **Human Microbiome:** Human microbiome project. Microbes related to human body. Disease and death, environmental health and migration. | Lecture, Discussion &  Assignment | Assignment, Class test & Semester final | 3 | **2**&**4** |
| **7** | **Regenerative Medicine:** Fundamentals of regenerative medicine. Present aspects of regenerative medicine. IPS cells. Cell therapy. Methods of gene therapy. | Lecture, Quiz &Discussion | Tutorial & Semester final | 4 | **1,2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Atlas RM. Principles of Microbiology. W.C. Brown Publishers. 2014.
2. Chakraborty P. A Text book of Microbiology. New central book agency Ltd. 2009.
3. Madigan MT. Biology of Microorganisms. Pearson. 12th Edition, 2009.
4. Schlegel G. General Microbiology. Cambridge Uni. Press.7th Edition, 2009.
5. Tortora FC. Microbiology an Introduction. Pearson Higher ED Pub. 2016.
6. Marchesi JR, Ravel J. The vocabulary of microbiome research: a proposal. 2015.

**Course Code: BMIC 702**

**Course Title: Microbial Metabolism**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course microbial metabolism deals the metabolisms. The course also contains carbon metabolism, biosynthesis of fatty acids, biosynthesis of cholesterol, regulation of cholesterol biosynthesis, uses of cholesterol, biological significance of HDL and LDL, β-carotene, and triglycerides, steroid hormones, prostaglandins, prostacycline, thromboxane and phospholipids.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Learn the define metabolism, types, economy of microbial metabolism and properties of metabolisms.

**CLO2:** Explores the biosynthetic pathways and techniques of carbohydrate, protein and lipids**.**

**CLO3:** Gather basic knowledge of aerobic metabolism, anaerobic respiration, and significance of HDL and LDL.

**CLO4:** Explain the chemolithotrophy and phototrophic metabolisms.

**CLO5:** Apply the biological knowledge of nitrogen metabolism significant in the fields of agriculture.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Concepts of Metabolism:** Definition, types and economy of metabolism. Heterotrophic microbial metabolism. | Lecture & Open discussion | Class test & Semester final | 3 | **1** |
| **2** | **Metabolic Properties:** Methylotrophy metabolism of methanol, methyl amines, formaldehyde and format. Syntrophic metabolism. | Lecture, Open discussion &Assignment | Class test, Tutorial & Semester final | 4 | **1** |
| **3** | **Carbohydrate, Protein, and Lipid Metabolic Pathways:** Connecting other sugars to glucose metabolism. Connecting proteins to glucose metabolism. Connecting lipids to glucose metabolism. Regulation of glycolytic pathway. | Lecture, Open discussion& Assignment | Assignment, Tutorial &Semester final | 4 | **1**&2 |
| **4** | **Cellular Respiration:** Aerobic metabolism occurs in bacteria, archaea and eucarya. Anaerobic respiration ecological importance, and economic relevance | Lecture, Open discussion &  Assignment | Assignment, Class test &Semester final | 3 | **2**&**3** |
| **5** | **Biosynthetic Pathways:** Biosynthesis definition. Biosynthesis substrates. Glycolytic pathway. Autotrophy Calvin cycle. Biosynthesis of cholester­ol. Biological significance of HDL and LDL. | Lecture, Open discussion & Assignment | Assignment, Tutorial &Semester final | 4 | **1**&**3** |
| **6** | **Chemolithotrophy and Phototrophy:** Hydrogen oxidizing bacteria. Sulfur oxidation. Acidophiles in acid mine drainage. Phototrophic metabolism. | Lecture, Open discussion &  Assignment | Assignment, Class test & Semester final | 4 | **2**&**4** |
| **7** | **Nitrogen Metabolism:** Assimilation of nitrogen. Nitrogen fixation. Nitrogen regulation in enterobacteriaceae family. | Lecture &  Assignment | Class test & Semester final | 4 | **1,2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Alberts B. Molecular biology of the cell. New York: Garland Science. 2007.
2. Zumdahl S, S. Zumdahl, Susan A. Chemistry. 8th edition. CA: Learning. 2008.
3. Pratt DV, Judith GV, Charlotte W. Fundamentals of biochemistry: life at the molecular level. 4th ed. Wiley. 2013.
4. Green KD, Garneau-Tsodikova S. Posttranslational Modification of Proteins. Module in Chemistry, Molecular Sciences and Chemical Engineering. Elsevier. 2010.
5. Lodish HF. Molecular cell biology. 4thedi. New York: W.H. Freeman, 2000.
6. Xu Z, Zhou G. Research advance in nitrogen metabolism of plant and its environmental regulation. 2004.

**Course Code: BMIC 703**

**Course Title: Food and Beverage Quality Control**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course is designed for the students to provide advanced knowledge in the interface between different types of quality food processing, food preservation and food security with a focus on microbiological knowledge. Relevant microorganisms, enzymes and food production technologies are detailed by the course. Students will be able to gather know on developing food industries, prevention of food spoilage and impacts of food microbiology in food security, food industries and economy.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1: D**efine quality, organization, and quality control of food and beverage.

**CLO2:** Apply the techniques for quality control of food and beverage as well as monitoring and good practices.

**CLO3:** Evaluate the sanitation to avoid hazard and quality assurance of food, fish and beverage.

**CLO4:** Understand the public health aspects of microbial infection in food and beverage.

**CLO5:** Apply the proper guidelines for controlling the foods and beverages quality.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Organization of Quality Control:** Concepts, principles, applications, problems of quality control. Importance of quality control of food, fish, beverages and mineral water. Future aspect of quality control. | Lecture, group discussion & Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Microbiological Quality Control:** Different techniques of microbial quality control. Chemical and microbiological indicators for quality assurance. Monitoring and good practices. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**&2 |
| **3** | **Sanitation and Inspections:** Sanitation and hygiene of processing plant. Water in processing and cleaning. Waste effluent treatment packaging. | Lecture, Quiz & Assignment | Tutorial & Semester final | 4 | **2**&**3** |
| **4** | **Hazard and Quality Assurance:** Sampling, hazard analyses and critical control point system. Identification of potential hazards, monitoring systems for critical control point. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **1**&**3** |
| **5** | **Health Concerns:** Public health aspects of microbial infection of food and beverage. Quality assurance research methodology. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **1**&**4** |
| **6** | **Personal Hygiene and Safety:** Safety at the Work Place: Necessity for Personal Hygiene and different sanitary practices, Safety at the Work Place taking proper measures. | Lecture &  Assignments | Tutorial & Semester final | 4 | **1**&**4** |
| **7** | **Laws and Regulations:** National and international standards and guidance for foods and beverages. | Lecture &  Assignments | Tutorial & Semester final | 3 | **1**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Herschdofrfer SM. Quality control in the food industry. Academic press London and NY, 2012.
2. StanburyP. Whitaker A, HallS. Principle of fermentation technology. Butterworth. 3rd Edition. 2016.
3. Reed G.Preseott, Dunn’s Industrial Microbiology. Globe Book services, London, 1984.
4. Frazier WC, Westhoff DC. Food Microbiology; McGraw-Hill College, 1988.
5. Rehm HJ, Reed G. Biotechnology. British Food Manufacturing Industries Research Association, UK. 1993.
6. Codex Alimentarius Commission. Principles for the Risk Analysis of Foods Derived from Modern Biotechnology. FAO/WHO, Rome, 2003.

**Course Code: BMIC 704**

**Course Title: Environmental Pollution and Bioremediation**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

To provide the insights and tools to create new bio products and the utilization of microbial processes in wastewater treatment, bio deterioration, and bioremediation. The course also discuss about the role of genetically engineered microbes in industrial and environmental sectors.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Gain knowledge on environment factors, effects, and controlling environmental pollution.

**CLO2:** Demonstrate the process ofbiodeterioration of leather, wool, feather, stones, microplastics and rubber.

**CLO3:** Identify different degradative microbes and their metabolic pathways.

**CLO4:** Distinguish industrial wastes recalcitrant, waste and wastewater treatment technologies.

**CLO5:** Apply the techniques and bioengineering approaches of bioremediation.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Environmental Pollution:** Definition, factors and effects of environmental pollution. Environmental pollution control measures. | Lecture, Open discussion &Assignment | Tutorial, Presentation & Semester final | 3 | **1** |
| **2** | **Biodeterioration:** Basic concepts. Factors involved in biodeterioration. Biodeterioration of leather, wool, fur, feather, stones, plastics and rubber. Control of biodeterioration. | Lecture & Assignment | Class test & Semester final | 4 | **1 &2** |
| **3** | **Degradative Microbes:** Recent approaches to enrich and isolate microbes having catabolic properties. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **1**&**3** |
| **4** | **Metabolism:** Metabolism of pesticide, aromatic compounds, phenols, organic residues and synthetic organic chemicals. | Lecture, Quiz & Assignment | Tutorial & Semester final | 3 | **2**&**3** |
| **5** | **Industrial Wastes Recalcitrant:** Xenobiotic chemicals in the environment. Biodegradable recalcitrant wastes, relationship between structure and recalcitrance property. Factors affecting microorganisms to degrade xenobiotics. | Lecture & Open discussion | Tutorial & Semester final | 4 | **2**&**4** |
| **6** | **Waste Treatment Technologies:** Solid waste treatment, landfill, and biological treatments. Biological removal of nitrogen and phosphorous. Phytoremediation of toxic metals. | Lecture, Quiz &  Assignments | Tutorial &Semester final | 4 | **2**&**4** |
| **7** | **Bioremediation:** Concept.Techniques of bioremediation. Limitations of bioremediation. Environmental modification for bioremediation. Microbial seeding and bioengineering approaches of bioremediation. | 4Lecture, Quiz &  Tutorials | Tutorial & Semester final | 4 | **1, 2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Vineet K, Gaurav S, Maulin S. Bioremediation for Environmental Sustainability Approaches to Tackle Pollution for Cleaner and Greener Society. 1st Edition, 2020.
2. Gaurav S, Vineet K, Maulin PS. Bioremediation for Environmental Sustainability, Elsevier Inc. 2020.
3. Kumar P. Environmental Pollution: Biodegradation and Bioremediation. Studium Press, 2017.
4. Ram NB. Environmental Pollutants and their Bioremediation Approaches. 1st Edition, CRC Press, 2017.
5. Deep CS, Ravindra S. Bioremediation of Environmental Pollutants: Emerging Trends and Strategies. Springer, 2022.

**Course Code: BMIC 705**

**Course Title: Enzymology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Enzymology is the study of enzymes, their kinetics, composition and function, as well as their relation to each other. This course focus on the basic understanding of enzyme, its structure and function, classification, nomenclature, active site structure and mechanism, enzymatic reactions and regulation, isolation and purification of enzyme and use of enzyme in practice.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Explain the concept of theoretical enzymology, general characteristics and actions of enzymes.

**CLO2:** Describe the enzymes catalysis and enzyme kinetics activities.

**CLO3:** Identify the procedure of enzyme inhibition and deactivation.

**CLO4:** Interpret the industrial enzymes for uses as proteolytic, metal degradation and immobilization.

**CLO5:** Explores the applications of enzymes in medical and clinical sectors.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Basic Enzymes:** Concept of enzymology. Theoretical enzymology. Characteristics of enzymes and co-enzymes. | Lecture, Open discussion & Assignment | Tutorial, Presentation & Semester final | 6 | **1** |
| **2** | **Action of Enzymes:** Enzyme substrate complex. Concept of active centre; binding sites; stereo-specificity and ES formation. Enzyme activities. | Lecture, Open discussion & Assignment | Tutorial, Assignment & Semester final | 6 | **1** |
| **3** | **Enzymes Catalysis:** General acid-base catalysis; covalent catalysis; non-protein catalytic groups and metal ions. Mechanism of action of chymotrypsin and lysozyme. | Lecture, Quiz & Assignment | Tutorial & Semester final | 5 | **1&2** |
| **4** | **Enzyme Kinetics:** Factors influencing catalytic activity; simple enzyme kinetics with single and multi-substrate. Michaelis-Menten kinetics; turnover number; Km and Vmax. | Lecture, Quiz &  Tutorials | Tutorial & Semester final | 5 | **1&2** |
| **5** | **Enzymes Inhibition and Deactivation**: Reversible enzyme, competitive, uncompetitive, mixed and noncompetitive inhibition. Irreversible inhibition and suicide in-activators. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 5 | **2**&**3** |
| **6** | **Industrial Enzymes:** Uses of proteolytic and metal degrading enzymes. Enzymes as thrombolytic agents. Enzymes immobilization. | Lecture, group discussion, & Tutorials | Assignment, Class test & Semester final | 3 | **1 & 4** |
| **7** | **Medical Enzymes:**  Importance of enzymes in medical device cleaning. Applications of enzymes in medicine and to treat disorders. | Lecture, Assignment & Tutorials | Assignment, Class test & Semester final | 3 | **3, 4 & 5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Albert L, David LN, Michael MC. Lehninger Principles of Biochemistry. 5thEdition.Freeman & Co. 2008.

2. Nicholas CP, Lewis S. Fundamentals of Enzymology. Oxford Press.2010.

3. Takahashi N, Isobe T. Proteomic Biology Using LC-MS. Wiley Interscience, 2008.

4.  Mateo C, Fernandez-Lorente G, Guisan J, Fernandez-Lafuente R. Improvement of enzyme activity, stability and selectivity via immobilization techniques. Enzyme and Microbial Technology. 2007.

5. Buchholz K. A breakthrough in enzyme technology to fight penicillin resistance—industrial application of penicillin amidase. Applied Microbiology and Biotechnology. 2016.

6. Devasena T. Enzymology. First Edition, World Rights, 2010.

**Course Code: BMIC 706**

**Course Title: Bioinformatics**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Bioinformatics is an interdisciplinary field that develops methods and software tools dealing with the statistical knowledge of biological data presentation and analyses. The course explores chemo-informatics tools for drug discovery and designing. It also discloses the knowledge of molecular modeling, protein, drug, and DNA relationship in microbial, agricultural and medical sectors.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:**  Acquire the basic concept of bioinformatics, goal, history and applications in the fields of microbiology.

**CLO2:** Know about the databases searching and sequence alignment.

**CLO3:** Learn about experimental design for bioinformatics.

**CLO4:** Show computational image processing, data integration and molecular dynamics simulations.

**CLO5:** Analyze chemical research data, chemo-informatics tools for drug discovery and research.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Fundamental of Bioinformatics:** Bioinformatics definition, goal, history and applications. Types of databases, pitfalls of biological databases, global bioinformatics centers and servers. Bioinformatics tools; Swissprot, Bioedit, MEGA, Chromas, Clustal W. | Lecture & Group discussion, Presentation | Assignment, Class test & Semester final | 4 | **1** |
| **2** | **Databases Searching and Sequence Alignment:** Nucleotide sequence databases; EMBL, Genbank, Gramene, DDBJ, UniGene, SGD, EMI Genomes, Genome Biology. Protein sequence databases; Swiss Prot/TrEMBL, PIR, UniProt. Protein databases; Protein Data Bank, SCOP, CATH. Literature database; PubMed. Multiple Sequence Alignments: Logic, Clustal Omega, Sequence profile. | Lecture, Assignment & Group discussion | Assignment, Class test & Semester final | 5 | **1**&**2** |
| **3** | **Experimental Design for Bioinformatics:** Bioinformatics pipeline to explore transcriptional regulation, differential expression analysis, transcriptomic analysis, compare and contrast microarray and RNA-seq methods. | Lecture, Presentation & Open discussion | Assignment, Class test & Semester final | 4 | **2**&**3** |
| **4** | **Computational Microscopy:** Computational image processing in microscopy, systems biology vs. traditional cell and molecular biology. Features of complex systems and data integration. Molecular mechanisms using molecular dynamics simulations. | Lecture, Open discussion & Assignment | Assignment, Class test & Semester final | 5 | **2**&**3** |
| **5** | **Chemical Research:** Structure representation, SMILES; Chemical Databases, 2D and 3D structures, reaction databases and searching techniques. Chemo-informatics tools for drug discovery. | Lecture & Group discussion | Assignment, Class test & Semester final | 4 | **1**&**4** |
| **6** | **Drug Design:** Drug design and its history. Concepts of molecular modeling. Molecular structure and internal energy. Application of molecular graphics. | Lecture & Open discussion | Class test & Semester final | 4 | **2**&**4** |
| **7** | **Other Applications of Bioinformatics:**  Literature analysis. High-throughput image analysis. Biodiversity informatics. | Lecture & discussion | Assignment, & Semester final | 4 | **2**&**5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Harisha S. Fundamentals of Bioinformatics. I. K. International Pvt Ltd, 2010.
2. Ikoma H. Computational microscopy for sample analysis. PhD diss., MIT. 2014.
3. DeHaan, K, Yair R, Yichen W, Aydogan O. Deep-learning-based image reconstruction and enhancement in optical microscopy.Proceedings of the IEEE. 2019.
4. Madsen U, Krogsgaard-Larsen P, Liljefors T. Textbook of Drug Design and Discovery. Taylor & Francis. 2002.
5. Reynolds CH, Ringe D. Drug Design: Structure- and Ligand-Based Approaches. Cambridge Uni Press. 2010.
6. Fosgerau K, Hoffmann T. Peptide therapeutics: current status and future directions. Drug Discovery Today. 2015.

**Course Code: BMIC 707**

**Course Title: Microbiology Practical** VII

**Course Type: Core**

**Credits: 6**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 150**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Analyze the viruses detection, laboratory diagnosis, prevention and treatment of viral infection

**CLO2:** Apply the techniques of protein, brewing yeast, alcohol and cheese production.

**CLO3:** Evaluate of marine microbes identification, biofilm observation and microalgae identification.

**CLO4:** Analyze antigen and antibody detection, SDS-PAGE and immunoblotting of bacterial protein.

**CLO5:** Evaluate the bacterial transformation, DNA digestion and restriction mapping.

**CLO6:** Acquire knowledge on research planning, data collection, data analysis, and scientific article writing.

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| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Medical Microbiology):**  DNA analysis by using HLA typing.  Isolation and characteristics of different stem cells  Isolation and inoculation of bacterial and fungal strains.  Study of common fungal diseases of plant and human | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Microbial Metabolism):**  Hydrolysis of biopolymers- starch, lipid, casein and gelatine  Carbohydrate fermentation  MIU, KIA and IMViC tests  Nitrate reduction, oxidise, catalase and litmus milk reaction tests  Antimicrobial sensitivity test (qualitative)  Demonstration of anaerobic culture techniques | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **2** |
| **3** | **Unit C (Food and Beverage Quality Control):**  Preparation of fermented food  Extraction of enzymes from food materials  Determination of essential components of food materials  Microbes in food materials and their load  Preservation technology for food and food products  Biosafety regulations of modern foods | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **3** |
| **4** | **Unit D** (**Environmental Pollution and Bioremediation):**  Isolation of biodegradative microbes from environment.  Non-culturable state of microorganisms.  Detection of indicators and pathogenic microorganisms in potable water.  Water purification (flocculation, chlorination, ozonization).  Determination of heavy metals in industrially-released water. | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **4** |
| **5** | **Unit E** (**Enzymology):**  Isolation of isozymes from different explants  Isolation technique of bacterial crude enzymes  Observation of enzyme activity  Calculation of IC50, Kcat, KmandVmax  Studying enzymatic activity in presence of inhibitor | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **5** |
| **6** | **Unit F (Bioinformatics):**  Internet using  Basic M.S. Word, M.S. Excel, Power point, Photoshop.  Maintenance of computer and statistical software  Retrieving sequence from Gene bank BLASTN, BLASTX, BLASTP  Multiple sequence alignment  Molecular modeling of protein development | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **6** |

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**Course Code: BMIC 708**

**Course Title: Field report/ Excursion VII**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 709**

**Course Title: Viva voce VII**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 7th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 701 to BMIC 706

**Course Code: BMIC 801**

**Course Title: Diagnostic Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Diagnostic microbiology takes most of its fundamentals from cutting edge concepts and techniques relevant to the modern medical sector. These approaches will lead to new breakthroughs in science and technology, create new markets, and generate substantial wealth and research in health sector. The course also reveals the potential benefits and impacts of the medical and pharmaceutical microbiology fields.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Know the approaches of clinical sample collection, handling, and safely maintenance

**CLO2:** Analyze the microbe’s infected diseases using different diagnosis methods.

**CLO3:** Learn the detection process and microbial identification using molecular and pathological approaches.

**CLO4:** Evaluate the strategies for antimicrobial susceptibility and antibiotic sensitivity tests.

**CLO5:** Design immunization techniques and vaccines against common viral diseases.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Sample Collection and Handling:** Approaches to clinical sample collection, maintenance and laboratory management. | Lecture, Open discussion & Assignment | Tutorial, Presentation & Semester final | 3 | **1** |
| **2** | **Infectious Diseases Diagnosis:** Bacterial, fungal, rikettsial, parasites, spirochetal, viral and mycoplasmal diseases. | Lecture & Assignment | Class test & Semester final | 3 | **2** |
| **3** | **Methods of Diagnosis:** Collection of serum, antibody titre, agglutination, diffusion, and immunofluorescence. Complement fixation and florescent antibody test. Radioimmuno and enzyme immunosorbant assay. | Lecture & Open discussion | Tutorial, Semester final | 5 | **1**&2 |
| **4** | **Accessory Detection System:** Biotin-avidin, amplified detection, chemiluminescence and immune-blotting. | Lecture & Assignment | Tutorial & Semester final | 3 | **2**&**3** |
| **5** | **Microbial Identification:** Nucleic acid probes for isolation and identification of infectious agents. PCR detection of genes for toxins and virulence. | Lecture, Quiz & Tutorials | Tutorial & Semester final | 4 | **1**&**3** |
| **6** | **Antimicrobial and Antibiotic Activity:** Mechanisms of antimicrobial and antibiotic sensitivity test. | Lecture &  Assignments | Tutorial & Semester final | 4 | **2**&**4** |
| **7** | **Vaccine Approach and Immunization:** Common viral diseases and antigens important in cellular and humoral immunity. Immunization and vaccination against common viral diseases. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **1,3**&5 |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. David H  
P, Thomas FS, Fred CT, ThomasJW.Diagnostic Molecular Microbiology: Principles and Applications. Amer Society for Microbiology. 1993.

2. Mathews R. Handbook of Serodiagnosis in Infectious Diseases.Butterworth-Heinemann. 1991.

3. Frances F, Marshall BD. A Manual of Laboratory and Diagnostic Tests.8th Edition. Lippincott Williams & Wilkins. 2008.

5. Betty A F, Daniel F S and Alice S W. Diagnostic Microbiology. 12th Edition. Mosby Publication. 2007.

6. Patric RM, Ellen JB, Michael AP, Fred CT, Robert HY. Manual of Clinical Microbiology.7thEdition.American Society for Microbiology. 1999.

7. Brown TA. Gene Cloning and DNA Analysis: An Introduction. 4th Edition. Blackwell Pub. 2010.

**Course Code: BMIC 802**

**Course Title: Analytical Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Analytical microbiology is the diversity of modern analytical experimental techniques used in the study of microbial systems at the cellular and molecular level. It explores structure and function of biological systems, light microscopy, image processing, biosensors and protein structure determination, electrophysiology, capacitance measurements as well as various chromatography technique and purification techniques of biomolecules from microbes.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:**  Analyze the spectroscopic techniques and centrifugations methodology in a microbiology laboratory.

**CLO2:** Learn the application of chromatography, flow-cytrometry and electrophoresis for research.

**CLO3:** Detection, measurement and applications of radioisotopes with safety diagnosis methods.

**CLO4:** Describe the instruments for monitoring and controlling biosensor.

**CLO5:** Ensure the management and quality assurance in the microbiology laboratory.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Spectroscopic Techniques:** Visible and ultraviolet light; fluorescence; atomic spectroscopy; spectrofluorimetry, lumiometry, infrared spectroscopy. Nuclear magnetic resonance. Mass spectrometry. | Lecture & Assignment | Class test & Semester final | 3 | **1** |
| **2** | **Centrifugations:** Principle of sedimentation. Types of centrifuges and their use. Rotortypes; preparative and analytical centrifuges. | Lecture & Open discussion | Tutorial & Semester final | 3 | **1** |
| **3** | **Chromatographic Techniques:** Principle of chromatography. Adsorption; high performance and ultra-performance liquid chromatography. Flow-cytrometry. | Lecture, Quiz & Assignment | Assignment, Tutorial & Semester final | 4 | **2** |
| **4** | **Electrophoresis:** Principles and factors of electrophoresis. Media for gel electrophoresis of proteins. Detection, estimation and recovery of proteins from gel. Electrophoresis of nucleic acids and pulse field gel electrophoresis. | Lecture, Quiz &  Tutorials | Tutorial & Semester final |  | **1,** & **2** |
| **5** | **Radioisotope Techniques:** Nature, detection, measurement and applications of radioisotopes. Safety aspects of radioisotopes and autoradiography. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **2**&**3** |
| **6** | **Biosensor:** Application of enzyme, cell and organelle-based biosensors. Affinity binding assay, biological reactant pairs, application of immunosensor and receptor-based biosensor. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **2,3**&4 |
| **7** | **Laboratory Quality Control:** Microbiological specification and regulations. Local and international approaches to obtaining safe food. Management and quality assurance in the microbiology laboratory. | Lecture, Quiz &  Assignments | Tutorial & Semester final | 4 | **2**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

* 1. Frederick K. Analytical Microbiology. Elsevier, 2014.
  2. Fox A, Larsson L, Morgan SL, Odham G. Analytical Microbiology Methods: Chromatography and Mass Spectrometry. Springer US, 2013.
  3. Wilson K, Walker J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge Uni Press. 2010.
  4. Dart RK. Microbiology for the Analytical Chemist. Royal Society of Chemistry, 2023.

**Course Code: BMIC 803**

**Course Title: Pharmaceutical Microbiology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

The course intends to get the basic knowledge of microbiological practice, sterilizations, absorptions, distribution and adaptation of drugs ensuring biological safety in laboratory and pharmaceutical industries.**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:**  Know the scope and applications of pharmaceutical microbiology.

**CLO2:**  Evaluate the microbial spoilage and sterilization of pharmaceutical products.

**CLO3:** Analyze the microbiol assays of antibiotics, vitamins and amino acids to assurance the products quality.

**CLO4:** Apply the knowledge of drugs metabolism, absorptions and distribution in local and global market.

**CLO5:** Understand the results for assurance of pharmaceuticals products quality in the pharmaceutical industry.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Definition, principles, objectives and scope of pharmaceutical microbiology. Atmosphere, water, raw materials, personal hygiene, environment control and sanitation of pharmaceutical microbiology. | Lecture & Open discussion | Assignments, Tutorial & Semester final | 4 | **1** |
| **2** | **Microbial Spoilage:** Preservation of pharmaceutical products. Microbial spoilage of pharmaceutical products. | Lecture & Assignment | Class test & Semester final | 3 | **1**&2 |
| **3** | **Sterilizations:** Principles and different methods of sterilization of pharmaceutical products. Advantages and disadvantages of sterilization. Sterilization control and sterility testing. | Lecture & Open discussion | Tutorial & Semester final | 4 | **1**&2 |
| **4** | **Microbiological Assays of Antibiotics, Vitamins and Amino Acids:** Introduction, importance and usefulness. Principle, methodologies and present status of microbial assays. Agar plate diffusion assays. LAL test. Turbidimetric assay. | Lecture & Open discussion | Tutorial & Semester final | 3 | **2**&**3** |
| **5** | **Metabolism of Drugs:** Drug discovery from microbes. General pathways of drug metabolism. Factors affecting drug metabolism. | Lecture, Quiz & Assignment | Class test, Tutorial & Semester final | 4 | **1, 2**&**4** |
| **6** | **Absorptions and Distribution of Drugs:** Mechanism of absorption, effect of factors on gastro-intestinal absorption of drugs. Significance of drug concentration in blood, bioavailability and biological half-life. | Lecture Quiz &  Tutorials | Tutorial & Semester final | 4 | **2**&**4** |
| **7** | **Quality Test of Pharmaceuticals Products:**  Microbial limit test. US pharmacopoeia (USP) examination of non-sterile products. Antimicrobial effectiveness test (AET). | Lecture & Open discussion | Tutorial & Semester final | 4 | **2**&**5** |

NB.: SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Richard AH, Pamela CC. Lippincott’s Illustrated Review: Pharmacology.4th Edi. 2008.

2. Bertram GK, Anthony J.T. Examinations and Board Review: Pharmacology. 12th Edi. 2019.

3. Goodman G. The Pharmacological Basis of Therapeutics.13th Edi. 2018.

4. Wilson,Gisvolds. Textbook of organic, Medicinal and Pharmaceutical Chemistry.12th Edi. 2011.

5. Saghee M, Sandle T, Tidswell E. Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices. Business Horizons. 2011.

6. Sandle T. The CDC Handbook: A Guide to Cleaning and Disinfecting Cleanrooms. Grosvenor H. Pub. 2012.

7. SandleT, Saghee MR. Cleanroom Management in Pharmaceuticals and Healthcare. Passfield, UK. 2013.

**Course Code: BMIC 804**

**Course Title: Nanobiotechnology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Nanobiotechnology is the study of materials which are in nanoscale range. Conversion of any material in nanoscale results in alteration of its physicochemical, biological, mechanical, optical, electronic, etc. properties. These newly acquired properties of the materials due to conversion into a nanoscale can be utilized for different useful activities. It is relevant for diverse sectors, such as chemicals, health, energy, industries and the environment. The use of this technology is increasing exponentially in the microbiological sector.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:**  Acquire knowledge on nanobiotechnology, nanomaterials and nanoparticles synthesis.

**CLO2:** Evaluate the microbial applications in nanotechnology.

**CLO3:** Gather knowledge uses of Quantum dots and BioMEMS**.**

**CLO4:** Apply several nanotechnologies as biosensors, drug delivery and diagnostics in medical sciences.

**CLO5:** Understand the values of nano products in local and global market.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Introduction:** Definition,history and applications of nanobiotechnology. Interdisciplinary relationship of nanobiotechnology. Green nanobioteechnology. | Lecture & Open discussion | Assignment, Class test & Semester final | 3 | **1** |
| **2** | **Nanomaterial and Nanoparticles:** Modern biomaterials. Nanocapsules, fullerenes nanotube sand gold nanoparticles. Synthesis of oxide and silver nanoparticles. | Lecture & Open discussion | Assignment, Tutorial & Semester final | 4 | **1** |
| **3** | **Microbes in Nanobiotechnology:** Microbial cells factories. Microbes in food nanobiotechnology and microbial food safety. | Lecture & Group discussion | Class test & Semester final | 3 | **1 &2** |
| **4** | **Quantum Dots and BioMEMS:** Concept of Quantum dots and BioMEMS**.** Quantum dots and cellular imagine. Recent developments in BioMEMS. | Lecture & Open discussion | Assignment & Semester final | 4 | **1**&**3** |
| **5** | **Biosensoring:** Definition and different types of biosensors. Techniques and functions of different biosensors. Uses of biosensors with reference to monitor blood glucose. | Lecture & Open discussion | Class test, Tutorial & Semester final | 4 | **1, 2**&**4** |
| **6** | **Nanomedical Engineering and Drug Delivery:** Manufacturing of nanomedicine. Nano drugs design and delivery techniques. Lyposomes as nanocarriers. | Lecture & Open discussion | Assignment, Tutorial & Semester final | 4 | **2**& **4** |
| **7** | **Future Prospects:** Future prospects of nanobiotechnology. Challenges for nanobiotechnology. Potential hazards of nanoparticles. Nanobiotechnoligical products and global market. | Lecture & Open discussion | Class test, Tutorial & Semester final | 4 | **1,3**&**5** |

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**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Boisseau P, HoudyP,LahmaniM. Nanoscience:Nanobiotechnology and Nanobiology, Springer, 2009.
2. Gazit E, Mitraki A. Plenty of Room for Biology at the Bottom. 2nd Edition. 2013.
3. Krishna VS. Comprehensive Nanobiotechnology. New Age Int.Pvt Ltd Publishers, 2011.
4. Niemeyer M, HYPERLINK "http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Chad+A.+Mirkin"MirkinCA. Nanobiotechnology: Concepts, Applications and Perspectives.HYPERLINK http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Christof+M.+NiemeyerWiley-VCH, 2004.
5. Poinern GEJ. A Laboratory Course in Nanoscience and Nanotechnology. CRC Press. 2014.
6. Rathi R. Nanotechnology. S. Chand Publishing, 1st Edition, 2009.
7. Zuccheri G. DNA Nanotechnology: Methods and Protocols. Humana, 2nd Edition. 2018.

**Course Code: BMIC 805**

**Course Title: Genomics and Proteomics**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Two Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Full Marks: 50** (Class attendance 5+Class assessment 10+Theory 35)

**Rational of the Course:**

Genomics and proteomics deals with a rapidly evolving scientific area of genomes, proteomes and databases that store various data about genes, proteins, genomes and proteomes. This course provides a broad overview of the historical development, methods, and applications of genomics and proteomics in the life science. The course also explores the molecular structure of protein, protein engineering techniques and application of quantitative proteomics, human genomics and functional genomics biology.

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Describe the basic concept, principles and structure with emphasis on genomics organization.

**CLO2:** Analyzethecomparative study ofgenomics in prokaryotes, eukaryotes-viruses, and organelle.

**CLO3:** Gain knowledge in proteomics, proteome analysis, molecular proteomics and modified genes**.**

**CLO4:** Apply protein engineering techniques, proteins analyzing and sequencing.

**CLO5:** Gain skills in applications of quantitative proteomics and human genomics for diseases identification.

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| **SI No.** | **Course content** | **TLS** | **AS** | **Lec.**  **No.** | **CLOs** |
| **1** | **Genomics Concept:** Definition and development of genomics. Physical mapping of genomes, whole genome sequencing project. Applications of genome sequencing. | Lecture & Group discussion | Assignment, Tutorial & Semester final | 3 | **1** |
| **2** | **Organization and Structure:** Structure of viruses, prokaryotes, organelle and eukaryotic genome. Chromatin structure to chromosome organization. | Lecture discussion & Assignment | Assignment, Class test & Semester final | 4 | **1** |
| **3** | **Comparative Genomics:** Orthologoues, paralogoues and gene displacement. Comparative genomic in prokaryotes, eukaryotes-viruses, and comparative organelle genomics. Bacterial genome assembly, annotation, genome submission to repository and MLSTs. Virulence, integron, bacteriophage and metal resistance genes. | Lecture, Group discussion & Assignment | Assignment, Class test & Semester final | 4 | **1& 2** |
| **4** | **Proteomics:** Concept, function and structure of commonly used peptide. Protein structures, identification and proteome analysis. Peptide mass fingerprinting. | Lecture, Open discussion & Assignment | Assignment, Tutorial & Semester final | 4 | **1&3** |
| **5** | **Molecular Proteomics:** Factors for protein folding. Constructing bacterial expression plasmids for natural and modified genes. Designing modifications to change the protein’s properties. | Lecture & Open discussion | Class test, Tutorial & Semester final | 4 | **1, 2 &3** |
| **6** | **Protein Engineering:** Protein engineering and construction. Proteins analyzing and comparing protein sequence data. Functions of individual amino acids. Protein sorting in *P. falciparum*. | Lecture, Assignment & Open discussion | Assignment, Tutorial & Semester final | 4 | **1&4** |
| **7** | **Quantitative Proteomics Applications:** Protein interactions and linkage maps. Quantitative proteomics applied to biomarker detection. Validation and human disease studies. | Lecture & Open discussion | Assignment, Class test & Semester final | 3 | **2&5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, TLS= Teaching Learning Strategy, AS= Assessment Strategy

**Learning Resources (Text Books, Reference Book, Online Resources and Other):**

1. Pevsner J. Bioinformatics and Functional Genomics. Wiley-Blackwell, 2009.
2. Twyman RM. Principles of Proteomics. Garland Science, 2014.
3. Hubert R. Protein Biochemistry and Proteomics. Academic Press, USA, 2006.
4. ArndtKM,Müller KM. Protein Engineering Protocols. Humana Press, 2010.
5. Veenstra TD, Yates JR. Proteomics for Biological Discovery Wiley-Liss, 2006.
6. Primrose SB, Twyman RM. Principles of Gene Manipulation and Genomics. 7th Edition. Blackwell Publishing. 2006.

**Course Code: BMIC 806**

**Course Title: Microbiology Practical** **VIII**

**Course Type: Core**

**Credits: 6**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Academic Committee

**Pre-requisite: No**

**Contract Hours: Minimum 26**

**Total Marks: 150**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Apply the molecular diagnosis techniques of microbial diseases

**CLO2:** Understand the uses of analytical equipment in microbiological experiments and research

**CLO3:** Analyze the drug design, drugs test and clinical trials pharmaceutical products

**CLO4:** Gain the knowledge of nanobiotechnology applications in agriculture, medicine and industries.

**CLO5:** Analyze the computational prediction on miRNA genes, microarray platforms and genomic data analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SI No.** | **Course Content** | **AS** | **Lec. No.** | **CLOs** |
| **1** | **Unit A (Diagnostic Microbiology):**  Molecular diagnosis of microbial diseases  β-thalassemia mutation using ARMS-PCR.  Specimen collection and management methods.  Techniques of drugs quality control. | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **1** |
| **2** | **Unit B (Analytical Microbiology):**  Familiarization of instruments used for biophysical methods.  TLC, silica gel preparation  Preparation of column for size exclusion chromatography  Size exclusion chromatography technique  Preparation of SDS page gel to run chromatographic factor | Continuous internal evaluation, viva voce & Semester final examination. | 3 | **2** |
| **3** | **Unit C (Pharmaceuticals Microbiology):**  Application of recombinant DNA technology in drug design  Drugs test  Clinical trials of selected drugs  Visits of clinics, pharmacies and drug industry | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **3** |
| **4** | **Unit D (Nanobiotechnology):**  Introduce in nano-substrate and tools  Measurement of blood glucose using biosensor  Different nanotools, synthesis and characterizations.  Study of top-up, bottom-up and multi-scale simulation.  Study of agricultural and industrial applications | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **4** |
| **5** | **Unit E (Genomics and Proteomics):**  Genomic browsers and databases  Search for transcription factor binding sites  Computational prediction of miRNA target genes  Microarray platforms and data analysis  Identification of protein structural and functional domains | Continuous internal evaluation, viva voce & Semester final examination. | 4 | **5** |

**NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hours, AS= Assessment Strategy

**Course Code: BMIC 807**

**Course Title: Field report/ Excursion VIII**

**Course Type: Core**

**Credits: 1**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** Teachers Assigned by the Examination Committee

**Pre-requisite: No**

**Full Marks: 25**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Perform teamwork**.**

**CLO2:** Correlate practical knowledge with theoretical knowledge

**CLO3:** Carry out research work and report preparation

**Course Content:** Different aspects of applied microbiology/ microbiology related industry/ institute/ farm visit.

**Course Code: BMIC 808**

**Course Title: Project/+ Internship**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Academic Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Learning Outcomes (CLOs):**

**A**t the end of the Course, the Student will be able to-

**CLO1:** Conduct initial self-dependent research

**CLO2:** Implement existing theoretical knowledge to prepare appropriate methodology and manuscripts

**CLO3:** Learn how to communicate with other disciplines and work in a team.

**Course Contents:** Research projects planned by researcher and supervised by the assigned supervisor/s or the following tropics-

1. Food microbiology

2. Microbial biotechnology

3. Industrial microbiology

4. Fermentation technology

5. Molecular biology and genetics

6. Environmental microbiology

7. Clinical microbiology

8. Immunology

9. Virology, bacteriology, phycology and mycology

10. Plant and animal pathology

11. Pharmaceutical microbiology

12. Bioinformatics and drug designing

13. Antimicrobials and antibiotics screening

14. Microbial antagonisms

15. Others related to microbiology

**Course Code: BMIC 809**

**Course Title: Viva voce VIII**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 4th Year 8th Semester**

**Academic Session: 2021-2022**

**Course Teacher:** All the member of Examination Committee

**Pre-requisite: No**

**Full Marks: 50**

**Course Content:** Theoretical courses from BMIC 801 to BMIC 805

**PART D**

**31. Grading/Evaluation Systems:**

The weighted average of the GPAs of a student in all 8 semesters (four years) shall be calculated as per the ordinance of the Rajshahi University.

**32. Award of Degree, Promotions and Improvement of Results:**

According to the ordinances of the University and faculty.