**UNIVERSITY OF RAJSHAHI**

**RAJSHAHI 6205, BANGLADESH**

**Outcome-based Curriculum for undergraduate program**

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

**Session: 2023-2024**

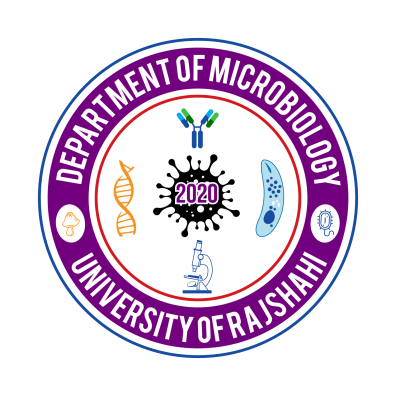
**Examination Schedule**

B. Sc. (Honours) 1st Year 1st and 2nd Semester 2024

B. Sc. (Honours) 2nd Year 1st and 2nd Semester 2025

B. Sc. (Honours) 3rd Year 1st and 2nd Semester 2026

B. Sc. (Honours) 4th Year 1st and 2nd Semester 2027



**DEPARTMENT OF MICROBIOLOGY**

**FACULTY OF BIOLOGICAL SCIENCES**

**EDITORIAL BOARD FOR THE CURRICULUM**

|  |
| --- |
| **PROFESSOR DR. IMTIAJ HASAN**  Chairman, Department of Microbiology, University of Rajshahi |
| **AMIT KUMAR DUTTA**  Associate Professor, Department of Microbiology, University of Rajshahi |
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| **PROFESSOR DR. MD. ZAKARIA MIA**  Department of Microbiology, Jagannath University, Dhaka |
| **PROFESSOR DR. SHUVRA KANTI DEY**  Department of Microbiology, Jahangirnagar University, Savar, Dhaka |
| **DR. NAZNIN SULTANA**  Chief Scientific Officer, Globe Biotech Limited, Dhaka, Bangladesh |

**Total Credits Hours**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **First Year** | | | **Second Year** | | | **Third Year** | | | **Fourth Year** | | | **Total** |
| **Semester** | 1st | 2nd | Total | 1st | 2nd | Total | 1st | 2nd | Total | 1st | 2nd | Total | **160** |
| **Credits** | 18 | 21 | **39** | 18 | 21 | **39** | 19 | 21 | **40** | 20 | 22 | **42** |

**OUTCOME-BASED CURRICULUM**

**Department of Microbiology**

**PART A: Introduction**

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

Bachelor of Science (Honours) in Microbiology

**Name of the Faculty:** Biological Sciences

1. **Name of the University:**

University of Rajshahi

**Location:** Rajshahi 6205, Bangladesh

**Mode of Study:** Full Time

**Language of Study:** English

**Applicable Session:** 2023–2024 and onwards

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 an excellent 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. |

**M= Mission of the University**

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

Department of Microbiology

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 (POE):**

|  |  |
| --- | --- |
| **M1** | Providing high quality microbiology education to students who enroll for a Bachelor (Honours) degree offered by the entity |
| **M2** | Creating research facilities that enables the students grasp the standard practices of formulation, manufacturing, and quality assurance of microbial processes, new pathogens discovery, characterization, control and regulatory affairs. |
| **M3** | Enabling the students to assist the health sector by applying their knowledge of industrial microbiology and create an eco-friendly environment for human welfare |
| **M4** | Offering various co-curricular activities and environment that help to develop potential leaders ready to undertake the challenge of building the society |
| **M5** | Fostering opportunities for the students to establish a close connection with alumni, international academics and employers to collaborate, address current need, and maintain an interactive relation with the professionals |
| **M6** | Producing graduates who can serve the community with their leadership for sustainable growth to meet the needs of the twenty-first century challenges. |

**M= Mission of the Department**

1. **Objectives of the Program Offering Entity (POE):**

|  |  |
| --- | --- |
| **O1** | To be recognized as a national and international leader in the progression of microbiology education and research. |
| **O2** | To assist in establishing improve crops and agriculture using biotechnology and genetic engineering technologies to achieve better food security. |
| **O3** | To improve microbial practice for providing eco-friendly environment for plant, animal as well as human welfare. |
| **O4** | To contribute the controlling pathogens and drugs development to meet the needs of the upcoming challenges in the field of medical sciences. |

**O= Objectives of the Department**

1. **Name of the Degree:**

B.Sc. (Hons.) in Microbiology

1. **Description of the Program:**

The Bachelor of Science (Honours) in Microbiology program offered by the Department ofMicrobiology, Faculty of Biological Sciences at the University of Rajshahi is leading and prestigious B. Sc. Degree in Bangladesh. As a developing country, Bangladesh needs to maintain its progress in the public health, eco-friendly agriculture, and sustainable environment, industrial, socio-economic 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 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. 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 as well as 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 information communication technology (ICT), computational applications for bioinformatics, diseases diagnostic, drug discovery, biosafety, and biosecurity and bioethics practice in laboratory in research. Moreover, the program will teach the graduates to interact with socio-economics, leaderships for development of eco-friendly environment as well as forecasting epidemic, pandemic and their controlling to save human, plants and animals. Upon completion of this program, the students will gain advanced knowledge of microbial, biotechnological, pharmaceutical, medical, industrial and molecular techniques to apply in home and abroad. Over all, the program is design for gathering knowledge and applications on better public health, modern agriculture and farming, establish eco-friendly environment, industrial microbiology production, and socio-economic development for play important role in GDPs, leading home and abroad.

1. **Graduate Attributes:**

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| --- | --- | --- |
| **GAs** | **Description** | **Domain** |
| **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. | **Fundamental** |
| **GA2** | Ability to learn modern microbiology-general information and technology through lifelong learning to improve professional skills. | **Thinking** |
| **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. | **Thinking** |
| **GA4** | Capability to analyse data, interpret scientific reports and perform research independently in the area of microbiology. | **Thinking** |
| **GA5** | Ethical behavior, including- honesty, sincerity, and integrity to serve as a professional microbiologist. | **Personal** |
| **GA6** | Leadership skills to apply positive impact and achieve effectively while working in a team of home and abroad. | **Personal** |
| **GA7** | Adaptability to work with people from different social and cultural background to support diversity and rule out systematic racism. | **Social** |

**GA= Graduate Attribute (s)**

1. **Mission of the Program Offering Entity (POEs):**

|  |  |
| --- | --- |
| **M1** | To prepare students with cutting-edge knowledge in the advance fields of microbiology in order to fulfill the requirements of 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. **Program Educational Objectives (PEOs):**

The PEOs of the Department are set as follows:

|  |  |  |
| --- | --- | --- |
| **PEOs** | **Description** | **Domain** |
| **PEO1** | The graduates will have successful professional careers as innovative microbiologists in government, academia, and institutions, eager to serve society locally and globally. | **Fundamental** |
| **PEO2** | Graduates will continue to study and enhance their professions by participating in professional organizations, obtaining professional certification, and pursuing higher education. | **Fundamental** |
| **PEO3** | Microbiology graduates will be versatile and adaptive in the industry, with the ability to accept new chances in developing technologies, as well as opportunities for leadership and teamwork, all of which will lead to long-term research jobs. | **Thinking** |
| **PEO4** | Our graduates will be able to act with the ethical, sociological and ecological awareness that practical microbiological experts are expected to have in home and abroad. | **Personal** |
| **PEO5** | Instilling a sense of bioethical and socio-economical commitment in the personal and professional lives of management graduates to contribute to society and country. | **Social** |

**PEO = Program Educational Objective (s)**

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Missions** | **M1** | **M2** | **M3** |
| **PEOs** |  |
| **PEO1** | | **3** | **3** | **1** |
| **PEO2** | | **3** | **2** | **2** |
| **PEO3** | | **3** | **3** | **3** |
| **PEO4** | | **3** | **2** | **1** |
| **PEO5** | | **3** | **2** | **3** |

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

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

The graduates are expected to develop the following PLOs.

|  |  |  |
| --- | --- | --- |
| **PLOs** | **Description** | **Domain** |
| **PLO1** | Understand and grasp microbial knowledge and effectively with the basic and advanced techniques of microbiology and communication networks. | **Fundamental** |
| **PLO2** | Demonstrate understanding of the methodology and address ethical, professional, global and social impact and humanistic problems in microbial terms. | **Fundamental** |
| **PLO3** | Develop the ability/skill to investigate microbial information databases thoroughly and uncover new knowledge using rigorous scientific reasoning. | **Fundamental** |
| **PLO4** | Acquire laboratory proficiency by honing and improving technical and analytical abilities. | **Thinking** |
| **PLO5** | Be able to examine a wide range of microbial work- general problems and difficulties, think critically, and conduct independent research studies. | **Thinking** |
| **PLO6** | Capable of presenting academic text, scientific data, demonstration, review and evaluation of scientific paper and public scientific reports, and oral presentations. | **Thinking** |
| **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 and intellectual property are required. | **Personal** |
| **PLO8** | Develop observational, analytical and critical thinking skills to solve real-world problems. | **Social** |

**PLO = Program Learning Outcome (s)**

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PLO** | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** | **PLO8** |
| **PEO** |
| **PEO1** | **3** | **1** | **3** | **3** | **3** | **2** | **2** | **1** |
| **PEO2** | **1** | **3** | **3** | **3** | **3** | **3** | **3** | **1** |
| **PEO3** | **1** | **3** | **2** | **2** | **3** | **3** | **3** | **3** |
| **PEO4** | **2** | **3** | **1** | **1** | **2** | **1** | **3** | **2** |
| **PEO5** | **3** | **1** | **2** | **1** | **1** | **2** | **1** | **3** |

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

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

**1st Year: 1st Semester**

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| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 1101 | Introductory Microbiology | **•** | **•** |  |  |  |  |  | **•** |
| BMIC 1102 | Basic Techniques in Microbiology | **•** | **•** |  |  |  |  | **•** |  |
| BMIC 1103 | Basic Genetics | **•** |  | **•** |  |  |  |  | **•** |
| BMIC 1104 | Introductory Microbiology Practical | **•** | **•** |  |  |  |  |  | **•** |
| BMIC 1105 | Basic Techniques in Microbiology Practical | **•** | **•** |  |  |  | **•** |  |  |
| MBIC 1106 | Basic Genetics Practical | **•** |  |  | **•** | **•** |  |  |  |
| BMIC 1107 | Basic Plant Sciences | **•** |  |  |  |  | **•** |  | **•** |
| BMIC 1108 | Basic Animal Sciences | **•** |  |  |  |  | **•** |  | **•** |
| BMIC 1109 | Biochemistry and Biomolecules | **•** |  | **•** | **•** |  |  | **•** |  |
| BMIC 1110 | Basic Plant and Animal Sciences Practical |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 1111 | Biochemistry and Biomolecules Practical |  |  | **•** |  | **•** |  |  | **•** |
| BMIC 1112 | Field Report/ Excursion/ Industrial Internship |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 1113 | Functional English |  |  | **•** |  |  |  |  | **•** |

**1st Year: 2nd Semester**

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| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 1201 | Basic Molecular Biology | **•** | **•** |  |  |  |  |  | **•** |
| BMIC 1202 | Microbial Ecology | **•** | **•** |  |  |  | **•** |  | **•** |
| BMIC 1203 | Basic Cell Biology | **•** |  |  |  | **•** |  |  |  |
| BMIC 1204 | Basic Molecular Biology Practical | **•** |  |  |  | **•** |  |  | **•** |
| BMIC 1205 | Microbial Ecology Practical |  |  | **•** |  |  |  | **•** | **•** |
| BMIC 1206 | Basic Cell Biology Practical | **•** |  |  |  |  | **•** |  |  |
| BMIC 1207 | Human Anatomy and Physiology |  |  |  | **•** |  |  | **•** | **•** |
| BMIC 1208 | ICT and Computer Applications |  |  |  | **•** |  |  |  | **•** |
| BMIC 1209 | Basic Chemistry |  |  |  |  | **•** |  |  | **•** |
| BMIC 1210 | Human Anatomy and Physiology Practical |  | **•** |  |  |  |  |  | **•** |
| BMIC 1211 | ICT and Computer Applications Practical | **•** | **•** |  |  |  |  |  | **•** |
| BMIC 1212 | Basic Chemistry Practical |  |  |  |  | **•** |  | **•** | **•** |
| BMIC 1213 | Field Report/ Excursion/ Industrial Internship |  |  |  |  |  |  | **•** | **•** |
| BMIC 1214 | Viva voce |  |  |  | **•** |  |  | **•** | **•** |

**2nd Year: 1st Semester**

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| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **LO**  **8** |
| BMIC 2101 | General Bacteriology | **•** | **•** |  |  |  | **•** |  | **•** |
| BMIC 2102 | Microbial Physiology |  | **•** |  |  | **•** | **•** |  | **•** |
| BMIC 2103 | Food Microbiology |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 2104 | Agricultural Microbiology |  |  |  |  |  | **•** |  |  |
| BMIC 2105 | General Bacteriology Practical | **•** |  |  |  |  | **•** |  |  |
| BMIC 2106 | Microbial Physiology Practical |  |  |  |  |  | **•** |  |  |
| BMIC 2107 | Food Microbiology Practical |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 2108 | Agricultural Microbiology Practical |  |  | **•** | **•** |  |  | **•** | **•** |
| BMIC 2109 | Biosafety and Biosecurity | **•** | **•** |  |  | **•** |  |  | **•** |
| BMIC 2110 | Bangladesh Studies |  |  |  | **•** |  | **•** |  | **•** |
| MBIC 2111 | Biosafety and Biosecurity Practical | **•** |  |  |  |  |  | **•** | **•** |
| BMIC 2112 | Field Report/ Excursion/ Industrial Internship |  |  |  |  | **•** |  |  | **•** |

**2nd Year: 2nd Semester**

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| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 2201 | General Mycology and Phycology |  | **•** |  |  |  | **•** |  | **•** |
| BMIC 2202 | Fermentation Technology |  | **•** |  |  |  | **•** |  | **•** |
| BMIC 2203 | Environmental Microbiology | **•** | **•** |  |  |  | **•** |  | **•** |
| BMIC 2204 | Microbial Genetics | **•** |  |  |  | **•** | **•** |  | **•** |
| BMIC 2205 | General Mycology and Phycology Practical |  |  |  |  | **•** | **•** |  | **•** |
| BMIC 2206 | Fermentation Technology Practical | **•** |  |  |  | **•** |  | **•** | **•** |
| BMIC 2207 | Environmental Microbiology Practical | **•** |  |  |  |  |  |  | **•** |
| BMIC 2208 | Microbial Genetics Practical | **•** |  |  |  |  |  |  | **•** |
| BMIC 2209 | Biostatistics |  | **•** |  |  |  |  |  | **•** |
| BMIC 2210 | Social Economics | **•** | **•** |  |  | **•** |  |  | **•** |
| BMIC 2211 | Biostatistics Practical | **•** |  | **•** |  |  | **•** |  | **•** |
| BMIC 2212 | Social Economics Practical | **•** |  |  | **•** |  |  | **•** |  |
| BMIC 2213 | Field Report/ Excursion/ Industrial Internship |  | **•** |  | **•** |  |  | **•** |  |
| BMIC 2214 | Viva voce |  |  |  |  | **•** |  |  | **•** |

**3rd Year: 1st Semester**

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| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 3101 | Introductory Virology | **•** | **•** | **•** |  |  |  |  |  |
| BMIC 3102 | Molecular Cell Biology |  |  |  |  | **•** | **•** |  | **•** |
| BMIC 3103 | Industrial Microbiology |  | **•** |  |  |  | **•** |  | **•** |
| BMIC 3104 | Fundamental Immunology |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 3105 | Introductory Virology Practical | **•** |  |  | **•** |  |  |  | **•** |
| BMIC 3106 | Molecular Cell Biology Practical |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 3107 | Industrial Microbiology Practical |  | **•** | **•** | **•** |  |  |  | **•** |
| BMIC 3108 | Fundamental Immunology Practical |  |  |  | **•** | **•** | **•** |  | **•** |
| BMIC 3109 | Cell and Tissue Engineering |  |  | **•** |  | **•** |  | **•** | **•** |
| BMIC 3110 | Metabolism and Bioenergetics | **•** |  |  | **•** |  |  | **•** | **•** |
| BMIC 3111 | Cell and Tissue Engineering Practical |  |  |  | **•** | **•** |  | **•** | **•** |
| BMIC 3112 | Metabolism and Bioenergetics Practical | **•** |  |  |  | **•** |  |  | **•** |
| BMIC 3113 | Field Report/ Excursion/ Industrial Internship |  |  |  | **•** |  |  |  | **•** |

**3rd Year: 2nd Semester**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 3201 | Advanced Virology |  | **•** |  |  | **•** |  |  | **•** |
| BMIC 3202 | Advanced Molecular Biology |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 3203 | Marine Microbiology | **•** |  |  | **•** |  | **•** |  | **•** |
| BMIC 3204 | Advanced Immunology |  |  | **•** |  | **•** |  |  | **•** |
| BMIC 3205 | Advanced Virology Practical |  |  |  |  | **•** |  |  | **•** |
| BMIC 3206 | Advanced Molecular Biology Practical |  |  | **•** |  |  |  | **•** |  |
| BMIC 3207 | Marine Microbiology Practical | **•** |  |  |  |  | **•** | **•** | **•** |
| BMIC 3208 | Advanced Immunology Practical |  | **•** |  |  |  |  |  | **•** |
| BMIC 3209 | Epidemiology and Public Health | **•** |  |  | **•** |  |  | **•** | **•** |
| BMIC 3210 | Research Methodology | **•** |  | **•** |  | **•** |  | **•** | **•** |
| BMIC 3211 | Epidemiology and Public Health Practical |  | **•** |  | **•** |  |  |  | **•** |
| BMIC 3212 | Research Methodology Practical |  | **•** |  | **•** | **•** | **•** |  | **•** |
| BMIC 3213 | Field Report/ Excursion/ Industrial Internship | **•** |  | **•** | **•** |  | **•** |  | **•** |
| BMIC 3214 | Viva voce | **•** |  | **•** |  | **•** |  | **•** | **•** |

**4th Year: 1st Semester**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 4101 | Medical Microbiology |  |  |  | **•** | **•** | **•** |  | **•** |
| BMIC 4102 | Microbial Biotechnology |  | **•** |  | **•** |  |  | **•** | **•** |
| BMIC 4103 | Food and Beverage Quality Control | **•** |  | **•** | **•** |  | **•** |  |  |
| BMIC 4104 | Antimicrobial Resistance | **•** |  | **•** | **•** |  | **•** |  | **•** |
| BMIC 4105 | Enzymology | **•** |  |  |  | **•** | **•** |  | **•** |
| BMIC 4106 | Bioinformatics |  |  | **•** |  |  |  | **•** | **•** |
| BMIC 4107 | Medical Microbiology Practical | **•** |  |  | **•** |  |  | **•** | **•** |
| BMIC 4108 | Microbial Biotechnology Practical | **•** |  | **•** |  |  |  | **•** | **•** |
| BMIC 4109 | Food and Beverage Quality Control Practical |  | **•** |  | **•** |  | **•** |  | **•** |
| BMIC 4110 | Antimicrobial Resistance Practical |  |  |  |  | **•** |  | **•** | **•** |
| BMIC 4111 | Enzymology Practical | **•** |  |  | **•** |  | **•** | **•** | **•** |
| BMIC 4112 | Bioinformatics Practical | **•** |  |  |  |  |  | **•** | **•** |
| BMIC 4113 | Research Orientation Practical | **•** |  |  | **•** |  | **•** | **•** |  |

**4th Year: 2nd Semester**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **P**  **L**  **O**  **1** | **P**  **L**  **O**  **2** | **P**  **L**  **O**  **3** | **P**  **L**  **O**  **4** | **P**  **L**  **O**  **5** | **P**  **L**  **O**  **6** | **P**  **L**  **O**  **7** | **P**  **L**  **O**  **8** |
| BMIC 4201 | Diagnostic Microbiology | **•** | **•** |  | **•** | **•** | **•** |  | **•** |
| BMIC 4202 | Analytical Microbiology |  |  |  |  | **•** |  | **•** |  |
| BMIC 4203 | Pharmaceutical Microbiology | **•** |  | **•** | **•** | **•** | **•** |  | **•** |
| BMIC 4204 | Nanobiotechnology |  |  |  | **•** | **•** | **•** |  | **•** |
| BMIC 4205 | Genomics and Proteomics |  |  |  | **•** | **•** | **•** | **•** | **•** |
| BMIC 4206 | Genetic Engineering | **•** | **•** |  |  |  |  |  | **•** |
| BMIC 4207 | Diagnostic Microbiology Practical | **•** |  |  | **•** |  |  |  | **•** |
| BMIC 4208 | Analytical Microbiology Practical | **•** |  | **•** |  |  |  |  | **•** |
| BMIC 4209 | Pharmaceutical Microbiology Practical | **•** |  |  |  | **•** |  |  | **•** |
| BMIC 4210 | Nanobiotechnology Practical |  | **•** |  |  |  |  | **•** | **•** |
| BMIC 4211 | Genomics and Proteomics Practical |  |  |  | **•** |  | **•** |  | **•** |
| BMIC 4212 | Genetic Engineering Practical | **•** |  |  |  | **•** |  | **•** | **•** |
| BMIC 4213 | Research Project/ Industrial Internship |  |  | **•** |  |  |  | **•** | **•** |
| BMIC 4214 | Viva voce |  |  |  |  |  | **•** |  | **•** |

**OUTCOME-BASED CURRICULUM**

**PART B: Structure**

1. **Structure of the Curriculum**

**Name of the program:** Undergraduate

1. **Number of academic years and semester:** 4 Years, 8 Semesters (2 semesters/ year)
2. **Academic Schedule:**

**20.1** 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. The schedule may be prepared according to the following guidelines:

|  |  |
| --- | --- |
| **Each Semester (24 weeks)** | **Number of weeks** |
| Teaching | 14 |
| Preparatory Leave | 2 |
| Examination Period | 2 - 4 |
| Result Publication | 2 - 4 |
| **Total** | **24** |

**20.2** Distribution of Marks, Units and Credits:The marks shall be distributed as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Semesters** | **Marks** | **Units** | **Credits** |
| First | First | **450** | **4.5** | **18** |
| Second | **525** | **5.25** | **21** |
| Second | First | **450** | **4.5** | **18** |
| Second | **525** | **5.25** | **21** |
| Third | First | **475** | **4.75** | **19** |
| Second | **525** | **5.25** | **21** |
| Fourth | First | **500** | **5.0** | **20** |
| Second | **550** | **5.5** | **22** |
|  | **Total** | **4000** | **40.0** | **160** |

**20.3** Marks: The program of study for the B.Sc. Honors degree shall carry a total of 4000 marks (40 units and 160 credits), 25% of which are for the General Education (GEd) courses, and 30-40% for the practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ research project/ Industrial internship etc. The GEd courses shall have to be completed within the Fourth Year: First Semester of the programme.

**20.4** Class hours (Theory and Practical/Sessional): Theory Class: 1 Credit = 1 class/week (1 hour), and so on. Practical/Sessional Class: 1 class/course/week (2-4 hours), and so on.

**20.5** Marks distribution: The Semester-wise distribution of marks among the theory, practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ industrial Internship/ research project, etc. shall be as follows:

**(i)** B.Sc. (Honors) 1st Year: 1st Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150 | 1.50 | 6 |
| Theory (GEd) | 150 | 1.50 | 6 |
| Practical (Major) | 75 | 0.75 | 3 |
| Practical (GEd) | 50 | 0.50 | 2 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| English (Non-credit) | 50 | - | - |
| Total (credit courses) | **450** | **4.50** | **18** |

**(ii)** B.Sc. (Honors) 1st Year: 2nd Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150 | 1.50 | 6 |
| Theory (GEd) | 150 | 1.50 | 6 |
| Practical (Major) | 75 | 0.75 | 3 |
| Practical (GEd) | 75 | 0.75 | 3 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| Viva-voce | 50 | 0.50 | 2 |
| Total (credit courses) | **525** | **5.25** | **21** |

**(iii)** B.Sc. (Honors) 2nd Year: 1st Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200 | 2.0 | 8 |
| Theory (GEd) | 100 | 1.0 | 4 |
| Practical (Major) | 100 | 1.0 | 4 |
| Practical (GEd) | 25 | 0.25 | 1 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **450** | **4.50** | **18** |

**(iv)** B.Sc. (Honors) 2nd Year: 2nd Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200 | 2.0 | 8 |
| Theory (GEd) | 100 | 1.0 | 4 |
| Practical (Major) | 100 | 1.0 | 4 |
| Practical (GEd) | 50 | 0.5 | 2 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| Viva-voce | 50 | 0.50 | 2 |
| Total (credit courses) | **525** | **5.25** | **21** |

**v)** B.Sc. (Honors) 3rd Year: 1st Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200 | 2.0 | 8 |
| Theory (GEd) | 100 | 1.0 | 4 |
| Practical (Major) | 100 | 1.0 | 4 |
| Practical (GEd) | 50 | 0.50 | 2 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **475** | **4.75** | **19** |

**(vi)** B.Sc. (Honors) 3rd Year: 2nd Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200 | 2.0 | 8 |
| Theory (GEd) | 100 | 1.0 | 4 |
| Practical (Major) | 100 | 1.0 | 4 |
| Practical (GEd) | 50 | 0.50 | 2 |
| Field work/Excursion/ Industrial internship, etc. | 25 | 0.25 | 1 |
| Viva-voce | 50 | 0.50 | 2 |
| Total (credit courses) | **525** | **5.25** | **21** |

**(vii)** B.Sc. (Honors) 4th Year: 1st Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 300 | 3.0 | 12 |
| Practical (Major) | 200 | 2.0 | 8 |
| **Total (credit courses)** | **500** | **5.0** | **20** |

**(viii)** B.Sc. (Honors) 4th Year: 2nd Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 300 | 3.0 | 12 |
| Practical (Major) | 150 | 1.50 | 6 |
| Research Project/Industrial internship | 50 | 0.50 | 2 |
| Viva-voce | 50 | 0.50 | 2 |
| **Total (credit courses)** | **550** | **5.50** | **22** |

**20.6** Marks on class attendance/participation: Marks on class attendance will be 10% of the total marks of theory and practical courses. The marks will be distributed as follows:

**Table for awarding marks for attendance**

|  |  |
| --- | --- |
| **Attendance** | **% of total marks** |
| 90% and above | 10 |
| 85% to below 90% | 9 |
| 80% to below 85% | 8 |
| 75% to below 80% | 7 |
| 70% to below 75% | 6 |
| 65% to below 70% | 5 |
| 60% to below 65% | 4 |
| Less than 60% | 0 |

1. **Credit point for each practical courses:** 1-2
2. **Marks distribution for each theoretical course:**
3. Class attendance/participation: 10%
4. Class test/assessment: 20%
5. Final examination: 70%
6. **Marks distribution for practical course:**
7. Class attendance/participation: 10%
8. Continuous assessment and or report: 30%
9. Practical examination: 60%
10. **Marks on class attendance/participation:** According to Faculty Ordinance (9.6)
11. **Eligibility for Examination:** According to Faculty Ordinance (12).
12. **Industrial training/ fieldwork/research project etc. courses:** Total 8 credits
13. **Non-credit course:** Non-Credit course ‘Functional English’ will be considered as Attended/ Not-Attended.
14. **Question setters and script examiners:** According to Faculty Ordinance (14)
15. **Practical examination:** Practical courses examiner will be internal with an external from outside the department or university.
16. **Viva-voce:**

At the end of second semester of each academic year, viva-voce examination will be conducted by Examination Committee in presence of the external member from outside of the Department/University. The viva-voce will be 1-2 credit(s) in each academic year.

1. **Grading systems:**

Out of 4 scale, the grading systemshall be awarded in accordance with provisions shown below:

|  |  |  |
| --- | --- | --- |
| **Marks obtained** | **Letter Grade (LG)** | **Grade Point (GP)** |
| 80% or its above | A+ (A plus) | 4.00 |
| 75% to less than 80% | A (A regular) | 3.75 |
| 70% to less than 75% | A-(A minus) | 3.50 |
| 65% to less than 70% | B+ (B plus) | 3.25 |
| 60% to less than 65% | B (B regular) | 3.00 |
| 55% to less than 60% | B- (B minus) | 2.75 |
| 50% to less than 55% | C+ (C plus) | 2.50 |
| 45% to less than 50% | C (C regular) | 2.25 |
| 40% to less than 45% | D (regular) | 2.00 |
| Less than 40% | F (fail) | 0.00 |

1. **Award of degree:** According to Faculty Ordinance (17)
2. **Annual/semester promotion:** According to Faculty Ordinance (18)
3. **Course improvement:** According to Faculty Ordinance (19)
4. **Final result (CGPA) improvements:**

A student obtaining Bachelor (Honors) Degree within 4 or 5 academic years will only be allowed to improve result in the immediate next regular examination after publication of result. A student will only be allowed to take part in result improvement examination for a maximum of two theoretical courses (maximum 6 credits) of the last semester (fourth year second semester). Result improvement in theoretical courses will only be allowed if the earned grade (CGPA) is less than letter grade B- (<2.75).

1. **Teaching feedback:** According to Faculty Ordinance (21)
2. **Class attendance record for students:** According to Faculty Ordinance (22)
3. **Examinations:**
4. The B.Sc. Honors examination shall be held semester-wise and shall consist of the First Year: First Semester to Fourth Year: Second Semester**.** A student, for obtaining the degree, shall have to pass all the examinations within 6 (six) academic years from the date of his/her first admission, and shall not be allowed to stay more than 2 (two) consecutive terms in the same semester/year. 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.
5. Class Test/ Class Assessment/Mid Term/Quiz: The individual course teacher will take 20% marks of each theory course as Class Test / Class Assessment /Mid Term/Quiz. The course teachers will evaluate it. Average of all class assessment of theory courses with scripts shall have to be submitted by the course teacher(s) concerned in sealed envelope to the Chairman of the relevant Examination Committee before the commencement of the final examination. A course teacher failing to submit the assessment marks before the commencement of the final examination, shall not be allowed to act as an examiner of the course examination. In such case the decision shall be taken by the relevant Examination Committee with the approval of the Departmental Academic Committee.
6. **Examination committee:** According to Faculty Ordinance (23)
7. **Category of Courses:**
8. Major
9. GEd

**41. Year/ Semester-wise Courses and Marks Distribution**

**1st Year: 1st Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Units** | **Credits** |
| **Theory (Major)** | BMIC 1101 | Introductory Microbiology | 50 | 0.5 | 2 |
| BMIC 1102 | Basic Techniques in Microbiology | 50 | 0.5 | 2 |
| BMIC 1103 | Basic Genetics | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 1104 | Introductory Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 1105 | Basic Techniques in Microbiology Practical | 25 | 0.25 | 1 |
| MBIC 1106 | Basic Genetics Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 1107 | Basic Plant Sciences | 50 | 0.5 | 2 |
| BMIC 1108 | Basic Animal Sciences | 50 | 0.5 | 2 |
| BMIC 1109 | Biochemistry and Biomolecules | 50 | 0.5 | 2 |
| **Practical (GEd)** | BMIC 1110 | Basic Plant and Animal Sciences Practical | 25 | 0.25 | 1 |
| BMIC 1111 | Biochemistry and Biomolecules Practical | 25 | 0.25 | 1 |
|  | BMIC 1112 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| **1Non-credit** | BMIC 1113 | Functional English | **50** | **-** | **-** |
| **Total** | | | **450** | **4.5** | **18** |

**1st Year: 2nd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Units** | **Credits** |
| **Theory (Major)** | BMIC 1201 | Basic Molecular Biology | 50 | 0.5 | 2 |
| BMIC 1202 | Microbial Ecology | 50 | 0.5 | 2 |
| BMIC 1203 | Basic Cell Biology | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 1204 | Basic Molecular Biology Practical | 25 | 0.25 | 1 |
| BMIC 1205 | Microbial Ecology Practical | 25 | 0.25 | 1 |
| BMIC 1206 | Basic Cell Biology Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 1207 | Human Anatomy and Physiology | 50 | 0.5 | 2 |
| BMIC 1208 | ICT and Computer Applications | 50 | 0.5 | 2 |
| BMIC 1209 | Basic Chemistry | 50 | 0.5 | 2 |
| **Practical (GEd)** | BMIC 1210 | Human Anatomy and Physiology Practical | 25 | 0.25 | 1 |
| BMIC 1211 | ICT and Computer Applications Practical | 25 | 0.25 | 1 |
| BMIC 1212 | Basic Chemistry Practical | 25 | 0.25 | 1 |
|  | BMIC 1213 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| BMIC 1214 | Viva voce | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**2nd Year: 1st Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Title** | **Marks** | **Units** | **Credits** |
| **Theory (Major)** | BMIC 2101 | General Bacteriology | 50 | 0.5 | 2 |
| BMIC 2102 | Microbial Physiology | 50 | 0.5 | 2 |
| BMIC 2103 | Food Microbiology | 50 | 0.5 | 2 |
| BMIC 2104 | Agricultural Microbiology | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 2105 | General Bacteriology Practical | 25 | 0.25 | 1 |
| BMIC 2106 | Microbial Physiology Practical | 25 | 0.25 | 1 |
| BMIC 2107 | Food Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 2108 | Agricultural Microbiology Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 2109 | Biosafety and Biosecurity | 50 | 0.5 | 2 |
| BMIC 2110 | Bangladesh Studies | 50 | 0.5 | 2 |
| **Practical (GEd)** | MBIC 2111 | Biosafety and Biosecurity Practical | 25 | 0.25 | 1 |
|  | BMIC 2112 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| **Total** | | | **450** | **4.5** | **18** |

**2nd Year: 2nd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Title** | **Marks** | **Units** | **Credits** |
| **Theory (Major)** | BMIC 2201 | General Mycology and Phycology | 50 | 0.5 | 2 |
| BMIC 2202 | Fermentation Technology | 50 | 0.5 | 2 |
| BMIC 2203 | Environmental Microbiology | 50 | 0.5 | 2 |
| BMIC 2204 | Microbial Genetics | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 2205 | General Mycology and Phycology Practical | 25 | 0.25 | 1 |
| BMIC 2206 | Fermentation Technology Practical | 25 | 0.25 | 1 |
| BMIC 2207 | Environmental Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 2208 | Microbial Genetics Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 2209 | Biostatistics | 50 | 0.5 | 2 |
| BMIC 2210 | Social Economics | 50 | 0.5 | 2 |
| **Practical (GEd)** | BMIC 2211 | Biostatistics Practical | 25 | 0.25 | 1 |
| BMIC 2212 | Social Economics Practical | 25 | 0.25 | 1 |
|  | BMIC 2213 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| BMIC 2214 | Viva voce | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**3rd Year: 1st Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Theory (Major)** | BMIC 3101 | Introductory Virology | 50 | 0.5 | 2 |
| BMIC 3102 | Molecular Cell Biology | 50 | 0.5 | 2 |
| BMIC 3103 | Industrial Microbiology | 50 | 0.5 | 2 |
| BMIC 3104 | Fundamental Immunology | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 3105 | Introductory Virology Practical | 25 | 0.25 | 1 |
| BMIC 3106 | Molecular Cell Biology Practical | 25 | 0.25 | 1 |
| BMIC 3107 | Industrial Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 3108 | Fundamental Immunology Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 3109 | Cell and Tissue Engineering | 50 | 0.5 | 2 |
| BMIC 3110 | Metabolism and Bioenergetics | 50 | 0.5 | 2 |
| **Practical (GEd)** | BMIC 3111 | Cell and Tissue Engineering Practical | 25 | 0.25 | 1 |
| BMIC 3112 | Metabolism and Bioenergetics Practical | 25 | 0.25 | 1 |
|  | BMIC 3113 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| **Total** | | | **475** | **4.75** | **19** |

**3rd Year: 2nd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credit** |
| **Theory (Major)** | BMIC 3201 | Advanced Virology | 50 | 0.5 | 2 |
| BMIC 3202 | Advanced Molecular Biology | 50 | 0.5 | 2 |
| BMIC 3203 | Marine Microbiology | 50 | 0.5 | 2 |
| BMIC 3204 | Advanced Immunology | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 3205 | Advanced Virology Practical | 25 | 0.25 | 1 |
| BMIC 3206 | Advanced Molecular Biology Practical | 25 | 0.25 | 1 |
| BMIC 3207 | Marine Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 3208 | Advanced Immunology Practical | 25 | 0.25 | 1 |
| **Theory (GEd)** | BMIC 3209 | Epidemiology and Public Health | 50 | 0.5 | 2 |
| BMIC 3210 | Research Methodology | 50 | 0.5 | 2 |
| **Practical (GEd)** | BMIC 3211 | Research Methodology Practical | 25 | 0.25 | 1 |
| BMIC 3212 | Epidemiology and Public Health Practical | 25 | 0.25 | 1 |
|  | BMIC 3213 | Field Report/ Excursion/ Industrial Internship | 25 | 0.25 | 1 |
| BMIC 3214 | Viva voce | 50 | 0.5 | 2 |
| **Total** | | | **525** | **5.25** | **21** |

**4th Year: 1st Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Theory (Major)** | BMIC 4101 | Medical Microbiology | 50 | 0.5 | 2 |
| BMIC 4102 | Microbial Biotechnology | 50 | 0.5 | 2 |
| BMIC 4103 | Food and Beverage Quality Control | 50 | 0.5 | 2 |
| BMIC 4104 | Antimicrobial Resistance | 50 | 0.5 | 2 |
| BMIC 4105 | Enzymology | 50 | 0.5 | 2 |
| BMIC 4106 | Bioinformatics | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 4107 | Medical Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 4108 | Microbial Biotechnology Practical | 25 | 0.25 | 1 |
| BMIC 4109 | Food and Beverage Quality Control Practical | 25 | 0.25 | 1 |
| BMIC 4110 | Antimicrobial Resistance Practical | 25 | 0.25 | 1 |
| BMIC 4111 | Enzymology Practical | 25 | 0.25 | 1 |
| BMIC 4112 | Bioinformatics Practical | 25 | 0.25 | 1 |
| BMIC 4113 | Research Orientation Practical | 50 | 0.5 | 2 |
| **Total** | | | **500** | **5.0** | **20** |

**4th Year: 2nd Semester**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Courses** | **Course Code** | **Course Title** | **Marks** | **Unit** | **Credits** |
| **Theory (Major)** | BMIC 4201 | Diagnostic Microbiology | 50 | 0.5 | 2 |
| BMIC 4202 | Analytical Microbiology | 50 | 0.5 | 2 |
| BMIC 4203 | Pharmaceutical Microbiology | 50 | 0.5 | 2 |
| BMIC 4204 | Nanobiotechnology | 50 | 0.5 | 2 |
| BMIC 4205 | Genomics and Proteomics | 50 | 0.5 | 2 |
| BMIC 4206 | Genetic Engineering | 50 | 0.5 | 2 |
| **Practical (Major)** | BMIC 4207 | Diagnostic Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 4208 | Analytical Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 4209 | Pharmaceutical Microbiology Practical | 25 | 0.25 | 1 |
| BMIC 4210 | Nanobiotechnology Practical | 25 | 0.25 | 1 |
| BMIC 4211 | Genomics and Proteomics Practical | 25 | 0.25 | 1 |
| BMIC 4212 | Genetic Engineering Practical | 25 | 0.25 | 1 |
|  | BMIC 4213 | Research Project/ Industrial Internship | 50 | 0.5 | 2 |
| BMIC 4214 | Viva voce | 50 | 0.5 | 2 |
| **Total** | | | **550** | **5.5** | **22** |

**OUTCOME-BASED CURRICULUM**

**PART C: Year/ Semester-wise Description of all Courses**

**Department of Microbiology**

**1st Year: 1st Semester**

**Course Code: BMIC 1101**

**Course Title: Introductory Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Gain basic knowledge on microbial concepts, scope, and importance.

**CLO2:** Evaluate organize the microbial classification and characterizations.

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

**CLO4:** Apply different types of physical factors for microbial growth and control.

**CLO5:** Achieve a clear concept regarding antagonisms in several purposes.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Microbiology and Microbes:** Definition, objectives, history, branches, scope and career in microbiology. Applications of microbes in human welfare. | 4 | CLO1 CLO2 |
| **2.** | **Classifications:** Classification of microorganisms. Binomial nomenclature. Whittaker’s five kingdom and Carl Woese’s classification systems and utility. | 4 | CLO2  CLO3 |
| **3.** | **General Characteristics:** Concept and characterictics of prokaryots and eukaryots. Microorganisms’ distribution in nature, occurrence, characteristics, replication and economic importance. | 3 | CLO1  CLO2 CLO3 |
| **4.** | **Microbial Groups:** Concept of microbes and microbial groups. Introduction of bacteria, fungi, viruses, archaea, protists, microscopic animals. | 4 | CLO1 CLO3 |
| **5.** | **Microbial Cells:** Concepts of microbial cells. Morphological characterization, ultra-structure and composition of cells. | 4 | CLO1  CLO4 |
| **6.** | **Microbial Growth and Control:** Microbial growth definition, mechanisms, growth phases, growth factors and nutrients. Principles of microbial control. The rate of microbial death. The action of microbial control agents. | 4 | CLO2 CLO4 |
| **7.** | **Antagonisms:** Definition and characteristic of an antagonist. Types, mechanisms and importance of antagonisms. | 3 | CLO1 CLO5 |

**2NB.:** SI No.= Serial number, CLO= Course Learning Outcome, Lec. No.= Lecture Numbers, 1 Lecture= 1 hour

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, Continuous Internal Evaluation (3CIE) and Semester End Examination (4SEE). |

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

* + 1. Chung K, Liu J. Pioneers in Microbiology: The Human Side of Science. W. Sci. Pub. 2017.
    2. Madigan MT, Martinko JM. Brock Biology of Microorganisms.12th edi. Pearson. 2009.
    3. Stanier RY, Ingraham JL, Wheelis ML. GEd Microbiology. McMillan. 2005.
    4. Tortora GJ, Funke BR, Case CL. Microbiology: An Introduction. Pearson Edu. 2008.
    5. De A. Practical and Microbiology. The National Book Depot. 5th Edition. 2020.
    6. Flint J. Principles of Virology. 4th edi. Asm Press Exclusive (Us), 2015.
    7. Vanmeter K.C. Microbiology for the Healthcare Professional. 3rd edi. Elsevier, 2021.

**Course Code: BMIC 1102**

**Course Title: Basic Techniques in Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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, and identification by molecular techniques and preservation.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Gain knowledge on basic equipment and chemicals uses in microbiology laboratory.

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

**CLO3:** Understanding the techniques of sterilization, disinfection and media preparation

**CLO4:** Know about microbial isolation, identification and growth measurement.

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

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | Lec. No. | CLOs |
| **1.** | **Microbiology Laboratory:** Introduction of microbiology laboratory. Microbial practices and management. Basic equipment and chemicals uses in microbiology laboratory. Safety rules. | 3 | CLO1 |
| **2.** | **Microscopy:** Principles, functions and applications of microscopes. Unit measurement-magnification, resolving power and numerical apparatus. Introducing different types of microscopy. | 4 | CLO1  CLO2 |
| **3.** | **Sterilization Techniques:** Concept of sterilization. Methods of sterilization. Sterilization of equipment, materials, and inoculums. Aseptic techniques. Tyndallization. | 4 | CLO1  CLO3 |
| **4.** | **Microbial Culture Media:** Culture media. Types of media. Media preparation, storage and applications. Culture techniques of aerobic and anaerobic microbes. | 4 | CLO1  CLO3 |
| **5.** | **Measurement of Growth:** Direct microscopy. Standard plate count. Dilution plate, membrane filtration and turbidity metric method. | 4 | CLO1  CLO4 |
| **6.** | **Microbe Isolation and Identification:** Bacteria, fungi and others microbe isolation from different sources. Morphological, physiological and serological characterizations. | 4 | CLO1  CLO3  CLO4 |
| **7.** | **Staining of Microorganisms:** Preparation of microorganisms for microscopic observations. Chemical properties of staining. Different mechanisms of microbial staining. | 3 | CLO1  CLO4  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. Gerand JT, Berdell RF, Christine L. Microbiology: An Introduction. Boston, 2016.
3. Hans GS, Zaborosch C, Kogut M. GEd Microbiology. Cambridge Univ. Press, 1993.
4. De A. Practical and Microbiology. The National Book Depot. 5th Edition. 2020.
5. Vanmeter K.C. Microbiology for the Healthcare Professional. 3rd edi. Elsevier, 2021.
6. Anuradha D. Practical and Applied Microbiology. 5th edi. Cbs National, 2020.

**Course Code: BMIC 1103**

**Course Title: Basic Genetics**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 linkage and crossing over, and multiple allelism.

**CLO4:** Gather knowledge oncytoplasmic inheritance, and chromosomal variations.

**CLO5:** Evaluate the basic techniques of population geneticsand genetic models of evolution.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 |
| **CLO2** | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 1 |
| **CLO4** | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 1 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 4 | CLO1  CLO2 |
| **2.** | **Gene Interaction:** Types of gene and gene interaction. Explanation of dominance, recessive and lethal gene. | 4 | CLO1  CLO2 |
| **3.** | **Linkage and Crossing Over:** Definition of linkage and crossing over. Coupling and repulsion, hypothesis of linkage. | 4 | CLO1  CLO3 |
| **4.** | **Multiple Alleles:** Definition, characteristics, types and expression of multiple alleles with examples. Multiple alleles among humans. | 3 | CLO1  CLO3 |
| **5.** | **Cytoplasmic Inheritance and Chromosome:** Definition and background of cytoplasmic inheritance. Male sterility. Structure and functions of chromosomes. Aneuploids and polyploids. | 4 | CLO1  CLO4 |
| **6.** | **Population Genetics:** Definition, origins and applications of population genetics. Hardy-Winberg Law. Genetic equilibrium. | 3 | CLO1  CLO5 |
| **7.** | **Genetic Models of Evolution:** Changes of gene and genotype frequency. Selection, mutation, drift, migration and non-random mating. Species and speciation, Population genetics and its critics. | 4 | CLO3  CLO4 CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Klung. Concepts of Genetics. Pearson. 12th Edition. 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 pub.1st Edition. 1997.
5. Strickberger MW. Genetics. Pearson India; 3rd Edition. 2015.
6. Verma PS, Agarwal VK. Genetics. S. Chard and Company Ltd, New Delhi. 2009.
7. Singh P. Genetics. Kalyani Publishers, 3rd Edition. 2016.

**Course Code: BMIC 1104**

**Course Title: Introductory Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn the practical knowledge of identification and applications of major instruments.

**CLO2:** Explain the basic knowledge of Lab. equipment operation.

**CLO3:** Show the techniques of isolation and identification of microbe from different samples.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CLO3** | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | Identification and applications of major instruments.  Principle and operation of Lab. equipment.  Collection, isolation, preservation and identification of bacteria and fungi from different samples.  Microbial culture techniques, spread plate and streak plate.  Microbial colony count, growth and control rate. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. James G. Cappuccino. Microbiology A Laboratory Manual, 11th Edition, 2016.
2. Atlas R.M. Principles of Microbiology.
3. Brock T.D. Biology of Microorganisms.

**Course Code: BMIC 1105**

**Course Title: Basic Techniques in Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn the practical knowledge of microscopy.

**CLO2:** Show the basic techniques of microbial media preparation and culture.

**CLO3:** Explain the basic knowledge of microorganism staining.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | Light microscopy: principles, parts and function, operation.  Microscopy of different microbes.  Preparation of microbial media.  Microbial staining (Gram, Cotton blue etc.)  Pipetting, serial dilution and different culture techniques  Demonstration of pH measurements of culture media. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Tortora GJ and Funke BR. Microbiology: An Introduction, 9th Edition.
2. Salle AJ. Fundamental Principles of Bacteriology.
3. James G. Cappuccino. Microbiology A Laboratory Manual 11th Edition, 2016.

**Course Code: BMIC 1106**

**Course Title: Basic Genetics Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn the practical knowledge of pollination, hybridization and Mendel laws.

**CLO2:** Show the basic techniques of the changes of gene frequency.

**CLO3:** Explain the basic knowledge of population selection and polymorphogenesis.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 1 |
| **CLO2** | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 |
| **CLO3** | 2 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Demonstration of pollination, emasculation  Study of hybridization.  Chi- square test for Mendel’s law, multiple alleles.  Changes of gene frequencies.  Population selection and polymorphogenesis. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Singh P. Genetics. Kalyani Publishers, 3rd Edition. 2016.

**Course Code: BMIC 1107**

**Course Title: Basic Plant Sciences**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Learn the basic knowledge of plants implication and future aspects.

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

**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.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 3 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 4 | CLO1 |
| **2.** | **Plant Ecology:** Plant kingdom. Photosynthetic eukaryotes, cells assembled and multicellular plants. Scope and challenges of the terrestrial environment. | 3 | CLO1 CLO2 |
| **3.** | **Social Networking of Plants:** Overview of Plant interactions, Plants-arthropods relationship. Plant–Plant interactions. | 4 | CLO2 |
| **4.** | **Life Cycles:** Concept of plant life cycle. Stages of plant life cycles. Life cycle of *Arabidopsis thaliana* as model plant. | 3 | CLO1  CLO3 |
| **5.** | **Concept of Phase Changes:** Juvenile phase, adult phase, and changes in meristem identity. | 4 | CLO2  CLO3 |
| **6.** | **Vegetative Development of Plants:** Leaf development, Shoot development and Root development. Factors slows down and stimulates vegetative growth of plants. | 4 | CLO1  CLO4 |
| **7.** | **Reproductive Development:** Reproduction in angiosperms and gymnosperms.Flower development. Senescence and cell death. | 4 | CLO1 CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment. | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Dube HC. A Textbook of fungi, Bacteria and Viruses. India, 3rd Edition, 2009.
2. Mukerjee SK. College Botany (Vol. III). New Central book Agency. 2016.
3. Pandey BP. Plant Anatomy. S. Chand and Com Ltd. India. 2012.
4. Shukla RS, Chandel PS. Plant Ecology and Soil Science. S. Chand, India. 9th Edition. 2000.
5. Gillings M, Holmes A. Plant Microbiology. BIOS Scientific Publishers. 1st Edition. 2019.

**Course Code: BMIC 1108**

**Course Title: Basic Animal Sciences**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

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

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

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CLO3** | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| **CLO4** | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO5** | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Animal Science Concept:** Definition and objectives of animal sciences. Careers in animal sciences. Economic importance of animals. | 3 | CLO1 |
| **2.** | **Animal Kingdom:** Animal etymology, characteristics, reproduction and development. Ecology and diversity of animals. Classifications and features of animal kingdom. | 4 | CLO1  CLO2 |
| **3.** | **Animal Husbandry:** Definition of animal husbandry. Origin of animal domestication and husbandry. Animal husbandry types. Role of Animal Husbandry in Human Welfare. Advantages of animal husbandry. | 4 | CLO1  CLO2  CLO3 |
| **4.** | **Applied Animal Sciences:** Definition of applied animal science. Potential careers. Study of applied animal farming and management (sericulture, apiculture, pisciculture, aquaculture, dairy and poultry). | 4 | CLO1  CLO2  CLO3 |
| **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. Integrated pest management. | 4 | CLO1  CLO4 |
| **6.** | **Animals Reproduce and Development:** Animal reproduction**.** Sexual and asexual reproduction in animals.Mammalian reproductive anatomy, gametogenesis, and hormonal regulation. | 4 | CLO5 |
| **7.** | **Animal Anatomy:** Concept of animal anatomy. Types and characteristics. Concepts of cells, tissues and organs. | 3 | CLO1  CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation CIE and SEE. |

**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, 2014.
4. Kotpal RL. Modern Textbook of Zoology. Rastogi Publications, India. 2012.
5. Kotpal RL. Modern Textbook of Zoology (Vertebrates).Rastogi Publications, India. 2010.
6. Michael D and Janice M. Animal Behavior. 3rd Edition. Academic Press, pp. 1–27. 2022.

**Course Code: BMIC 1109**

**Course Title: Biochemistry and Biomolecules**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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, and transmission.

**Course Learning Outcomes (CLOs):**

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

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

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

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 1 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CLO3** | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 3 | 2 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Concepts of Biochemistry:** Scopes and prospects, relationship of biochemistry with biology, chemistry, medicine, agriculture, industry, diseases and microbiology. | 3 | CLO1 |
| **2.** | **Carbohydrates and Glycobiology:** Nomenclature, classification and functions. Method of estimation. Natural sources. Reducing and non-reducing sugars and amino sugars. Ketogenic diets. | 4 | CLO1  CLO2 |
| **3.** | **Proteins:** Introduction and classification. Natural sources. Amino acid, peptides and protein. Protein structure and functions. | 4 | CLO1  CLO2 |

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| **4.** | **Lipids:** Nomenclature, classification and biological functions. Nomenclature and reactions of fatty acids, Essential fatty acids. Sterols, estimation and functions of cholesterol. | 4 | CLO1  CLO2 |
| **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 of hormones and treatment of hormonal disorders. | 4 | CLO1  CLO3 |
| **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. | 4 | CLO1 CLO4 |
| **7.** | **Enzymes:** Definition, nomenclature, classifications and characteristics of enzymes. | 3 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

* + 1. David LN, Michael MC. Lehninger Principles of Biochemistry. Mac. Pub. 4th Edi.. 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 1110**

**Course Title: Basic Plant and Animal Sciences Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Gain practical knowledge on plant collection, identification and herbarium preparation.

**CLO2:** Explain the plant development and disease infection.

**CLO3:** Learn the practical knowledge on identification of different animals.

**CLO4:** Explain practical knowledge on animal anatomy.

**CLO5:** Gain the practical knowledge of different animal, industry, fields and firms.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |
| **CLO6** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Identification of plants and development study.  Plant collection and herbarium preparation.  Identification of diseases, host and pathogen. | 26 | CLO1  CLO2  CLO3  CLO4  CLO5 |
| **4.**  **5.**  **6.**  **7.** | Collection and identification of different animals and organs.  General anatomy of selected animals and parts.  Collection and identification of insects and pest along with IPM.  Visit of dairy, sheep, goat and buffalo farms of Bangladesh. |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Verma PS, Srivastava PC. Advanced Practical Zoology. 2000.
2. Ganguly BB, Sinha AK, Adhikari S. Biology of Animals. Calcutta, India. 2011.
3. Michael D and Janice M. Animal Behavior. 3rd Edition. Academic Press. 2022.

**Course Code: BMIC 1111**

**Course Title: Biochemistry and Biomolecules Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn the practical knowledge on basic biochemistry.

**CLO2:** Gain practical knowledge on creatinine and carbohydrates tests.

**CLO3:** Explain the basic techniques of proteins and lipids isolation and quantification.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Creatinine test.  Color reactions of carbohydrates.  Identification of secondary metabolites, proteins and lipids.  Qualitative test for carbohydrate, protein and DNA | 26 | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Hofstein, A., and Lunetta, V. N. The role of the laboratory in science teaching. 1982.

**Course Code: BMIC 1112**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Full Marks: 25**

**Rational of the Course:**

This course is designed to improve basic knowledge of microbial sources in nature.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 3 | 2 | 3 | 1 | 3 | 3 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | Different aspects of applied microbiology/ microbiology/ industry/ microbial industry/ farm visit. | - | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection. | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Course Code: BMIC 1113**

**Course Title: Functional English**

**Course Type: 1Non-credit**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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, article, and poster preparation.

**Course Learning Outcomes (CLOs):**

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

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

**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.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 1 | 3 | 3 | 2 | 2 | 3 | 2 |
| **CLO3** | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| **CLO4** | 2 | 1 | 2 | 3 | 2 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 3 | 3 | 1 | 3 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Introduction:** Concept of functional English. Perquisites, functional, uses and benefits of functional English. | 3 | CLO1 CLO2 |
| **2.** | **Grammar and Usage:** Noun, subject-verb, prepositions and tenses. Sentences. Mechanics capitalization, number style and punctuation. | 4 | CLO1 CLO2 |
| **3.** | **Reading:** Textual reading. Making deductions and drawing logical conclusions from reading and reading for others. | 4 | CLO1  CLO3 |

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| **4.** | **Writing:** Concept of writing, types of writing, comprehension and summary writing. Writing in newspaper, magazine, newsletters etc. | 4 | CLO1  CLO3 |
| **5.** | **Discourse:** Listening and understanding communications. Taking part in group discussion, reading and participating. | 4 | CLO4 |
| **6.** | **English for Science:** Writing a project, thesis and research paper. Conceptual model, experiment design, writing results, organizing and presenting. | 4 | CLO2  CLO5 |
| **7.** | **Ethical Issue:** Ethical issues of project, thesis and article writing. Plagiarism and similarity checking. | 3 | CLO2 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group and open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Chowdhury MYA, Hossain MM. Advanced Learners Functional English. Dhaka, 2015.
2. Jasim UM. Planning Research and Writing Research Papers. Bangla prokashoni. 2004.
3. Robert AD, Gastel B. How to Write and Publish a Scientific Paper. 7th Edition. 2011.

**Department of Microbiology**

**1st Year: 2nd Semester**

**Course Code: BMIC 1201**

**Course Title: Basic Molecular Biology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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 RNAs.

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 1 |
| **CLO3** | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 1 |
| **CLO4** | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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, promoters and regulatory elements. | 4 | CLO1 |
| **2.** | **Genetic Code:** Origin and history. Properties, wobble hypothesis, codons and anticodons, standard codon tables, alternative genetic codes, mutations. | 3 | CLO1  CLO2 |
| **3.** | **Replication:** Replication of DNA, mode of replication. Enzymes of DNA replication and its control. | 4 | CLO1  CLO3 |
| **4.** | **Transcription:** Mechanism of transcription. Transcription initiation complex, inhibition and regulation. Mechanism of RNA splicing and RNA processing. Structure of rRNA and tRNA. | 4 | CLO1  CLO3 |
| **5.** | **Translation:** Activation initiation, elongation and termination of protein biosynthesis. Functions of tRNA, post transcriptional modification of tRNA, mRNA and rRNA. | 4 | CLO1  CLO3 |
| **6.** | **DNA Extraction:** Preparation and extraction of total DNA from bacterial, plant and animal cells. Purification of DNA. | 3 | CLO2  CLO4 |
| **7.** | **PCR Amplification and Gel Docking:** Selective amplification of genomic DNA and fragments concept. Principles, procedure, stages, optimization, applications, advantages, limitations and variations of PCR and gel electrophoresis. | 4 | CLO1  CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Alberts B, Bray D, Lewis J. Molecular Biology of the Cell. Garland Pub. 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. Sci. Amer Inc. 2nd Edi. 1990.
4. Nelson DL, Cox MM. Lehninger. Principles of Biochemistry. 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 1202**

**Course Title: Microbial Ecology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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, 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.

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| **CLO2** | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CLO3** | 1 | 2 | 2 | 3 | 1 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 2 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Microbial Ecology Concept:** Definition, **s**cope of microbial ecology. Relation of microbial ecology to general ecology. Microbial ecology and role of microorganism in ecosystem. | 3 | CLO1 |
| **2.** | **Microbial Ecology and Public Health:** Harnessing microbial ecology. Importance of microbial ecology. Interaction of antibiotic and antimicrobial uses. Microbiome potential. | 4 | CLO2 |
| **3.** | **Microorganism Natural Habitats:** Climate change and microbial ecology. Diversity and habitats of microbes. Airborne microbes. | 4 | CLO1  CLO3 |

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| **4.** | **Microbial Communities:** Definition and elements of microbial communities. Patterns and processes of microbial community assembly. Importance of microbial communities. | 3 | CLO1 CLO4 |
| **5.** | **Microbial Interactions:** Classes, regulations and applications of microbial interactions. Unique microbial interactions. | 4 | CLO2 CLO4 |
| **6.** | **Microbial Adaptations:** Concept of microbial adaptations. Mechanisms and implications of microbial adaptation. Adaptation and preservation of ecological stability. | 4 | CLO1  CLO5 |
| **7.** | **Microbial Degradations:** Definition, mechanisms and factors of microbial degradation. Applications and importance. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Atlas RM, Bartha R. Microbial Ecology: Fundamentals and Applications. USA. 2000.

2. Madigan MT, Martinko JM, Parker J. Brock Biology of Microorganisms. Pearson. 2009.

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

4. Rao N S S. Soil Microbiology. 4th edi. Oxford & Ibh Publishing, 2022.

5. Elsas J.D.V. Modern Soil Microbiology. 3rd edi. Taylor & Francis, 2021.

**Course Code: BMIC 1203**

**Course Title: Basic Cell Biology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

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

**CLO2:** Introduces the basic knowledge of cells types, characteristics and structure.

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 3 |
| **CLO2** | 2 | 3 | 1 | 2 | 2 | 2 | 1 | 2 |
| **CLO3** | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 2 | 2 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Concepts of Cell Biology:** Introduction of cells and cell biology. Cell theory. Structure and functions of cells. Techniques of cell biology study. | 4 | CLO1 |
| **2.** | **Types of Cells:** Definition and characteristics of prokaryotic and eukaryotic cells. Structure and functions of prokaryotic cells. | 4 | CLO1  CLO2 |
| **3.** | **Cytopathology:** Definition. Cells collection. Imprint cytology: preparation and observation under microscope. | 4 | CLO1  CLO3 |
| **4.** | **Stem Cell:** Embryonic and adult stem cells. Enipotency and pluripotency. Stem cell isolation, expansion and transplantation. | 3 | CLO1 CLO3 |
| **5.** | **Cell** **Growth and Development:** Concept and history of cell division. Types and phases of cells division. Mitosis and meiosis cell division. Cell cycle phases. | 4 | CLO1  CLO4 |
| **6.** | **Membrane Structure:** Models of membrane structure. Membrane lipids, proteins and carbohydrates. Eukaryotic and prokaryotes cell membrane. | 4 | CLO1  CLO4 |
| **7.** | **Membrane Transport:** Membrane transport. Types of transporters. Endocytosis. Organelles transport across the membrane. | 3 | CLO2 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Karp G. Cell and Molecular Biology. 6thEdi. Wiley & Sons. Inc. 2010.

2. De Robertis E.D, Robertis D. 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. The World of the Cell. 7th Edition. 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 1204**

**Course Title: Basic Molecular Biology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**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 genetic materials isolation and purification.

**CLO2:** Achieve knowledge of genetic materials measures and gel electrophoresis.

**CLO3:** Apply the techniques of primers designing, PCR, RT-PCR assay.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 3 | 2 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Genomic and plasmid DNA isolation.  Purification and measures of genetic materials.  Agarose gel electrophoresis.  Study of primers designing, PCR. | 26 | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others

2. Atlas RM and Bartha R. Microbial Ecology, Fundamental and Applications.

3. Lynch JM and Poole NJ Microbial Ecology: A conceptual Approach.

**Course Code: BMIC 1205**

**Course Title: Microbial Ecology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Gain practical knowledge on collection, isolation and identification of microbes.

**CLO2:** Achieve knowledge of BOD and microbial degradation.

**CLO3:** Apply the techniques of algae, cyanobacteria and parasites detection.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 2 | 3 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Isolation and identification of microbes from ecosystems.  Study of BOD.  Study of microbial degradations.  Characterization of algae, cyanobacteria and parasites. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others

2. Atlas RM and Bartha R. Microbial Ecology, Fundamental and Applications.

3. Lynch JM and Poole NJ Microbial Ecology: A conceptual Approach.

**Course Code: BMIC 1206**

**Course Title: Basic Cell Biology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the basic techniques of cell isolation, and observation under microscope.

**CLO2:** Learn some practical experience on human anatomy and physiological systems.

**CLO3:** Achieve practical knowledge of blood cells staining and cell divisions.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 1 | 2 |
| **CLO2** | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Observation of plant, animal and microbial cells.  Blood cells staining and observation under microscope.  Study of mitosis and meiosis. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. Widmaier EP, Raff H and Strang KT. Vander's Human Physiology: The Mechanisms of Body Function, 12th Edition - 2010.

**Course Code: BMIC 1207**

**Course Title: Human Anatomy and Physiology**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 and control of circulatory system and cardiac physiology.

**CLO3:** Know the cardiac physiology, digestive system, functions and clinical significance.

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 3 | 3 | 2 | 2 | 2 | 2 |
| **CLO3** | 1 | 1 | 2 | 3 | 2 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 2 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Human Anatomy:** Human body and anatomy. Fast facts on human anatomy. History and importance of human anatomy. Ways to explore human anatomy. | 3 | CLO1 |
| **2.** | **Human Physiology:** Introduction and importance of human physiology. Biological systems and branches of physiology. Homeostasis. Physical therapy. | 4 | CLO1  CLO2 |
| **3.** | **Circulatory and Cardiac Physiology:** Circulatory system. Cardiac physiology. Cardiac output and its control. The blood vessels and blood pressure. | 4 | CLO1  CLO3 |
| **4.** | **Digestive System:** Introduction, components and functions of human digestive system. Development and clinical significance of digestive system. | 4 | CLO1  CLO3 |
| **5.** | **Respiratory and Urinary System**: Respiratory and urinary systems. Structure and functions. Disorders and healthy systems. Interaction of respiratory and urinary systems. | 4 | CLO1  CLO4 |
| **6.** | **Reproductive and Endocrine Systems:**  Androgen production and physiological effects in males. Secretion and effects of estrogen.Endocrine hormones signals. The principals of endocrine glands. | 4 | CLO1  CLO2  CLO5 |
| **7.** | **Nervous System:** Prenatal and postnatal development of the human nervous system. The central nervous and peripheral nervous system. | 3 | CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. Marieb EN. Human Anatomy and physiology Benjamin. California. 9th Edition. 2012.
4. Smith E, Pateson CR, Scratecherd T, Read NW. Text Book of physiology. Hongkong. 2011.
5. Sherwood, L. Introduction to human physiology. Cengage learning. 2012.
6. Malik B. S A Laboratory Manual of Veterinary Microbiology, 4th edi. Cbs 2003.
7. Hirsh. Veterinary Microbiology, 2nd Edition. John Wiley, 2004.

**Course Code: BMIC 1208**

**Course Title: ICT and Computer Applications**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**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):**

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

**CLO1:** Learn about the components and impact of information technology.

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

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 2 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| **CLO3** | 2 | 1 | 2 | 3 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Concept of Computers:** Basic concept of computers and microcomputer system. Computers applications and its impacts in biological sciences. | 4 | CLO1 |
| **2.** | **Information and Communication Technology (ICT):** Etymology. Components of an ICT system. Models of access to ICT. Impact of ICT in biology. | 4 | CLO1 CLO2 |
| **3.** | **Internet Application and Security:** Information security learning. Internet basics, applications, digital signature, Troubleshooting and maintenance of computer. Antivirus software. | 4 | CLO1 CLO3 |
| **4.** | **Computer Software and Operating Systems:** Types of operating systems and applications. Basic of software and referencing software; Package programmes and programming language. Applications of MS Word, Excel, PowerPoint, Photoshop etc. | 4 | CLO1 CLO2 |
| **5.** | **Bioinformatics Concept:** Bioinformatics definition, goal, history and applications. Types of databases, pitfalls of biological databases, global bioinformatics centers and servers. Database software, structure, management system and its merits and demerits. | 3 | CLO1 CLO3 |
| **6.** | **Sequence Alignment and Analysis:** Sequence alignment. Alignment methods. Scoring matrices and database searching. | 4 | CLO4 |
| **7.** | **Phylogenetic Analysis:** Phylogenetic tree basics and construction algorithms. Elements of phylogenetic models. Data analysis. | 3 | CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Gillings M R, Hilbert M, Kemp D J. Information in the Biosphere. 2016.
2. Rahman M L, Hossain MA. Computer Fundamentals. Systech, Dhaka 2011.
3. Murrill PW, Smith CL. Introduction to Computer Science. 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 1209**

**Course Title: Basic Chemistry**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

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

**CLO2:** Gather knowledge of the ionization potential and transition elements.

**CLO3:** Acquire knowledge about gases, thermodynamic and chemical processes equipment.

**CLO4:** Learn about sigma and bonds, buffer, solubility product, and common ion effect.

**CLO5:** Explores the types of solutions, vapor pressure, solubility product, and ion effects.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 3 | 1 | 1 | 1 |
| **CLO2** | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| **CLO3** | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 1 |
| **CLO4** | 2 | 1 | 2 | 3 | 1 | 3 | 1 | 1 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Atomic Structure:** Fundamental particles, discovery of electron, proton, neutron, and charge. Isotope, wave nature of electrons, electron configuration of atom. | 4 | CLO1  CLO2 |
| **2.** | **Periodic Classification of Elements:** Modern periodic table. Types of elements in the periodic table, atomic and transition elements. | 4 | CLO2  CLO4 |
| **3.** | **Chemical Bonds:** Electronic, valance bonds, molecular orbital theory. Sigma and bonds and polar molecules, electro negativity and electron affinity. | 4 | CLO1  CLO4 |
| **4.** | **Gases:** Concept of gases, free energy, direction of chemical and biochemical process, energetic of biochemical reaction. | 4 | CLO1 CLO4 |
| **5.** | **Thermodynamics:** Fundamentals of thermodynamic concepts. Classification of system. First, second and third law of thermodynamics. Entropy, free energy and work functions. | 3 | CLO1CLO3 |
| **6.** | **Acids, Bases and Buffers:** Concepts of pH, acids and buffer, indicators. Solubility product principle with applications. Measurement of pH, solution and concentration units. | 4 | CLO1CLO2CLO4 |
| **7.** | **Aqueous Solutions:** Types of solutions. Lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, and colligative properties of electrolytes. | 3 | CLO1CLO4CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Ebbing DD. General Chemistry.11th Edition, 2021.
2. Bahl. B.S, Bahl A. Advanced organic Chemistry. 2012.
3. Bahl A. Bahl. BS, Tuli GD. Essential of Physical Chemistry. Revised Edition. 2009.
4. Madan RD. Modern Inorganic Chemistry, 4th Edition, 2014.
5. Haque M.M. and Nawab M.A. Principles of Physical Chemistry.
6. Cotton and Wilkinson. Basic Inorganic Chemistry, 4th Edition.
7. Morrison RH and Boyd RN. Organic Chemistry, Prentice-Hall, Inc.

**Course Code: BMIC 1210**

**Course Title: Human Anatomy and Physiology Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the basic techniques of cells identification.

**CLO2:** Learn practical experience on human blood cells staining.

**CLO3:** Apply measurement of glucose, pressure, oxygen and temperature levels.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 2 |
| **CLO2** | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 |
| **CLO3** | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Identification of different cells, tissue and organs of human  Dissection of different system in mammals and birds.  Study of human blood cells staining  Measurement of blood glucose level, temperature, oxygen levels and blood pressure of human body. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, presentation, viva voce, CIE and SEE. |

**Learning Resources:**

1. Widmaier EP, Raff H and Strang KT. Vander's Human Physiology. 12th Edition. 2010.

**Course Code: BMIC 1211**

**Course Title: ICT and Computer Applications Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Gain practical knowledge on Microsoft office.

**CLO2:** Introduce toreferencing software, and expressing computation.

**CLO3:** Apply data searching, alignment, and spreadsheet handling.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 3 |

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

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| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4.  5. | Microsoft office (MS word, excels, MS PowerPoint).  Introduction to referencing software.  Computational language for expressing computation.  Data base search, alignment and phylogenic tree.  Spreadsheet handing, working with worksheets, creating a spreadsheet, tables and graphs. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, presentation, viva voce, CIE and SEE. |

**Learning Resources:**

1. Morrison C, Wells D and Ruffolo L. Computer literacy basics. 2014.
2. Wempen F. Computing fundamentals: Digital Literacy Edition. J. Wiley & Sons. 2014.

**Course Code: BMIC 1212**

**Course Title: Basic Chemistry Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Gain practical knowledge on acid and bases and molar mass.

**CLO2:** Acquire knowledge on determination of neutralization, coefficient and reactant rates.

**CLO3:** Apply of the melting point of the organic compounds.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 3 |
| **CLO3** | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4.  5. | Preparation of acid and bases.  Study of acid calorimetrically.  Determination of partition coefficient.  Investigation of the gas production.  Determination of the melting point of the organic compounds. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Hofstein A and Lunetta VN. The role of the laboratory in science teaching: Neglected aspects of research. Review of educational research, 52(2), 1982.

**Course Code: BMIC 1213**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Full Marks: 25**

**Rational of the Course:**

This course is designed to improve basic knowledge of microbial sources in nature.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 3 |
| **CLO2** | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 1 |
| **CLO3** | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | Different aspects of applied microbiology/ microbiology/ industry/ microbial industry/ farm visit. | - | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection. | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Course Code: BMIC 1214**

**Course Title: Viva voce**

**Course Type: Major and GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board. This course also gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies

**Course Learning Outcomes (CLOs):**

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

**CLO1:** To learn the way of how to prepare and face a viva board, how to present thyself and how to communicate with others.

**CLO2:** The students will acquire the ability to link ideas together to build their own way of expression.

**CLO3:** They also will learn brainstorming to solve a given problem.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 |
| **CLO2** | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | Oral viva will be conducted by a panel of examiners at the end of theory courses. Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire semester. The examiners will aim to assess whether the student has acquired the essence of their yearlong learnings through the expression of their understanding. The questionnaire usually will be linked with one another to investigate whether the student have achieved the level of understanding to solve a given problem from the information they have gathered during their course of study. | - | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Problem-based learning and team works | Viva voce |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Department of Microbiology**

**2nd Year: 1st Semester**

**Course Code: BMIC 2101**

**Course Title: General Bacteriology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 fungi, and viruses, there has been a tendency for the field of bacteriology.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn about 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 and generation time of bacteria.

**CLO5:** Explores of the archaebacterial, purple bacterial and eubacteria.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 |
| **CLO2** | 2 | 3 | 2 | 3 | 2 | 3 | 1 | 2 |
| **CLO3** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 3 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Bacterial Systematic:** Concepts of bacteria and bacteriology. Characteristics and Importance. Composition of bacteria. Bacterial taxonomy and diversity. Classification and identification. | 4 | CLO1  CLO2 |
| **2.** | **Bacterial Growth:** Bacterial growth types and phases. Shapes and sizes of different bacteria. Bacterial multiplication, growth time, bacteria counting. | 4 | CLO1 CLO2 |
| **3.** | **Cytoplasm:** Concepts of bacterial cytoplasm.Components of bacterial cytoplasm. Functions of bacterial cytoplasm. | 3 | CLO1 CLO3 |
| **4.** | **Endospore:** Ancient bacteria. Bacterial spore and endospore. Bacterial endospores formation, structure and functions. | 3 | CLO1 CLO3 |
| **5.** | **Bacterial Reproduction:** Asexual reproduction. Logarithmic representation of bacterial populations. Generation time and rate. | 4 | CLO1 CLO4 |
| **6.** | **Archaebacteria and Eubacteria:** General characteristics. Morphology and metabolism. Ecological and economic importance. | 4 | CLO1  CLO5 |
| **7.** | **Purple Bacteria and Relatives:** Classes and unique features of proteobacteria phylum. Life cycle of Chlamydia. | 4 | CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. 4th Edition. 1995.
3. Byung HK, Geoferry MG. Bacterial physiology and metabolism. Cam. Univ. Press, 2008.
4. Johnsbor O, Eldholm V. Natural genetic transformation. Res. Microbiol. 2007.
5. Schulz H, Jorgensen B. Big bacteria. Annu Rev Microbiol. 2001.

**Course Code: BMIC 2102**

**Course Title: Microbial Physiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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 culture techniques and the effective factors.

**CLO4:** Understand the chemolithotrophic and phototrophic metabolism techniques.

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 2 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 2 |
| **CLO3** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 2 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 3 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 2 | 3 | 2 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Introduction of Microbial Physiology:** Concept of microbial physiology. Nutritional classification of microorganisms. Primary nutritional groups. Important of microbial physiology. | 4 | CLO1 |
| **2.** | **Metabolite Transport:** Types of transport across membranes. Endo and exocytosis. Fueling reactions. Group translocation. Iron uptake. | 4 | CLO1  CLO2 |
| **3.** | **Microbial Culture:** Batch and continuous culture. Measurement of colonies numbers, morphology, cell mass and metabolic activity. | 4 | CLO1  CLO3 |
| **4.** | **Microbial Growth Factors:** Types of factors. Effects of temperature and pH ranges and adaptations, solutes, water activity, oxygen concentration, radiation and pressure. | 4 | CLO2  CLO3 |
| **5.** | **Chemolithotrophic Metabolism:** Physiological groups of aerobic and anaerobic chemo-lithotrophs. Hydrogen-oxidizing bacteria and methanogens. | 3 | CLO1  CLO2  CLO4 |
| **6.** | **Phototrophic Metabolism:** Photoautotrophism and photoheterotroph. Diversity of phototrophic bacteria. Photosynthetic pigments. Physiology of bacterial photosynthesis. | 4 | CLO2  CLO4 |
| **7.** | **Biological Carbon Fixation:** Concept of carbon fixation. Elucidation of the carbon pathway. The Calvin-Benson cycle. Differences in carbon fixation pathways. | 3 | CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. Cam. Uni. 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 2103**

**Course Title: Food Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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. Graduates would be able to create the employment opportunities in order to achieve the SDG goal of Bangladesh.

**Course Learning Outcomes (CLOs):**

At 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 fermented products and probiotics in home and industry.

**CLO4:** Evaluate food-borne diseases, food contaminants, sanitation and prevention.

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 3 | CLO1 |
| **2.** | **Spoilage of Foods:** Spoilage of vegetables, fruits, meat, eggs, milk, butter, bread and canned foods. | 3 | CLO1  CLO2 |
| **3.** | **Food Preservation:** Principles of food preservation. Methods of food preservation. Microwave processing and aseptic packaging. Effect of freezing/thawing of foods. | 5 | CLO1 CLO2 |
| **4.** | **Dairy Foods:** Dairy foods production. Dairy starter cultures. Fermented products and probiotics. | 3 | CLO2  CLO3 |
| **5.** | **Food Borne Diseases:** Concept of food borne diseases**.** Food and microbes intoxications. Food-borne diseases causing and effects. | 4 | CLO2  CLO4 |
| **6.** | **Food Sanitation and Control:** Types of food contaminants, sanitation, management and prevention. HACCP in sanitation. Quality assurance for sanitation. | 4 | CLO1  CLO4 |
| **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. Genetically modified food. New trends in food packaging and technology. | 4 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. James MJ. Modern food microbiology. 7th Edi. 2021.
2. Adams MR, Moss MO. Food microbiology. 3rd Edi. 2007.
3. Banwart G. J. Basic Food Microbiology. 2nd edin. Cbs, 2004.
4. Jay J. M. Modern Food Microbiology. 4th edin. Cbs. 2005.
5. Hutkins R.W. Microbiology and Technology of Fermented Foods. Wiley India, 2014.

**Course Code: BMIC 2104**

**Course Title: Agricultural Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 agricultural 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):**

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

**CLO1:** Gain basic knowledge of microbes in agricultural and in soil.

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

**CLO3:** Evaluate the knowledge of the different types of crops processing and preservation.

**CLO4:** Analyze the pathogens, disease diagnosis, microbial fertilizers and controlling.

**CLO5:** Explain the uses of bio-fertilizer, bio-pesticides microbial research in agriculture.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 3 |
| **CLO4** | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 3 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Concept and importance of microbiology in agriculture. Good agricultural practices. Progress through multidisciplinary research. | 3 | CLO1 |
| **2.** | **Crops and Beneficial Microbes:**  Plants and mycorrhizal fungi, Microorganisms as fertilizers and nitrogen fixation. Overcoming barriers to successful agricultural microbiology research Genetically modified crops. Genetic engineering for disease resistance in plants. | 4 | CLO1  CLO2 |
| **3.** | **Microbiological Challenges to Agriculture:** Microbial threat to agriculture. Disease formation process, the disease triangle, strategies of pathogenicity and plant immune responses. Plant responses to necrotrophic, and viruses, prevent and manage plant diseases. | 4 | CLO1  CLO2  CLO3 |
| **4.** | **Soil and Microorganisms:** Major groups of microorganisms in soil. Role of microbes in soil fertility plant nutrition and plant growth promotion. | 4 | CLO1 |
| **5.** | **Microorganism in Agro-processing:** Preservation and storage of forage crops. Role of microbes in foods producing, processing and preservation. | 3 | CLO3  CLO4 |
| **6.** | **Biofertilizer:** Biofertilizer - plant growth promoting rhizobacteria (PGPR); bioinoculant mass production using Rhizobium, Azotobacter and Cyanobacteria; Compost- green manure, town compost, vermicompost, production and applications. | 4 | CLO4  CLO5 |
| **7.** | **Biopesticides:** biopesticides concept. Biopesticides of microbial origin. Biology and application of *Bacillus thuringiensis* (Bt) in pest control. Bt transgenic plants and foods: risks and benefits. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Shaista N, Iqra A, Yuanda S. Microbes as Biofertilizers, a Potential Approach for Sustainable Crop Production. Sustainability. 13 (4), 1868. 2021.
2. Choudhury ATMA, Kennedy IR. Prospects and potentials for systems of biological nitrogen fixation in sustainable rice production. Biol. Fertil. Soils. 39 (4), 219–227. 2004
3. Mukherjee, Ghosh T. Agricultural Microbiology.2nd Edition. Kalyani Publishers, 2020.
4. Vieira. Bacterial colonization of minerals in grassland soils is selective and highly dynamic. Environmental Microbiology. 2020.
5. Falkowski PG, Fenchel T, Delong EF. The Microbial Engines That Drive Earth's Biogeochemical Cycles. Science. 2008.

**Course Code: BMIC 2105**

**Course Title: General Bacteriology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

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

**CLO2:** Learn about the Gram staining tests of bacteria.

**CLO3:** Achieve practical knowledge on biochemical and pathogenicity test of bacteria.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Collection, identification and preservation of bacteria.  Different Gram staining tests of bacteria.  Biochemical test for bacteria identification.  Bacterial DNA isolation, purification and amplification  Infection process and pathogenicity test of bacteria. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Moat AG, Foster JW, Spector MP. Microbial Physiology. 4th Edition. 2002.
2. Muhammad BA. Introduction to Microbiology Lab Manual. 2016.

**Course Code: BMIC 2106**

**Course Title: Microbial Physiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Adopt practical knowledge onmicrobial growth factors and development.

**CLO2:** Learn the environmental effects on microbial growth.

**CLO3:** Achieve practical knowledge on isolation of microbial metabolites.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4. | Microbial growth factors study.  Measurement of microbial growth and development.  Detection of environmental effects on microbial growth.  Isolation of microbial metabolites. | 26 | CLO1CLO2 CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, continuous internal evaluation, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. Moat AG, Foster JW, Spector MP. Microbial Physiology. 4th Edition. 2002.

**Course Code: BMIC 2107**

**Course Title: Food Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the techniques of sampling.

**CLO2:** Analyze the milk adulteration, pasteurization and homogenization.

**CLO3:** Evaluate the techniques of food production and preservation.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4.  5. | Sampling procedures, composite and preservation  Adulteration, pasteurization and homogenization of milk. Dairy food and beverage production.  Isolation and detection of microbes from dairy foods.  Methods of preservation of meat. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Hutkins R.W. Microbiology and Technology of Fermented Foods. Wiley India, 2014.
2. Adams MR, Moss MO, Food Microbiology. 2023.

**Course Code: BMIC 2108**

**Course Title: Agricultural Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Adopt practical knowledge onrhizosphere and rhizoplane.

**CLO2:** Learn the physiological activities of plant growth hormones.

**CLO3:** Achieve knowledge on identification of pathogens and their uses in agriculture.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 |
| **CLO2** | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4. | Study of microflora of soil, rhizosphere and rhizoplane.  Plant growth hormones test.  Identification of plant pathogens.  Effect of microbes in crops. | 26 | CLO1CLO2CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Moat AG, Foster JW, Spector MP. Microbial Physiology. 4th Edition. 2002.
2. Elsas J.D.V. Modern Soil Microbiology. 3rd edi. Taylor & Francis Exclusive, 2021.
3. Gillings. Plant Microbiology. Taylor & Francis, 2004.

**Course Code: BMIC 2109**

**Course Title: Biosafety and Biosecurity**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Describe the ways to treat a laboratory with proper safety.

**CLO2:** Know the biosafety levels required to maintain the risks and PPE use.

**CLO3:** Apply the knowledge of good laboratory practice and decontamination processes.

**CLO4:** Describe the laboratory security systems to develop own environment

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

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Biosafety and Risk Assessment:** Biosafety and biorisk definition and management. Important of biosafety. Risk assessment concept and techniques. Aerosol hazards and it’s minimizing in the laboratory. | 4 | CLO1 |
| **2.** | **Biosafety Cabinet:** Operation, use, and misuse. Building Automation systems. Mistakes in facility design. Fire detection and control systems. Effluent decontamination systems. Facility layout and material flow. Biosafety levels and animal biosafety levels. | 4 | CLO1  CLO2 |
| **3.** | **Personal Protective Equipment:** Types of PPE. Selection and proper fit, use of PPE. Cross contamination and proper doffing, disposal of PPE. Poor combinations of PPE. | 3 | CLO1  CLO2 |
| **4.** | **Facilities and Safety Equipment:** Visitors safety. Good laboratory practices (GLPs). Laboratory safeguards and procedures. Biological safety cabinets. Emergency procedures. | 4 | CLO1  CLO3 |
| **5.** | **Biosafety Practices:** Disinfection and decontamination. Spill cleanup, waste disposal, selection of disinfectants. Mechanisms of action and categories of disinfectants. | 3 | CLO1  CLO3 |
| **6.** | **Biosecurity and Emergency Response:** Personnel suitability. Insider threat awareness. Mental health awareness. Physical and information security. Emergency response. Lab animal and chemical handling practice. | 4 | CLO1 CLO4 |
| **7.** | **Bioethics:** Principles of bioethics, ethical dilemma. Ethical considerations in microbial research in the area of agriculture, plants, animals, medical sciences and GMOs. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Michael JS. Gain-of-Function Research: Ethical Analysis, SciEng Ethics. 2016.
2. Miller JM, Astles R, Baszler T, Chapin K, Wiedbrauk D. Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories. 2012.
3. [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.
4. Farida K. Enhancing Responsible Science Research. NSAB for Biosecurity. 2013.
5. World health organization. Laboratory biosafety manual. 3rd Edition.
6. Diane O. Fleming, Debra L. Hunt. Biological Safety: Principles and Practices, 4th Edition.
7. Centers for Disease Control and Prevention (U.S.). Biosafety in Microbiological and Biomedical Laboratories 5, 5th edition, 2009.

**Course Code: BMIC 2110**

**Course Title: Bangladesh Studies**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Achieve information regarding 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 democracy, government and independence of Bangladesh.

**CLO5:** Explores the history of different religion, cultures, activities and development.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 1 | 2 | 2 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Introduction:** Etymology of Bengal, ancient Bengal, Nawabs of Bengal, company and British rule. | 3 | CLO1 |
| **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. | 4 | CLO1  CLO2 |
| **3.** | **Birth of People’s Republic of Bangladesh:** Declaration of independence. Mujibnagar Government and Liberation war. Surrender and aftermath. | 4 | CLO3 |
| **4.** | **Independent Bangladesh:** Sheikh Mujib administration. Military coups and presidential regimes. Parliamentary republic. | 4 | CLO2  CLO3 |

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| **5.** | **Constitution:** Constitution of People's Republic of Bangladesh. Early democracy and socialism. | 3 | CLO3  CLO4 |
| **6.** | **Religions and Cultures:** Different religions and activities. Religious pluralism. Bengali cultures and national days. Small ethnic groups of Bangladesh and cultures. | 4 | CLO5 |
| **7.** | **Present Activities of Bangladesh:** Developments in different sectors. Structure and change of economy from 1971 to date in Bangladesh. World leadership. Future aspect of Bangladesh. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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, 1. 1704-71. Asiatic Society of Bangladesh, 1997.
4. Raghavan S. 1971: A Global History of the Creation of Bangladesh. H.U. Press; 2014.
5. Van Schendel W. A History of Bangladesh. Cambridge University Press, 2009.
6. Chakrabarti DK. Ancient Bangladesh. Delhi Press. 1992.

**Course Code: BMIC 2111**

**Course Title: Biosafety and Biosecurity Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

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

**CLO2:** Apply the techniques of biosafety cabinets handling, aseptic techniques.

**CLO3:** Understand proper use of PPEs, disinfection and decontamination techniques.

**CLO4:** Learn different case studies.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 1 |
| **CLO4** | 3 | 1 | 2 | 3 | 3 | 3 | 1 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Microbiology Lab. tour and case studies.  Follow proper techniques of biosafety and biosecurity.  Aseptic techniques, disinfection and decontamination.  Proper use of PPEs and safety practices. | 26 | CLO1 CLO2  CLO3  CLO4 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. World health organization. Laboratory biosafety manual. 3rd Edition.
2. Davis D. Laboratory Safety- A Self-Assessment Workbooks. 1st Edition.
3. Georgia Institute of Technology Laboratory Safety Manual. Revision 2018.

**Course Code: BMIC 2112**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Full Marks: 25**

**Rational of the Course:**

The rationale of this course is to enrich the students’ practical knowledge on manufacturing microbial products, procedure, management and marketing aspects.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 1 | 2 | 1 | 2 | 3 | 1 |

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

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| --- | --- | --- |
| **SI NO.** | **Course Contents** | **CLOs** |
| **1.** | Different aspects of applied microbiology/ microbial industry/ institute/ farm visit/ clinic/ medical/ microbial ecosystems observation and management. | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection, hands on training and team works | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Department of Microbiology**

**2nd Year: 2nd Semester**

**Course Code: BMIC 2201**

**Course Title: General Mycology and Phycology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**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):**

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

**CLO1:** Explain the principles of fungi and algae as host-pathogen interaction and diagnosis.

**CLO2:** Achieve 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.

**CLO5:** Evaluate the implications of fungi and algae.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| **CLO5** | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction of Fungi:** Concept of mycology and mycologist. How to become a mycologist. General characteristics and classification. | 3 | CLO1 CLO3 |
| **2.** | **Life Cycle of Fungi:** Reproduction, morphology, structure and life cycle of fungi. | 3 | CLO1  CLO2 |
| **3.** | **Molecular Mycology:** Current approaches to fungal pathogenesis. Molecular diagnostics. Challenges to molecular-based diagnostic mycology. Antigen detection. | 4 | CLO1  CLO3 CLO4 |
| **4.** | **Applications of Fungi:** Economic importance of fungi. Drug development. Psychotropic effects. Vitamin D2 production. Mycotoxins. Edible fungi. Fungal diseases. The future of fungi. | 4 | CLO1 CLO5 |
| **5.** | **Introduction of Algae:** Definition and history of phycology. Classification and characteristics. Pigments and types of algae. | 4 | CLO1 CLO3 |
| **6.** | **Life Cycle of Algae:** Reproduction, occurrence and life cycles of algae. Characteristics of blue-green algae. Molecular characterization and diagnosis. | 4 | CLO1  CLO2 CLO3 |
| **7.** | **Applications of Algae:** Applications of algae. Culture and farming of algae. Algae as a source of energy, fuel and rich oils. Paleophycology. Diseases cause by algae. | 4 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Sharma OP. Textbook of Algae. Tata McGraw Hill Publishing Co. Ltd. 2005.
2. Vashishta BR. Algae. 3rd edition. S. Chand and Company Ltd., New Delhi. 2005.
3. Vashishta BR, Sinha AK. Fungi. S. Chand and Company Ltd. 2008.
4. Lu N. Fungi Their Nature and Uses. Koros Press, 2017.
5. Thajuddin N. Fungicides Beneficial and Harmful Aspects. Intech, 2014.
6. Dhanasekaran D. Fungicides for Plant and Animal Diseases. Intech ,2014.

**Course Code: BMIC 2202**

**Course Title: Fermentation Technology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**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):**

At 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 bioreactor design, configuration, associated of instrument and services.

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

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

**CLO5:** Apply the potential microbes and marketing locally and globally.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction to Fermentation:** Concept, process and components of fermentation. Chronological development of the fermentation industry. | 3 | CLO1 |
| **2.** | **Bioreactor Design:** Bioreactor types and configuration. Impeller designs and baffles agitation and aeration. Fermentor associated instrument and services. | 4 | CLO1  CLO2 |
| **3.** | **Media and Inoculums Development:** Energy and carbon sources. Precursors and metabolic regulators to media. Oxygen requirements, submerged, surface and solid state fermentations. Inoculums preparation and scale up. | 4 | CLO1  CLO3 |
| **4.** | **Sterilization:** Media sterilization, sterilization processes. Sterilization of the fermenter; feed and air. | 3 | CLO2  CLO3 |
| **5.** | **Microbial Growth Kinetics:** Rate equations for cell growth, substrate utilization and product formation. | 4 | CLO2  CLO3 |
| **6.** | **Instrumentation and Control:** Agitation and aeration, foam sensing, measurement. Control of dissolved oxygen. | 4 | CLO2  CLO4 |
| **7.** | **Fermentation Economics:** Isolation and strain improvement of potential microbes. Market potential, legislation, water usage and recycling, effluent treatment. | 4 | CLO1  CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

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

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

3. Mclaughlin L. Fermentation Microbiology and Biotechnology. Kaufman Press, 2022.

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

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

**Course Code: BMIC 2203**

**Course Title: Environmental Microbiology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**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. 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):**

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

**CLO1:** Gain basic knowledge on modern environmental microbiology.

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

**CLO3:**  Evaluate the concerns of waste and sewage treatments and sustainable development.

**CLO4:** Gain knowledge on the process ofbiodeterioration.

**CLO5:** Identify degradation microbes and bioengineering approaches of bioremediation.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 3 | 1 | 3 | 2 | 1 | 3 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 3 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Concept of modern environmental microbiology. Microbial factors, effects and environmental pollution.Environmental pollution control measures. | 3 | **CLO1** |
| **2.** | **Global Environmental Problems:** Global environmental problems and role of microbes for solutions. Microbial populations and pollutants detection. | 4 | **CLO1**  **CLO2** |
| **3.** | **Sustainable Development:** Concept of sustainable development. Important of sustainable development for the environment. Role of microbes in sustainable development. | 4 | **CLO1**  **CLO2** |
| **4.** | **Water and Waste Treatment:** Water, wastewater, solid waste and sewages treatment systems. Biodegradable recalcitrant wastes. Factors affecting microorganisms to degrade xenobiotics. | 4 | **CLO1**  **CLO3** |
| **5.** | **Biodeterioration:** Basic concepts. Factors involved in biodeterioration. Biodeterioration of leather, wool, fur, feather, stones, plastics and rubber. Control of biodeterioration. | 4 | **CLO1**  **CLO2**  **CLO4** |
| **6.** | **Degradative Microbes:** Recent approaches to enrich and isolate microbes having catabolic properties. | 3 | **CLO2**  **CLO5** |
| **7.** | **Bioremediation:** Concept, techniques and limitations of bioremediation. Environmental modification for bioremediation. Microbial seeding and bioengineering approaches. | 4 | **CLO3**  **CLO5** |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Bitton G. Wastewater Microbiology. 4th edi. Wiley India, 2018.
2. Mitchell R, Ji-Dong. Environmental Microbiology. Wiley-Blackwell, 2nd Edition, 2009.
3. Vineet K, Gaurav S, Maulin S. Bioremediation for Environmental Sustainability Approaches to Tackle Pollution for Cleaner and Greener Society. 1st Edition, 2020.
4. Gaurav S, Vineet K, Maulin PS. Bioremediation for Environmental Sustainability. 2020.
5. Kumar P. Environmental Pollution: Biodegradation and Bioremediation. Studium Press, 2017.
6. Ram NB. Environmental Pollutants and their Bioremediation Approaches. 1st Edition, 2017.
7. Deep CS, Ravindra S. Bioremediation of Environmental Pollutants. Springer, 2022.

**Course Code BMIC 2204**

**Course Title: Microbial Genetics**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**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 characteristics and mechanisms of microbial genetics.

**CLO3:** Learn about bacterial genetics, genetic exchange and regulation of gene expression.

**CLO4:** Analyze the archaeal genetics and viral phase genetics.

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

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Content** | **Lec. No.** | **CLOs** |
| **1.** | **Genomic Organization of Microbes:** Concept of microbial genetics. Genomic organization in prokaryotes. Multigene and pseudogenes family. | 4 | CLO1 |
| **2.** | **Recombination in Living Cells:** Transformation of bacterial cells and selection of recombinants. Phage DNA induction and selection of recombinant phage. Transformation of non-bacterial cells. | 5 | CLO1  CLO2 |
| **3.** | **Bacterial Genetics Exchange:** Genetic exchange mechanism in bacteria. Mutant phenotypes in bacteria, Genetic techniques to detect mutations. Transformation, transduction and d gene mapping, Conjugation and gene mapping, Transduction and gene mapping, the evolutionary significance of sexuality in bacteria | 3 | CLO1  CLO3 |
| **4.** | **Regulation of Bacterial Gene Expression:** Constitutive, inducible and repressive gene expression; positive and negative control; lactose and histidine operon in E. coli, induction and catabolite repression; tryptophan operon in E. coli repression and attenuation, arabinose operon in E. coli; transcriptional, translational and post-translational regulatory mechanisms | 4 | CLO2 CLO3 |
| **5.** | **Archaeal Genetics:** Chromosomes and DNA replication in the archaea. Features of aacteria, archaea and eukaryotes. | 3 | CLO2  CLO4 |
| **6.** | **Genetics of Viruses:** Viral genomes, types of virus genomes Cloning of fragments of viral genomes. Genetic manipulation of viral genomes. Virulence and attenuation. Generation of recombinant viruses. | 4 | CLO2  CLO4 |
| **7.** | **Applications of Microbial Genetics:** Concept and uses of microbial genetics in medicine, agriculture, industry and animal husbandry. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Robert J B. Genetics: Analysis and Principles.7th Edition. 2021.

2. Drost H, Sanchez D. Becoming a selfish clan. Genome Biology and Evolution. 2019.

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

4. Prichard RK. Antimicrobial Drug Resistance. Mc Gill University, 2017.

5. Flint J. Principles of Virology. 4th edi. Asm Press Exclusive (Us), 2015.

**Course Code: BMIC 2205**

**Course Title: General Mycology and Phycology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**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 media preparation for fungi and algae.

**CLO3:** Analysis of fungi under microscope.

**CLO4:** Collection, culture and characteristics of different algae.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 2 |
| **CLO4** | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 2 |

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

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| --- | --- | --- | --- |
| SI No. | **Course Contents** | **Lec. No.** | **CLOs** |
| 1.  2.  3.  4.  5. | Preparation of media for fungi culture.  Collection and identification of different fungi.  Fuagal DNA isolation, purification and amplification.  Study of *Mucor, Saccharomyces, Penicillium* and *Agaricus.* Collection, culture and characteristics of different algae. | 26 | CLO1 CLO2 CLO3  CLO4 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Lu N. Fungi Their Nature and Uses. Koros Press, 2017.
2. Schneiter R. Genetics, Molecular and Cell Biology of Yeast. 2004

**Course Code: BMIC 2206**

**Course Title: Fermentation Technology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the demonstration techniques of fermenter and fermentation.

**CLO2:** Analyze the process of inoculums preparation for fermentation.

**CLO3:** Evaluate the capability of microbial production.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Demonstration of a typical fermenter.  Demonstration of fermentation techniques.  Inoculums preparation.  Production of cell mass.  Production of industrial alcohol. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Mclaughlin L. Fermentation Microbiology and Biotechnology. Kaufman Press, 2022.
2. Kuila A, Sharma V. Principles and Applications of Fermentation Technology. 1st Edition. 2018.

**Course Code: BMIC 2207**

**Course Title: Environmental Microbiology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Acquire knowledge of pollutants, and identification of waterborne pathogens.

**CLO2:** Explain the metal-microbes interactions, sewage treatment, and metals detection.

**CLO3:** Evaluate the techniques of batch culture and pesticide degradation.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Pollutants isolation, and identification.  Sewage treatment for safe environment.  Heavy metals and chemical pesticide degradation. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Buckley R.G. Environmental Microbiology. Cbs, 2019.
2. Brownstein. Environmental Microbiology Methods and Protocols. Springer, 2007.

**Course Code: BMIC 2208**

**Course Title: Microbial Genetics Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Acquire knowledge of genetic materials from microbes by Isolation and modification.

**CLO2:** Adopt practical knowledge on the preservation of microbial glycerol stock.

**CLO3:** Evaluate the techniques the microbial growth.

**CLO4:** Analyze the bacterial degradation of batch culture.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Isolation and modification of genetic materials from microbes  Preparing glycerol stock  Colony counting, bacterial cell density.  Bacterial degradation of various carcinogens by growing cell | 26 | CLO1  CLO2  CLO3 CLO4 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Tortora GJ and Funke BR. Microbiology: An Introduction, 9th Edition. 2022.
2. Heinz and Stoph. Microbial Ecology – Organisms, habitants and activities. 2021.

**Course Code: BMIC 2209**

**Course Title: Biostatistics**

**Course Type: GEd**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**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):**

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

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

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

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 3 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 4 | CLO1 |
| **2.** | **Probability and Distributions:** Basic concept of probability. The binomial, poisson and normal distribution. Study of normal, χ2and t-distribution. | 3 | CLO1  CLO2 |
| **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. | 4 | CLO1  CLO2 |
| **4.** | **Analysis of Variance:** Properties, assumptions and significance of F-test. One-way and two-way analysis and F-test. Least significant difference and critical difference. | 4 | CLO1  CLO2 |
| **5.** | **Experimental Design:** Complete randomized design. Randomized complete block design, Latin square design and Split-plot design. | 4 | CLO1  CLO3 |
| **6.** | **Survival Analysis:** Basic designs follow-up, cross-sectional and case-control studies. Survival and hazard function. Product limit estimate of survival function. | 4 | CLO1  CLO4 |
| **7.** | **Computer Applications in Biostatistics:** Data presentation and analysis by using computer software. Application of online platforms for quantitative data. | 3 | CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation and semester final |

**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 2210**

**Course Title: Social Economics**

**Course Type: GEd**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

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

**Rational of the Course:**

This course contains the economic concepts and theories that are fundamental to decision making. Prospective microbiologists need to be quick and proper in decision making while they will have to lead in different areas of microbiological science.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Understand the concept of sociology and its interaction with microbiology.

**CLO2:** Gain knowledge of economics and interpret demand functions and supply.

**CLO3:** Formulate alternative pricing strategies to increase GDP.

**CLO4:** Understand the role of saving, economics and marketing in national development.

**CLO5:** Apply the microbial products in social and political institutions and daily life.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 3 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 3 |
| **CLO4** | 3 | 1 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Sociology:** Concept of sociology. Link between sociology and microbiology. Sociology and evolutionary microbiology. | 3 | CLO1 |
| **2.** | **Economics:** Wants, scarcity, competing ends, and choice - defining economics, basic economic problems, microeconomics and macroeconomics, normative economics and positive economics; production possibilities model; Limits, Alternatives, and Choices; the market systems, and the circular flow model. | 4 | CLO1  CLO2 |
| **3.** | **Price Determination, Demand and Supply:** Production economics. Optimal quantity determination. Production and cost functions. Elasticity of demand and supply. | 4 | CLO1  CLO2 |
| **4.** | **Macroeconomic Activity:** Macroeconomic issues and ideas; objectives, policy targets, instruments, goals, and the role of government; the economic problem, government, and the economy. GDP growth rates. Contribution of microbial products in GDP. Measuring unemployment, Economic and social impact of unemployment; causes of inflation, consequences of inflation; the relationship between inflation and unemployment; policy implications of inflation, deflation. | 4 | CLO3  CLO5 |
| **5.** | **Indicators of Macroeconomic Performance:** Some basics of fiscal and monetary policies; definition, objectives, and instruments. Saving, investment and financial markets. Standard of living. Productivity, growth rate, investment and saving rates. | 4 | CLO1  CLO4 |
| **6.** | **Marketing:** Market structure and price-output decisions under various competition. Similarities between economic markets and microbial markets. Market equilibrium. | 4 | CLO1  CLO4 |
| **7.** | **Microbiology in Economics:** Relationship of economics and microbiology. Assumptions and implications. Productions possibility. Social and political institutions in leadership. Microbial industry and production. | 3 | CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation and semester final |

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

1. Kenneth N. Matziorinis, Business Economics: Theory and Practice, 4th Edition. 2022.
2. Samuelson P. Economics. William Nordhaus, 19th edition, 2009.
3. Gregory N. Principles of economics. Cengage Learning, 2020.

**Course Code: BMIC 2211**

**Course Title: Biostatistics Practical**

**Course Type: GEd**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the techniques of random sampling, T-test and F-test.

**CLO2:** Analyze correlation and regression and layout and perform CRD, RCBD.

**CLO3:** Explores the statistical test and computation on biological data.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Techniques of random sampling.  T-test and F-test.  Correlation and regression analysis and their interpretations.  Layout and perform CRD, RCBD, Latin square design.  Data base and computation. | 26 | CLO1CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others.
2. Montgomery DC. Designs and Analysis of Experiments. 6th Edition, Wiley, NY. 2005.

**Course Code: BMIC 2212**

**Course Title: Social Economics Practical**

**Course Type: GEd**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply practical knowledge ondocuments and microbial industries.

**CLO2:** Learn the techniques of survey of microbial production and processing.

**CLO3:** Achieve practical knowledge on marketing process of microbial products.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 3 | 3 | 1 | 3 | 1 | 2 | 3 | 3 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Observe and socio-economic zones and status of people.  Survey of microbial industry, products processing and value.  Marketing process of microbial products. | 26 | CLO1  CLO2 CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Benhabib J, Bisin A, Jackson MO. Handbook of Social Economics. 1, 1-1340, 2011.
2. Tortora GJ, Funke BR, Case CL. Microbiology: an introduction. 3rd Edition. 2010.

**Course Code: BMIC 2213**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Full Marks: 25**

**Rational of the Course:**

The rationale of this course is to enrich the students’ practical knowledge on manufacturing microbial products, procedure, management and marketing aspects.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO2** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- |
| **SI NO.** | **Course Contents** | **CLOs** |
| **1.** | Different aspects of applied microbiology/ microbiology general industry/ institute/ farm visit/ clinic/ medical/ microbial ecosystems observation and management. | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection, hands on training and team works | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Course Code: BMIC 2214**

**Course Title: Viva voce**

**Course Type: Major and GEd**

**Credits: 2**

**Year/ Semester: 2nd Year 2nd Semester**

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board. This course also gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Prepare and face a viva board, to present thyself and how to communicate with others.

**CLO2:** Acquire the ability to link ideas together to build their own way of expression.

**CLO3:** They also will learn brainstorming to solve a given problem.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO3** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |

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

|  |  |  |
| --- | --- | --- |
| **SI NO.** | **Course Contents** | **CLOs** |
| **1.** | Oral viva will be conducted by a panel of examiners at the end of theory courses. Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire semester. The examiners will aim to assess whether the student has acquired the essence of their yearlong learnings through the expression of their understanding. The questionnaire usually will be linked with one another to investigate whether the student have achieved the level of understanding to solve a given problem from the information they have gathered during their course of study | **CLO1**  **CLO2**  **CLO3** |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Problem-based learning and team works | Viva voce |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Department of Microbiology**

**3rd Year: 1st Semester**

**Course Code: BMIC 3101**

**Course Title: Introductory Virology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**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 thesatellite viruses and prions with their economic important.

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

**CLO3:** Gain knowledgeof helical, icosahedral, capsid, enveloped and non-enveloped viruses.

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

**CLO5:** Identify viral diseases for designing vaccines and antiviral drugs**.**

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 3 | CLO1  CLO2 |
| **2.** | **Viral Taxonomy:** Classification and nomenclature of different groups of viruses. ICTV and Baltimore classification. | 4 | CLO1  CLO2 |

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| **3.** | **Structure of Viruses:** Structures of helical, icosahedral, prolate, capsid symmetry, enveloped and non-enveloped and complex viruses. | 4 | CLO3 |
| **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. | 4 | CLO1  CLO2  CLO4 |
| **5.** | **Virus Transmission:** Modes of virus transmission, infection, entry, and barriers. Infection and transmission of SARS- CoV-2. | 4 | CLO3  CLO4 |
| **6.** | **Viral Diseases:** Study of plant virology, animal virology and human or medical virology. Detecting viruses. | 4 | CLO3 CLO5 |
| **7.** | **Prevention and Control:** Vaccines. Antiviral drugs. Tamiflu-resistant pandemic influenza H1N1 virus selected by prophylaxis. | 3 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. 26th Edition. 2013.
3. Thomas DB, Michael TM, John MM. Biology of microorganism. Prentice Hall. 1994.
4. Jeffrey W. The Fundamentals of Human Virology. Fort Collins. 2005.
5. Nicholas HA. Fundamentals of Molecular Virology, 2nd Edition. 2011.

**Course Code: BMIC 3102**

**Course Title: Molecular Cell Biology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**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):**

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

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

**CLO2:** Show the cell cycle control and cell-cell adhesion system.

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

**CLO4:** Explain protein degradation and posttranslational processing of proteins.

**CLO5:** Apply stem cell transplantation and recombination of DNA into living cells.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 1 |
| **CLO3** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Cellular Processes:** Over view of cellular processes and function, growth and metabolism, and cell motility. | 4 | CLO1 |
| **2.** | **Cell Cycle:** Phases of eukaryotic cell cycle: G1, S, G2 and M phase cell cycle control system. | 3 | CLO2 |
| **3.** | **Cell-cell Adhesion:** Extracellular matrix, intercellular recognition and cell adhesion, cell junctions. | 4 | CLO1  CLO2 |
| **4.** | **Cell Signaling:** Principles of signaling, Types of Cell Signaling, Forms of Signaling, Functions and Types of Hormones, Hormone Signaling Pathways and Steps, Receptors for cell signaling. Signal transduction. Target cell adaptation. Role of extracellular vesicles. | 4 | CLO1  CLO3 |
| **5.** | **Apoptosis:** Activation mechanisms and negative regulators of apoptosis. Methods for distinguishing apoptotic. Programmed cell death. Excessive and insufficient apoptosis. | 4 | CLO1  CLO2  CLO3 |
| **6.** | **Protein Turn Over:** Proteasome, chaperon; protein degradation and ubiquitination. Posttranslational processing of proteins. | 4 | CLO2  CLO4 |
| **7.** | **Intracellular Trafficking:** Concepts and causes of intracellular trafficking. Intracellular trafficking and secretion of very low-density lipoprotein. | 3 | CLO1 CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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.

2. Bruce A,Bray D, Lewis J, Raff M, Watson J.D. Molecular Biology of Cell. New York: 2002.

3. Jeremy MB, John LT, Lubert S. Biochemistry. 5th edition, New York: W H Freeman; 2002.

4. Darnell J, Loddis H, Baltimore D. Molecular cell biology. WH Freeman, 1986.

5. Felfly H, Haddad GG. Hematopoietic stem cells. J. Stem Cells. 2014.

**Course Code: BMIC 3103**

**Course Title: Industrial Microbiology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Adoptstrain development and processing of industrial fermentation for bio products.

**CLO2:** Apply the techniques ofDNA ligase, metabolites and recombinant DNAproduction.

**CLO3:** Produce antibiotics, 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 economy, and marketing globally.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 1 | 3 | 2 | 2 | 3 | 1 |
| **CLO3** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 3 | 3 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Industrial Microbes:** Primary and secondary screening, strain development, preservation and maintenance. | 3 | CLO1 |
| **2.** | **Fermented Products:** Crude and synthetic media. Production of molasses, corn-steep liquor, sulphite waste liquor and yeast extract. | 4 | CLO1 |
| **3.** | **Molecule Products:** Production of *Taq* polymerase, restriction enzymes, and DNA ligase. Primary and secondary metabolites. Recombinant products. | 4 | CLO1  CLO2 |
| **4.** | **Health Care Products:** Industrial production of antibiotics, vitamins, essential amino acids, enzymes and steroids. Insulin production. Metabolites identification. | 4 | CLO1  CLO2  CLO3 |
| **5.** | **Food and Beverage:** Dairy foods. Food additives and supplements.Production of beverages. Manufacture of baker’s yeast and single cell protein. Edible fungi and algae production. | 4 | CLO1  CLO3 |
| **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. | 4 | CLO1 CLO4 |
| **7.** | **Global Economy:** Contribution of industrial microbiology to economic growth and employment creation. | 3 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

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

## Ian FR. Culture of Animal Cells. 7th Edt., Wiley, 2016.

## Gordon N. Industrial Microbiology and Recombinant DNA Technology. Cbs, 2022.

## Vanmeter K.C. Microbiology for the Healthcare Professional. 3rd edi. Elsevier, 2021.

## Tille P.M. Bailey and Scotts Diagnostic Microbiology. 15th edi. Elsevier, 2022.

**Course Code: BMIC 3104**

**Course Title: Fundamentals of Immunology**

**Course Type: Core**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

**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**: Learn about major histocompatibility complex and its implication in immune system

**CLO5:** Gain knowledge on basic concept of antigens and antibodies.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 3 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 1 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 3 | 1 | 3 |

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

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| **SI No.** | **Course Content** | **Lec. No.** | **CLOs** |
| **1** | **Introduction to Immunology:** Definition of immunology, immunity, immune systems. Historical development of immunology. | 3 | **1** |
| **2** | **Innate and Adaptive Immunity:** Components of the innate and adaptive immunity. Types of adaptive immune response, active and passive immunity. | 4 | **1**&**2** |
| **3** | **Cells of the Immune Systems:** Basic of lymphoid progenitor- B-lymphocytes and T-lymphocytes. Natural killer cells. Dendritic cells. Myeloid progenitor. | 4 | **2**&**3** |
| **4** | **Organs of the Immune Systems:** Classification, hematopoiesis and maturation stages of lymphoid organs. Tonsils and adenoids. Thymus. Spleen. Bone marrow. |  | **2**&3 |
| **5** | **Histocompatibility Complex:** Discovery of MHC molecules, general features of MHC genes and binding of peptides to MHC molecules. | 4 | **4** |
| **6** | **Antigens and Antibodies:** Definition determinants and binding of antigen. Definition, classification and functions of antibody. Antibody diversification and receptors. | 4 | **1**& **4** |
| **7** | **Immunity to Infections:** immunity to extracellular and intracellular bacteria; bacterial survival strategies; immunity to viral infection; innate and specific immune response to viruses; strategies for evading immune defences by viruses; immunity to parasitic infection |  | **5** |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

**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.
8. Text Book of Immunology: an Introduction to Immunochemistry and Immunobiology- J.T. Barrett, Mosby, New York

**Course Code: BMIC 3105**

**Course Title: Introductory Virology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the techniques of isolation and characterizations of viruses.

**CLO2:** Analyze the ELISA test and serological methods for virus detection.

**CLO3:** Evaluate the techniques of TMV virus isolation and pathogenicity test.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Collection and identification of viral disease samples.  Cultivation, enumeration and isolation of bacteriophages.  ELISA test for virus identification.  Detection of HBsAg by serological methods.  Isolation of TMV virus and infecting plants. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Knipe H. Fields Virology - Emerging Viruses. 7th edition, 2020.
2. Flint J. Principles of Virology. 4th edi. Asm Press Exclusive (Us), 2015.

**Course Code: BMIC 3106**

**Course Title: Molecular Cell Biology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply the techniques of protein synthesis.

**CLO2:** Analyze the apoptosis cells identification and counting.

**CLO3:** Evaluate the techniques of gene transfer, stem cells isolation and cell-cell interaction.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Protein synthesis and motility.  Isolation, identification and counting of apoptosis cells.  Gene transfer in living cells.  Stem cells isolation. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Course Code: BMIC 3107**

**Course Title: Industrial Microbiology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply techniques of single cell protein, yeast and bread production.

**CLO2:** Explore the knowledge to isolate milk coagulating bacteria in lab.

**CLO3:** Evaluate the process of cheese production.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Production of single cell protein from microbial sources.  Isolation of yeast and production of bread.  Isolation of milk coagulating bacteria from milk and yogurt. Production of cheese from milk. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Gordon N. Industrial Microbiology and Recombinant DNA Technology. Cbs, 2022.
2. Hurst C.J. Manual of Environmental Microbiology. 3rd edi. Sp Asm Press, 2007.

**Course Code: BMIC 3108**

**Course Title: Fundamentals of Immunology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Analyze the techniques of bacterial whole cell and outer membrane protein preparation.

**CLO2:** Evaluate the serum and plasma collection and blood leucocytes separation.

**CLO3:** Apply the test for cell viability and determination of human blood groups.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | 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. | 3 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. David M, Brian C, Anne C, Michael O. Advanced Immunology. W. & Wilkins, 1991.

**Course Code: BMIC 3109**

**Course Title: Cell and Tissue Engineering**

**Course Type: GEd**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**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 for plant and animals development. The course will be helpful to research on transgenic plants and animals with their applications.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Conceptualize general knowledge of cells culture and tissue engineering.

**CLO2:** Acquire knowledge on cell and tissue culture media and culture techniques.

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

**CLO4:** Understand the vectors preparation, gene cloning, transfer and expression.

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Plant Cell and Tissue Culture:** Concept of plant cell and tissue engineering. Importance and scope of cell and tissue engineering. Media preparation. Cell and tissue culture techniques. Cellular differentiation. Problems and remedies. | 3 | CLO1 |
| **2.** | **Plant Improvement Techniques:** Embryo rescue and culture. In vitro selection of mutants–tolerance for disease, and herbicide. Meristem culture and virus elimination. | 4 | CLO1  CLO2 |
| **3.** | **Transgenesis in Plants:** Gene transformation and transfer methods in plants. Advantage and disadvantages of gene transfer. CRISPR-Cas9 gene transfer. | 4 | CLO2  CLO3 |
| **4.** | **Animal Cell and Tissue Culture:** Types of cells.Concept of animal cell and tissue culture and engineering. Advantages of animal cell culture. | 4 | CLO3  CLO4 |
| **5.** | **Media Preparation and Culture Techniques:** Animal cell and tissue culture media preparation. Techniques of animal cell and tissue culture. Techniques of animal cell and tissue culture. | 4 | CLO1  CLO2 |
| **6.** | **Applications:** Tissue engineering and regenerative medicine. Tissue engineering and regenerative medicine in current medical practices. Stem cell therapy and gene therapy. | 3 | CLO2  CLO4 |
| **7.** | **Transgenic Animal Development:** Development of transgenic animal, microinjection technique, embryo transfer and in vitro fertilization. Transgenic animal production. | 4 | CLO1  CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment. | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

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

**Course Code: BMIC 3110**

**Course Title: Metabolism and Bioenergetics**

**Course Type: GEd**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**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, homeostasis and diseases.

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Define metabolism, properties and differences between anabolism and catabolism.

**CLO2:** Describe metabolic pathways and cellular respiration.

**CLO3:** Describe the pathway of glucose catabolism, amino acid, lipid and nucleotide biosynthesis.

**CLO4:** Describe bioenergetics, major bioenergetic processes, thermodynamics and energy conservation.

**CLO5:** Learn the concept, types of reactions and salient feature of oxidative phosphorylation, electron transport and chemiosmotic hypothesis.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 3 | 2 | 2 | 3 | 3 | 1 | 1 | 1 |
| **CLO3** | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 1 |
| **CLO4** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO5** | 2 | 2 | 1 | 3 | 1 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Definition of metabolism, Importance, differences and relationship between anabolic and catabolic metabolism. Carbohydrate, protein, and lipid metabolic pathways. | 3 | CLO1 |
| **2.** | **Amino acid and Nucleotide Metabolism:** Glucogenic and ketogenic amino acids. Oxidative degradation of amino acids. Regulation of amino acid and folic acid metabolism. Functions of nucleotides, Synthesis of purine and pyrimidine, Regulation, degradation and biosynthesis of nucleotide co-enzymes. | 4 | CLO1  CLO2  CLO3 |
| **3.** | **Biosynthetic Pathways and Alternative Metabolic Pathways:** Amino acid, lipid and nucleotide biosynthesis. Alternative pathways of glucose catabolism. Pathway for utilization of sugars other than glucose, Methylotrophic metabolism, Syntrophic metabolism. | 4 | CLO2  CLO3 |
| **4.** | **Phototrophic Metabolism and Cellular Respiration:** Phototrophy, Metabolism of phototrophic bacteria, Photosynthesis, Cellular respiration, Aerobic metabolism in bacteria, archaea and eucarya, Anaerobic respiration. | 4 | CLO2  CLO3  CLO4 |
| **5.** | **Bioenergetics and Metabolism:** Concept and overview, Types of reactions, Examples of major bioenergetic processes, Cycling of carbondioxide, oxygen and nitrogen in the biosphere. Energy relationship in catabolic and anabolic pathways, Energy production and balance. | 4 | CLO1  CLO4 |
| **6.** | **Bioenergetics and Thermodynamics:** Principles of bioenergetics, Laws of thermodynamics in bioenergetics, Free energy, entropy and heat content in bioenergetics, ATP in muscle contraction, Energy conservation and conversion in mitochondria, ATP-ADP cycle. | 3 | CLO1  CLO4 |
| **7.** | **Biological Oxidation-Reduction and Oxidative Phosphorylation:** Flow of electron and biological work, oxidation-reduction reaction, Salient features of oxidative phosphorylation, Generation of proton gradient, Electron transport chain and chemiosmotic hypothesis, respiratory control. | 4 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Thomas M.D. Text Book of Biochemistry.7th Edi. 2010.
2. Nelson DL, Cox, Michael ML. Principles of Biochemistry. Freeman and Company, 2014
3. Pratt DV, Judith GV, Charlotte W. Fundamentals of biochemistry. 4th ed. Wiley. 2013.
4. Green KD, Garneau-Tsodikova S. Posttranslational Modification of Proteins. Elsevier. 2010.
5. Xu Z, Zhou G. Research advance in nitrogen metabolism of plant. 2004.

**Course Code: BMIC 3111**

**Course Title: Cell and Tissue Engineering Practical**

**Course Type: GEd**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Learn the different media preparation for plant cell and tissue culture.

**CLO2:** Apply meristem for virus free plant regeneration, protoplast and single cell culture.

**CLO3:** Gain the techniques of animal cell culture media preparation and cell culture.

**CLO4:** Apply the techniques of embryo transfer and in vitro fertilization.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO4** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | Preparation of different media for tissue culture.  Development of virus free plants through meristem.  Protoplast and single cell culture.  Cell culture media preparation and culture techniques.  Embryo transfer and in vitro fertilization techniques.  Microscopic observation of cells. | 26 | CLO1  CLO2  CLO3  CLO4 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. Raju SR, Suma MS and Chandrashekara KN. Animal Biotechnology. India. 2017.
3. Parmar N and Dufresne J. Beneficial Interactions of Plant Growth Promoting Rhizosphere Microorganisms. Canada. 2016.

**Course Code: BMIC 3112**

**Course Title: Metabolism and Bioenergetics Practical**

**Course Type: GEd**

**Credits: 1**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop techniques of DNA analysis.

**CLO2:** Perform characteristics of different stem cells and microbial strains.

**CLO3:** Prepare skills of common fungal diseases.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 1 | 2 | 1 | 2 | 3 | 1 |
| **CLO2** | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | 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. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, continuous internal evaluation, viva voce, CIE and SEE. |

**Learning Resources:**

1. Ferrick DA, Beeson C. Advances in measuring cellular bioenergetics using extracellular flux. Drug Discovery. 2008.
2. Petersen, Joan and McLaughlin, S. Laboratory Exercises in Microbiology: Discovering the Unseen World @rough Hands-On Investigation. CUNY Academic Works. 2016.

**Course Code: BMIC 3113**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 3rd Year 1st Semester**

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

This course is designed to observe the process of microbial production in industry, fermentation technology, molecular aspects of microbes in different fields and their eco-friendly uses.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 2 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **CLOs** |
| **1.** | Different aspects of applied microbiology/ microbiology general industry/ institute/ farm visit/ nodule producing crops fields/ fruits, pulses, sugarcane, rice, wheat etc. fields visit to observe diseases causing pathogens and their management systems. | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection, hands on training and team works. | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Department of Microbiology**

**3rd Year: 2nd Semester**

**Course Code: BMIC 3201**

**Course Title: Advanced Virology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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, treatment strategy and vaccine approaches.

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

**CLO5:** Explain the use of antiviral compounds, interferon and vaccination and treatment.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Virus in Human Physiology Systems:** Viral Infections to the common cold, influenza, measles, mumps, rubella, chicken pox, shingles and viral diarrhoea. | 4 | CLO1 |
| **2.** | **Arthropod-Borne Diseases:** Diseases causing Japanese encephalitis virus and yellow fever virus. | 3 | CLO1 |
| **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. | 4 | CLO1  CLO2 |
| **4.** | **Non-oncogenic Retroviruses-HIV:** Structure, genome organization, transmission, epidemiology, disease, pathogenicity, diagnosis and control, treatment strategy and vaccine approaches. | 4 | CLO1  CLO2  CLO3 |
| **5.** | **Oncogenic Viruses:** General features and classification; retro-viridae genome structure; replication of HTLV; DNA tumor viruses. Mechanism of oncogenic transformation. | 5 | CLO1  CLO2  CLO4 |
| **6.** | **Human Papilloma and Influenza Viruses:** General properties and replication; antigenic shift and drift; pathogenesis epidemiology and vaccine approaches. | 4 | CLO2  CLO3  CLO4 |
| **7.** | **Prevention and Treatment:** Antiviral compounds, interferon and viral vaccines. Gene therapy and phage display. | 3 | CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, CIE and SEE. |

**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. Jeffrey W. The Fundamentals of Human Virology. Fort Collins. 2005.
4. Nicholas HA. Fundamentals of Molecular Virology, 2nd Edition. 2011.
5. Flint J.Principles of Virology. 4th edi. Asm Press Exclusive (Us), 2015.

**Course Code: BMIC 3202**

**Course Title: Advanced Molecular Biology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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.

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 2 |
| **CLO4** | 3 | 1 | 3 | 3 | 3 | 3 | 1 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **RNA Extraction and Expression Analysis:** Current trends, and applications of advanced molecular biology. Preparation and purification of total RNA. cDNA synthesis,RT-PCR and qRT-PCR analysis and its applications. Microarray and RNA seq analysis. | 3 | CLO1 |
| **2.** | **DNA Manipulative Enzymes:** Restriction endonucleases and other nucleases; ligases; polymerases; DNA-modifying enzymes, topoisomerases and ligation systems. Use of linkers and adaptors. | 4 | CLO1  CLO2 |
| **3.** | **DNA Recombination and Gene Manipulation:** General recombination and interactions of complementary strands of DNA molecules. Gene cloning strategies, gene transfer and genetic manipulation.Transferring recombinant plasmid and electroporation. | 4 | CLO1  CLO3 |
| **4.** | **Mutation:** Mutation definition, types and rate. Mutagenic agents. Molecular basis of mutagenesis. Mutation induced by chemical and physical agents. Effects of mutations. | 4 | CLO1  CLO3 |
| **5.** | **Repair:** DNA repair mechanisms, nature of DNA damage, and reversal of UV damage in prokaryotes. Mismatch repair; post replication, SOS, and error prone. Ultimate match of DNA-RNA. | 3 | CLO2  CLO4 |
| **6.** | **Transposable Genetic Elements:** Definitions, types and General features of transposons. Model for transposition, transposons in eukaryotes. Transposable elements, composite transposons, tn3 elements, retroviruses and retrotransposons. | 4 | CLO1  CLO2  CLO4 |
| **7.** | **Sequencing of DNA:** Sanger-Coulson, Maxam-Gilbert methods. Study of First, second and third generation sequencing. Advantages and limitations of sequencing. | 4 | CLO3 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Alberts B, Raff M, Walter P. Molecular Biology of the Cell. 6th Edition. 2019.
2. Brown TA. Gene cloning and DNA analysis. Blackwell Sci. 7th Edition. 2016
3. Darnell J, Lodish H, Baltimore. Molecular Cell Biology. Freeman and Com. 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 3203**

**Course Title: Marine Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

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

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

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 1 |
| **CLO4** | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 3 | 3 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Aquaculture and marine microbiology applications. Microbes into the wild, marine pollution and biological control. | 3 | CLO1 |
| **2.** | **Aquaculture Microbiology:** Fish and aquaculture microbiome. Importance of microbial communities and sustainable aquaculture. | 3 | CLO1  CLO2 |
| **3.** | **Marine Resources:** Marine phytoplanctons, algae and plants. Marine invertebrates, vertebrates and reptile. Importance marine resources. | 4 | CLO1  CLO2 |
| **4.** | **Marine Microbes:** Marine viruses, bacteria, archaea, protists, fungi. Marine micro-animals. Marine micro-plankton. Marine sediments and microfossils. Marine micro-benthos. | 4 | CLO2  CLO3 |
| **5.** | **Marine Diversity:** Marine microbenthos. Marine microbiomes. Marine food web. Niche communities. Microbial diversity. | 4 | CLO1  CLO3 |
| **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. | 4 | CLO2  CLO4 |
| **7.** | **Marine Microbiology and Human Society:** Beneficial and detrimental effects. Marine pollutants. Microbiology of fish and seafood products. Micro-plastics effects. | 4 | CLO2  CLO3  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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 3204**

**Course Title: Advanced Immunology**

**Course Type: Core**

**Credits: 2**

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

**Academic Session: 2023-2024**

**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:** Learn the disorders (hypersensitivity and autoimmune diseases) caused by excessive immune response.

**CLO3:** Have a grasp on knowledge on immunity to infections have a hand on training on methods of immunological techniques for laboratory and research methodology.

**CLO4:** Learn the principles of governing vaccination and to understand the immunological methods used in research and diagnosis purposes.

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

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

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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 and Autoimmune Diseases:** Hypersensitivity type I, II, III and IV reactions. effector mechanisms of immunologic tissue injury and diseases, immediate hypersensitivity, sequence and biochemical events of immediate hypersensitivity reactions. Basic concept of autoimmunity, mechanism of autoimmunity, genetic and non-genetic factors of autoimmunity, autoimmune diseases. | Lecture &Assignment | Tutorial & Semester final | 4 | **2** |
| **4** | **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** |
| **5** | **Vaccines:** Objectives and strategies for the development of vaccines, characteristics of successful vaccines, types of vaccines, compositions of various types vaccines, RNA and DNA vaccines, adjuvants. | Lecture & Open discussion | Tutorial & Semester final |  | **5** |
| **6** | **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 | Tutorial & Semester final |  | **5** |
| **7** | **Immunological Techniques:** precipitation reactions; immunodiffusion; immuno-electrophoresis; agglutination; co-agglutination; haemagglutination; direct and indirect immunofluorescence; Enzyme-linked immunosorbent assay (ELISA) | Lecture, Quiz & Assignment | Class test & Semester final |  | **3** |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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 3205**

**Course Title: Advanced Virology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply techniques to detect virus by ELISA and PCR assay.

**CLO2:** Explore the knowledge to diagnosis of virus infection in lab.

**CLO3:** Evaluate the process of viral infection and tumor formation.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 1 | 2 | 2 | 3 | 2 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Virus detection by ELISA.  PCR amplification of HBV Major and surface genes. Laboratory diagnosis of virus infection.  Prevention and treatment of viral infection.  Viral infection and tumors formation | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. Flint J. Principles of Virology. 4th edi. Asm Press Exclusive (Us), 2015.

**Course Code: BMIC 3206**

**Course Title: Advanced Molecular Biology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Acquire knowledge of primers designing.

**CLO2:** Explain the techniques of mutation study, restriction digestions and ligations.

**CLO3:**  Analysis of transformation andelectrophoresisas well as sequencing.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 3 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Study of primers designing.  Mutation analysis.  Study of restriction digestions and ligations.  Transformation and electrophoresis.  Study of sequencing system. | 26 | CLO1  CLO2 CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others
2. Glick BR. Molecular biotechnology. 4th edition. 2010.

**Course Code: BMIC 3207**

**Course Title: Marine Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply techniques of marine microbes and fish parasites identification.

**CLO2:** Explain the anatomy and internal organs of marine animals.

**CLO3:** Evaluate the process of marine algae identification.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Identification of marine microbes and fish parasites.  Internal anatomy of different aquatic animals.  Study of different internal organ of fishes.  Identification of marine macro and micro algae. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Dhanasekaran D. Fungicides for Plant and Animal Diseases. Intech, 2014.
2. Buller NB. Bacteria and Fungi from Fish and Other Aquatic Animals. 2nd edi. 2015.

**Course Code: BMIC 3208**

**Course Title: Advanced Immunology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Apply techniques of antigen and antibody identification.

**CLO2:** Explain the process of SDS-PAGE for protein purification.

**CLO3:** Evaluate the knowledge of complement fixation and HLA tests.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO2** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Detection of antigen and antibody.  SDS-PAGE and immunoblotting of microbial proteins. Study of the complement fixation tests.  HLA typing. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Text Books, Reference Book, Online Resources and Others.
2. Ivan MR, Peter JR. Essential Immunology. 13th edition Delves .Wiley-Blackwel, 2016.

**Course Code: BMIC 3209**

**Course Title: Epidemiology and Public Health**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 Major 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 information on infection chain and Major epidemiologic functions.

**CLO2:** Learn about disease outbreak and surveillance system to control disease outbreak.

**CLO3:** Explain the design of epidemiology and measures of potential impact.

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

**CLO5:** Know the physical and mental health information for improving health surveillance.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO 8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 1 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Definition and difference of endemic, epidemic and pandemic. Causes, types and importance. | 4 | CLO1 |
| **2.** | **Disease Outbreak and Control:** Disease outbreak. Notable outbreaks. Infection chain and disease occurrence. Prevention and management strategies. | 4 | CLO1  CLO2 |
| **3.** | **Study Design:** Intervention or experimental studies. Randomized, non-randomized, controlled clinical, field and community trials. | 4 | CLO1 CLO3 |
| **4.** | **Statistical Methods in Epidemiology**: basic incidence measures; risk and rate; prevalence measures; measures of association; risk ratio or relative risk; exposure odds ratio; risk odds ratio; measures of potential impact; attributable risk | 3 | CLO1 CLO3 |
| **5.** | **Health Development, Care and Service:** Health and family planning. Role of health in development, and millennium development goal.Health professionals care. Home and community care. Health services. Health information technology. | 3 | CLO1  CLO4 |
| **6.** | **Public Health Surveillance:** Purpose and characteristics of public health surveillance. Identifying health problems and evaluation. Improving health surveillance. | 4 | CLO2  CLO5 |
| **7.** | **Mental Health:** Concept, history and importance. Mental health problems symptoms, diagnosis and solutions. | 4 | CLO1 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation and semester final |

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

1. Aschengrau A, Seage GR. Essentials of Epidemiology in Public Health. 4th Edi. 2021.
2. Goldsteen L, Goldsteen K, Dwelle T. Introduction to Public Health. 2nd Edi. 2021.
3. Spellman F.R. Fundamentals of Wastewater Based Epidemiology Biomonitoring of Bacteria Protozoa Covid 19 and other Viruses. Taylor & Francis, 2021.
4. Schneider M. Introduction to Public Health. 4th Edition. 2014.
5. Fleming ML and Parker E. Introduction to Public Health. 3rd Edition. 2015.
6. Georgia A. Principles of Epidemiology in Public Health Practice. 3rd Edition. 2012.

**Course Code: BMIC 3210**

**Course Title: Research Methodology**

**Course Type: GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 about literature review, methodology and types of design.

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

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 1 |
| **CLO3** | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Concepts and Approaches:** Concept, objectives, characteristics, types, importance and limitation of research. | 4 | CLO1 |
| **2.** | **Literature Review:** Learning objectives and uses of literature review. Organization of information on index cards and exercises. | 4 | CLO1  CLO2 |
| **3.** | **Research Design:** Research methodology. Attributes of research. Features of good design and development of research plan. Types of program design. | 4 | CLO1  CLO2 CLO3 |
| **4.** | **Data Collection, Processing and Analysis:** Data collection and selection. Data analysis and interpretation. Problems, graphical representation and tabulation. | 4 | CLO1  CLO4 |
| **5.** | **Guidelines for Communication:** General principles and methods in people’s participation. 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. | 3 | CLO2  CLO4 |
| **6.** | **Research Ethics:** Fund collection and managing public research funds. Data collection, handling and management. Rules for collaborative research. | 3 | CLO1  CLO5 |
| **7.** | **Publication Ethics:** Authorship. Plagiarism. Rules of quotation and bibliography. Ethical issues on scientific papers writing. | 4 | CLO2  CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE |

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

1. Niglas K. The Multidimensional Model of Research Methodology. 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.2012.

**Course Code: BMIC 3211**

**Course Title: Epidemiology and Public Health Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Explain the epidemiologic diseases effects on health surveillance systems and control.

**CLO2:** Acquire knowledge on immune system, immunity power boosting

**CLO3:** Study immunity related diseases

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | 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 | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Aschengrau A, Seage GR. Essentials of Epidemiology in Public Health. 4th Edi. 2021
2. Georgia A. Principles of Epidemiology in Public Health Practice. 3rd Edition. 2012

**Course Code: BMIC 3212**

**Course Title: Research Methodology Practical**

**Course Type: GEd**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop questionnaires and interview individuals.

**CLO2:** Perform data processing and data analysis.

**CLO3:** Prepare research manuscripts for publication.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 3 | 2 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Research planning, questionnaire and schedule designing.  Data processing and analysis.  Manuscript preparation and submission. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Getu D, Tegbar Y. Research Methodology. University of Gondar. 2006.
2. Gottesman MM. Guidelines and Policies for the Conduct of Research. 7th Edn. 2021.

**Course Code: BMIC 3213**

**Course Title: Field Report/ Excursion/ Industrial Internship**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Full Marks: 25**

**Rational of the Course:**

This course is designed to observe the process of microbial production in industry, fermentation technology, molecular aspects of microbes in different fields and their eco-friendly uses.

**Course Learning Outcomes (CLOs):**

At 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.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |
| --- | --- | --- |
| **SI No.** | **Course Contents** | **CLOs** |
| 1. | Different aspects of applied microbiology/ microbiology general industry/ institute/ farm visit/ nodule producing crops fields/ fruits, pulses, sugarcane, rice, wheat etc. fields visit to observe diseases causing pathogens and their management systems. | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching, laboratory work, microbial sample collection, hands on training and team works. | Quiz test, report writing, viva voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Course Code: BMIC 3214**

**Course Title: Viva voce**

**Course Type: Major and GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board. This course also gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies

**Course Learning Outcomes (CLOs):**

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

**CLO1:** To learn the way of how to prepare and face a viva board, how to present thyself and how to communicate with others.

**CLO2:** The students will acquire the ability to link ideas together to build their own way of expression.

**CLO3:** They also will learn brainstorming to solve a given problem.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | | **PLO 3** | | **PLO 4** | **PLO 5** | | **PLO 6** | | **PLO 7** | | **PLO8** | |
| **CLO1** | 2 | 2 | 2 | | 1 | | | 1 | | 2 | | 1 | | 3 |
| **CLO2** | 3 | 2 | 2 | | 2 | | | 3 | | 2 | | 3 | | 3 |
| **CLO3** | 3 | 3 | 2 | | 3 | | | 3 | | 3 | | 2 | | 3 |

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

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| --- | --- | --- |
| **SI No.** | **Course Contents** | **CLOs** |
| **1.** | Oral viva will be conducted by a panel of examiners at the end of theory courses. Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire semester. The examiners will aim to assess whether the student has acquired the essence of their yearlong learnings through the expression of their understanding. The questionnaire usually will be linked with one another to investigate whether the student have achieved the level of understanding to solve a given problem from the information they have gathered during their course of study. | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Problem-based learning and team works | Viva voce |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Department of Microbiology**

**4th Year: 1st Semester**

**Course Code: BMIC 4101**

**Course Title: Medical Microbiology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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 human pathogens and host-pathogen interactions.

**CLO2:** Acquire knowledge of disease transport, culturing, and diagnostic tests**.**

**CLO3:** Learn about clinical manifestation, pathogenesis and antimicrobial therapy.

**CLO4:** Explain the human microbiome project, microbes and diseases.

**CLO5:** Gain knowledge of regenerative medicine, IPS cells and methods of gene therapy.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 1 | 2 | 3 | 1 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Human-microbes Interactions:** Normal microbial population of healthy human body-skin, mouth, upper respiratory, intestinal, urino-genital tract and eye. | 4 | CLO1 |
| **2.** | **Host-Pathogen Interaction:** Pathogenicity, toxigenicity, virulence, carriers and their types. Nosocomial and opportunistic infections, septicemia, septic shock, transmission and spread of infection. | 4 | CLO1 |
| **3.** | **Collection, Transport and Diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. | 4 | CLO1  CLO2 |
| **4.** | **Microbes and Diseases:** Clinical manifestation, pathogenesis, virulence factors, and control of diseases causing microbes. | 3 | CLO2  CLO3 |
| **5.** | **Antimicrobial Therapy:** General properties of antimicrobial agents. Selective toxicity, spectrum of activity, modes of action, side effects and resistance of microorganisms. | 4 | CLO1  CLO3 |
| **6.** | **Human Microbiome:** Human microbiome project. Microbes to human body. Disease and death, environmental health and migration. | 3 | CLO2  CLO4 |
| **7.** | **Regenerative Medicine:** Fundamentals of regenerative medicine. Present aspects of regenerative medicine. IPS cells. Cell therapy. Methods of gene therapy. | 4 | CLO1  CLO2 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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 4102**

**Course Title: Microbial Biotechnology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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):**

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

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

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

**CLO3:** Explain the microbial leaching, metal recovery and bioprocess engineering.

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

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Microbes and Biotechnology:** Development, and essential features of microbial biotechnology. Microbial biotechnology for food and life sciences. Microbes and biotechnology: a crucial scientific revolutions. | 3 | CLO1 |
| **2.** | **Biological Fuels Generation:** The ultimate energy source. Conversion of energy from biomass. Biofuel and other bio-electrochemical devices. | 4 | CLO1  CLO2 |
| **3.** | **Chemistry and Microbiology:** Current developments production of solvents, organic acid and amino acid from biomass. | 4 | CLO1  CLO3 |
| **4.** | **Materials and Microbiology:** Microbial leaching and microbes. Mechanisms of metal recovery. Biopolymers. | 3 | CLO1  CLO3 |
| **5.** | **Bioprocess Engineering:** Bioprocess engineering. Real time monitoring of cell and biomass concentration. Methods. | 4 | CLO1  CLO4 |
| **6.** | **Downstream Processing:** Downstream processing separation and disintegration of cells. Concentration and purification of product. | 4 | CLO3 CLO4 |
| **7.** | **Biotechnology and Biosafety:** Hazards mitigation. Biosafety-trans-production, biomarkers for GMOS. General agreements on tariffs and trade. Patenting and significance of patents. | 4 | CLO4  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. Marieb EN. Human Anatomy and physiology Benjamin. 9th Edition. 2012.
5. Smith E, Pateson CR, Scratecherd T, Read NW. Text Book of physiology. Hongkong. 2011.

**Course Code: BMIC 4103**

**Course Title: Food and Beverage Quality Control**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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:** Define quality, organization, and quality control of food and beverage.

**CLO2:** Apply the techniques for quality control of food and beverage for good practices.

**CLO3:** Evaluate the 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.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |
| **CLO2** | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 |

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

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| **SI No.** | **Course Contents** | **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. | 3 | CLO1 |
| **2.** | **Quality Control:** Different techniques of food quality control. Monitoring and good practices. Common food-borne microorganisms. Types of contaminants in food. Spoilage foods. | 4 | CLO1  CLO2 |
| **3.** | **Hygienic Food Handling:** Purchase and storage of food. Sanitary procedures while preparing, holding, serving and displaying food. | 4 | CLO2  CLO3 |
| **4.** | **Hazard and Quality Assurance:** Hazard analyses and critical control point system. Identification of potential hazards and monitoring systems. | 4 | CLO1  CLO3 |
| **5.** | **Health Concerns:** Public health aspects of microbial infection of food and beverage. Quality assurance research methodology. | 4 | CLO1  CLO4 |
| **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. | 4 | CLO1  CLO4 |
| **7.** | **Laws and Regulations:** National and international standards and guidance for foods and beverages. Future aspect of quality control. | 3 | CLO1  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation and semester final |

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

1. Herschdofrfer SM. Quality control in the food industry. Academic press, NY, 2012.
2. StanburyP. Whitaker A, HallS. Principle of fermentation technology. 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. UK. 1993.
6. Codex Alimentarius Commission. Principles for the Risk Analysis of Foods Derived from Modern Biotechnology. FAO/WHO, Rome, 2003.

**Course Code: BMIC 4104**

**Course Title: Antimicrobial Resistance**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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. 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):**

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

**CLO1:** Describe the concepts, history and importance of antimicrobial resistance.

**CLO2:** Apply general mechanisms of drug resistance and designing in laboratories.

**CLO3:**  Discovering new drug targets using bioinformatics knowledge.

**CLO4:** Describe the antibiotics' intrinsic actions, reactions and mechanisms against pathogens.

**CLO5:** Understand the antimicrobial drug discovery and impact of natural products.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 3 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** History of drug-resistant microbes. Evolutionary biology of drug resistance. Importance of drug resistance in medical. | 3 | CLO1 |
| **2.** | **General Mechanisms of Drug Resistance:** Genetic mechanisms of drug resistance. Target-mediated antibacterial resistance. Biochemical logic of antibiotic inactivation and modification. | 4 | CLO1  CLO2 |
| **3.** | **Bacterial Drug Resistance Mechanisms:** Mechanisms of action and resistance. Resistance in bacteria. Mechanisms of action and resistance of the antimycobacterial agents. | 4 | CLO3  CLO4 |
| **4.** | **Fungal Drug Resistance Mechanisms:** Fungal drug resistance. Treatment and resistance mechanisms. Antifungal targets. Mechanisms of action and fungal resistance. | 4 | CLO1  CLO4 |
| **5.** | **Viral Drug Resistance Mechanisms:** Mechanisms of resistance of antiviral drugs active against the human diseases. Molecular mechanisms. Hepatitis B virus and antiviral drug resistance, patterns and mechanisms. | 4 | CLO1  CLO4 |
| **6.** | **Antibacterial Drug Discovery:** Screening strategies. Computational chemistry. Structure and fragment-based drug design. Problems and possibilities of antimicrobial resistance. | 3 | CLO1  CLO5 |
| **7.** | **Impact of Natural Products:** Natural products for drug discovery. Microbial natural products. The challenge of finding novel antibiotics. Antimicrobial activities and continuing source for inspiration. | 4 | CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Prichard, R. K. Antimicrobial Drug Resistance. Mc Gill University, 621-628. 2017.
2. Gualerzi C. O., Brandi L., Fabbretti A. Antibiotics. John Wiley & Sons. 2013.
3. Tortora, G. J., Funke, B. R., Case C. L. Microbiology. PB Cummings. p. 912. 2007.

**Course Code: BMIC 4105**

**Course Title: Enzymology**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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, 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 enzymes for uses as proteolytic, metal degradation and immobilization.

**CLO5:** Explores the applications of enzymes in medical and clinical sectors.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 2 | 3 | 2 | 1 | 2 | 2 |
| **CLO2** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO3** | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Basic Enzymes:** Concept of enzymology. Theoretical enzymology. Characteristics of enzymes and co-enzymes. | 6 | CLO1 |
| **2.** | **Action of Enzymes:** Enzyme substrate complex. Concept of active centre; binding sites; stereo-specificity and ES formation. Enzyme activities. | 6 | CLO1 |
| **3.** | **Enzymes Catalysis:** General acid-base catalysis; covalent catalysis; non-protein catalytic groups and metal ions. Mechanism of action of chymotrypsin and lysozyme. | 5 | CLO1  CLO2 |
| **4.** | **Enzyme Kinetics:** Factors influencing catalytic activity; simple enzyme kinetics with single and multi-substrate. Michaelis-Menten kinetics; turnover number; Km and Vmax. | 5 | CLO1  CLO2 |
| **5.** | **Enzymes Inhibition and Deactivation**: Reversible enzyme, competitive, uncompetitive, mixed and noncompetitive inhibition. Irreversible inhibition and suicide in-activators. | 5 | CLO2  CLO3 |
| **6.** | **Industrial Enzymes:** Uses of proteolytic and metal degrading enzymes. Enzymes as thrombolytic agents. Enzymes immobilization. | 3 | CLO1 CLO4 |
| **7.** | **Medical Enzymes:**  Importance of enzymes in medical device cleaning. Applications of enzymes in medicine and to treat disorders. | 3 | CLO4 CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Albert L, David LN, Michael MC. Lehninger Principles of Biochemistry. 5th Edition. 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. 2007.

5. Buchholz K. A breakthrough in enzyme technology to fight penicillin resistance—industrial application of penicillin amidase. App. Microbiol. Biotechnol. 2016.

6. Devasena T. Enzymology. 1st Edition, World Rights, 2010.

**Course Code: BMIC 4106**

**Course Title: Bioinformatics**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:**  Acquire knowledge of bioinformatics 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 data integration and molecular dynamics simulations.

**CLO5:** Analyze chemical research data, chemo-informatics tools and drug development.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Fundamental of Bioinformatics and Databases Searching :** Bioinformatics tools;Basic concepts of database. 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. Swissprot, Bioedit. | 5 | CLO1 |
| **2.** | **Sequence Alignment:** Multiple Sequence Alignments: Logic, MEGA, Chromas, Clustal W.Clustal Omega, Sequence profile. | 4 | CLO1  CLO2 |
| **3.** | **Experimental Design for Bioinformatics:** Bioinformatics pipeline to explore transcriptional regulation, differential expression analysis, transcriptomic analysis, compare and contrast microarray and RNA-seq methods. | 4 | CLO2  CLO3 |
| **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. | 5 | CLO2  CLO3 |
| **5.** | **Chemical Research:** Structure representation, SMILES; Chemical Databases, 2D and 3D structures, reaction databases and searching techniques. Chemo-informatics tools for drug discovery. | 4 | CLO1  CLO4 |
| **6.** | **Drug Design:** Drug design and its history. Concepts of molecular modeling. Molecular structure and internal energy. Application of molecular graphics. | 4 | CLO2  CLO4 |
| **7.** | **Other Applications of Bioinformatics:**  Literature analysis. High-throughput image analysis. Biodiversity informatics. | 4 | CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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, K-Larsen P, Liljefors T. Textbook of Drug Design and Discovery. 2002.
5. Reynolds CH, Ringe D. Drug Design. Cambridge Uni Press. 2010.
6. Fosgerau K, Hoffmann T. Peptide therapeutics. Drug Discovery Today. 2015.

**Course Code: BMIC 4107**

**Course Title: Medical Microbiology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop techniques of DNA analysis.

**CLO2:** Perform characteristics of different stem cells.

**CLO3:** Prepare skills of microbial strains and fungal diseases.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | 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 | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, voce, CIE and SEE. |

**Learning Resources:**

* + - 1. Vanmeter K.C. Microbiology for the Healthcare Professional. 3rd edi Elsevier, 2021.
      2. Tille P.M. Bailey and Scotts Diagnostic Microbiology. 15th edi. Elsevier, 2022.
      3. Randhawa VS. Essentials of Microbiology an Integrated Clinical Based Approach Including Parasitology. Cbs, 2022.

**Course Code: BMIC 4108**

**Course Title: Microbial Biotechnology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Prepare skills of common cell immobilization.

**CLO2:** Perform growth rate, and batch culture.

**CLO3:** Apply pesticide degradation.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO2** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Whole cell immobilization by Ca-alginate.  Determination of specific growth rate substrate.  State batch culture.  Pesticide degradation by bacterial dehalogenase. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, voce, CIE and SEE. |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

Anuradha D. Practical and Applied Microbiology. 5th edi. Cbs National, 2020.

**Course Code: BMIC 4109**

**Course Title: Food** **and Beverage Quality Control** **Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop techniques of fermented foods.

**CLO2:** Perform characteristics of food enzymes and essential components.

**CLO3:** Prepare skills of common food and food products preservation.

**CLO4:** Apply the biosafety rules of modern foods.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| **CLO2** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO3** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO4** | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | 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. | 26 | CLO1  CLO2  CLO3  CLO4 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Banwart G. J. Basic Food Microbiology. 2nd edi. Cbs, 2004.
2. Jay J. M. Modern Food Microbiology. 4th edi. Cbs, 2005.
3. Palumbo. Detection Methods for Algae, Protozoa & Helminths in Fresh & Drinking Water. John Wiley, 2002.
4. Spellman F.R. Fundamentals of Wastewater Based Epidemiology Biomonitoring of Bacteria Protozoa Covid 19 and Other Viruses. Taylor & Francis, 2021.

**Course Code: BMIC 4110**

**Course Title: Antimicrobial Resistance Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop techniques of characterization of drug-resistant microbes.

**CLO2:** Evaluate the antibiotics susceptibility screening.

**CLO3:** Apply antimicrobial test for novel antibiotics screening

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Isolation and characterization of drug-resistant microbes  Antibiotics susceptibility test  Antibacterial and antifungal test  Novel antibiotics screening from new natural sources. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Thomas S. Antimicrobial Resistance Global Challenges and Future Interventions. 2020.
2. Capelo-Martínez J-L, Igrejas G. Antibiotic Drug Resistance. John Wiley & Sons, 2020.

**Course Code: BMIC 4111**

**Course Title: Enzymology Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Prepare skills of enzymes isolation from different sources.

**CLO2:** Apply the techniques of isozymesisolation and identification.

**CLO3:** Observe the enzymes activity inhibitors.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Isolation and identification of enzymes from microbes  Isolation and identification of isozymes.  Isolation technique of bacterial crude enzymes.  Observation of enzyme activity in presence of inhibitor. | 26 | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Okotore RO. Essentials of Enzymology. 2015.
2. Bisswanger H. Practical Enzymology. 2019.

**Course Code: BMIC 4112**

**Course Title: Bioinformatics Practical**

**Course Type: Major**

**Credits: 1**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Develop techniques of internet using.

**CLO2:** Perform using basic M.S. and sequencing.

**CLO3:** Prepare skills of sequence alignment and molecular modeling of protein development.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | Internet using.  Basic M.S. Word, M.S. Excel, Power point, Photoshop. Maintenance of computer and statistical software.  Retrieving sequence using BLASTN, BLASTX, BLASTP  Multiple sequence alignment.  Molecular modeling of protein development. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Yongxian W, Zhenghua W. Sequence Analysis and Parallel Computing. 2023.
2. Ramsden J. Bioinformatics: An Introduction. 2023.

**Course Code: BMIC 4113**

**Course Title: Research Orientation Practical**

**Course Type: Major**

**Credits: 2**

**Year/ Semester: 4th Year 1st Semester**

**Academic Session: 2023-2024**

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

**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:** Perform teamwork.

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

**CLO3:** Carry out research work.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.** | Learn to use research tools and techniques.  Laboratory orientation for research purposes.  Hands on training on research. | 26 | CLO1 CLO2 CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Gottesman MM. Guidelines and Policies for the Conduct of Research. 7th Edn. 2021.

**Department of Microbiology**

**4th Year: 2nd Semester**

**Course Code: BMIC 4201**

**Course Title: Diagnostic Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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 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.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 1 |
| **CLO3** | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 3 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Sample Collection and Handling:** Approaches to clinical sample collection, maintenance and laboratory management. | 3 | CLO1 |
| **2.** | **Infectious Diseases Diagnosis:** Bacterial, fungal, rikettsial, parasites, spirochetal, viral and mycoplasmal diseases. | 3 | CLO2 |
| **3.** | **Methods of Diagnosis:** Collection of serum, antibody titre, agglutination, diffusion, and immunofluorescence. Complement fixation and florescent antibody test. Radioimmuno and enzyme immunosorbant assay. | 5 | CLO1  CLO2 |
| **4.** | **Accessory Detection System:** Biotin-avidin, amplified detection, chemiluminescence and immune-blotting. | 3 | CLO2  CLO3 |
| **5.** | **Microbial Identification:** Nucleic acid probes for isolation and identification of infectious agents. PCR detection of genes for toxins and virulence. | 4 | CLO1  CLO3 |
| **6.** | **Microbial Sensitivity:** Mechanisms of antimicrobial and antibiotic sensitivity test. | 4 | CLO2  CLO4 |
| **7.** | **Vaccine Approach and Immunization:** Common viral diseases and antigens important in cellular and humoral immunity. Immunization and vaccination against common viral diseases. | 4 | CLO1  CLO3  CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. David H  
P, Thomas FS, Fred CT, Thomas JW. Diagnostic Molecular Microbiology: Principles and Applications. Amer Society for Microbiology. 1993.

2. Mathews R. Handbook of Serodiagnosis in Infectious Diseases. B.-Heinemann. 1991.

3. Frances F, Marshall BD. A Manual of Laboratory and Diagnostic Tests. 8th Edition. Lippincott Williams & Wilkins. 2008.

5. Betty AF, Daniel FS, Alice SW. Diagnostic Microbiology. 12th Edition. Mosby Pub. 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. 4th Edition. Blackwell Pub. 2010.

**Course Code: BMIC 4202**

**Course Title: Analytical Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

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

**CLO1:** Analyze the spectroscopic techniques and centrifugations methodology in laboratory.

**CLO2:** Learn the application of chromatography, flow-cytrometry and electrophoresis.

**CLO3:** Measure and apply the 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.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 3 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| **CLO4** | 3 | 1 | 2 | 1 | 3 | 3 | 2 | 2 |
| **CLO5** | 1 | 2 | 1 | 3 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.** | **Spectroscopic Techniques:** Visible and ultraviolet light; fluorescence; atomic spectroscopy; spectrofluorimetry, lumiometry, infrared spectroscopy. Nuclear magnetic resonance. Mass spectrometry. | 3 | CLO1 |
| **2.** | **Centrifugations:** Principle of sedimentation. Types of centrifuges and their use. Rotortypes; preparative and analytical centrifuges. | 3 | CLO1 |
| **3.** | **Chromatographic Techniques:** Principle of chromatography. Adsorption; high performance and ultra-performance liquid chromatography. Flow-cytrometry. | 4 | CLO2 |
| **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. |  | CLO1  CLO2 |
| **5.** | **Radioisotope Techniques:** Nature, detection, measurement and applications of radioisotopes. Safety aspects of radioisotopes and autoradiography. | 4 | CLO2  CLO3 |
| **6.** | **Biosensor:** Application of enzyme, cell and organelle-based biosensors. Affinity binding assay, biological reactant pairs, application of immunosensor and receptor-based biosensor. | 4 | CLO2  CLO3  CLO4 |
| **7.** | **Laboratory Quality Control:** Microbiological specification and regulations. Local and international approaches to obtaining safe food. Management and quality assurance in the laboratory. | 4 | CLO2  CLO5 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. 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 4203**

**Course Title: Pharmaceutical Microbiology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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):**

At 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 antibiotics, vitamins and amino acids to assurance the products quality.

**CLO4:** Apply the knowledge of drugs metabolism, absorptions and distribution.

**CLO5:** Understand the results for assurance of pharmaceuticals products quality.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 1 |
| **CLO3** | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 |
| **CLO4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **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. | 4 | CLO1 |
| **2.** | **Microbial Spoilage:** Preservation of pharmaceutical products. Microbial spoilage of pharmaceutical products. | 3 | CLO1  CLO2 |
| **3.** | **Sterilizations:** Principles and methods of pharmaceutical products sterilization. Advantages and disadvantages of sterilization. Sterilization control and sterility testing. | 4 | CLO1  CLO2 |
| **4.** | **Drugs Test:** Principle, methodologies and present status of microbial assays. Agar plate diffusion assays. LAL test. Turbidimetric assay. | 3 | CLO2  CLO3 |
| **5.** | **Metabolism of Drugs:** Drug discovery from microbes. General pathways of drug metabolism. Factors affecting drug metabolism. | 4 | CLO1  CLO4 |
| **6.** | **Absorptions 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. | 4 | CLO2  CLO4 |
| **7.** | **Quality Test:** Microbial limit test. USP examination of non-sterile products. Antimicrobial effectiveness test. | 4 | CLO2  CLO5 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Bertram GK, Anthony J.T. Examinations and Board Review: Pharmacology. 12th Edi. 2019.

2. Goodman G. The Pharmacological Basis of Therapeutics.13th Edi. 2018.

3. Gisvolds W. Textbook of organic, Medicinal and Pharmaceutical Chemistry.12th Edi. 2011.

4. Saghee M, Sandle T, Tidswell E. Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices. Business Horizons. 2011.

5. Sandle T. The CDC Handbook: A Guide to Cleaning and Disinfecting Cleanrooms. 2012.

6. SandleT, Saghee MR. Cleanroom Management in Pharmaceuticals and Healthcare. UK. 2013.

7. Willing SH, Stoker JR. Good Manufacturing practices for Pharmaceuticals. Dekker Inc. 2022.

**Course Code: BMIC 4204**

**Course Title: Nanobiotechnology**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 nano scale range. Conversion of any material in nano scale results in alteration of its physicochemical, biological, mechanical, optical, electronic, etc. properties. These newly acquired properties of the materials due to conversion into a nano scale 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):**

At 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 NPs in biosensors, drug delivery and diagnostics in medical sciences.

**CLO5:** Understand the values of nano products in local and global market.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CLO3** | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Introduction:** Definition,history and applications of nanobiotechnology. Interdisciplinary relationship of nanobiotechnology. Green nanobioteechnology. | 3 | CLO1 |
| **2.** | **Nanomaterial and Nanoparticles:** Modern biomaterials. Nanocapsules, fullerenes nanotube sand gold nanoparticles. Green synthesis of nanoparticles (NPs). | 4 | CLO1 |
| **3.** | **Microbes in Nanobiotechnology:** Microbial cells factories. Microbes in food nanobiotechnology and microbial food safety. | 3 | CLO1  CLO2 |
| **4.** | **Quantum Dots and BioMEMS:** Concept of Quantum dots and BioMEMS**.** Quantum dots and cellular imagine. Recent developments in BioMEMS. | 4 | CLO1  CLO3 |
| **5.** | **Biosensoring:** Definition and different types of biosensors. Techniques and functions of different biosensors. Uses of biosensors with reference to monitor blood glucose. | 4 | CLO1  CLO2  CLO4 |
| **6.** | **Nanomedical Engineering and Drug Delivery:** Manufacturing of nanomedicine. Nano drugs design and delivery techniques. Lyposomes as nanocarriers. | 4 | CLO2  CLO4 |
| **7.** | **Future Prospects:** Future prospects of nanobiotechnology. Challenges for nanobiotechnology. Potential hazards of nanoparticles. Nanobiotechnoligical products and global market. | 4 | CLO1  CLO3  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

1. Boisseau P, Houdy P, Lahmani M. Nanoscience, 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.HYPERLINK http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Christof+M.+NiemeyerWiley-VCH, 2004.
5. Rathi R. Nanotechnology. S. Chand Publishing, 1st Edition, 2009.
6. Zuccheri G. DNA Nanotechnology: Methods and Protocols. Humana, 2nd Edition. 2018.

**Course Code: BMIC 4205**

**Course Title: Genomics and Proteomics**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 principles and structure with emphasis on genomics organization.

**CLO2:** Analyzethestudy ofgenomics in prokaryotes, eukaryotes-viruses, and organelle.

**CLO3:** Gain knowledge in molecular proteomics and modified genes**.**

**CLO4:** Apply protein engineering techniques, proteins analyzing and sequencing.

**CLO5:** Gain skills in quantitative proteomics and human genomics for diseases identification.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO5** | 3 | 2 | 3 | 3 | 1 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | CLOs |
| **1.** | **Genomics Concept:** Definition and development of genomics. Physical mapping of genomes, whole genome sequencing project. Applications of genome sequencing. | 3 | CLO1 |
| **2.** | **Organization and Structure:** Structure of viruses, prokaryotes, organelle and eukaryotic genome. Chromatin structure to chromosome organization. | 4 | CLO1 |
| **3.** | **Comparative Genomics:** Orthologoues, paralogoues and gene displacement. Bacterial genome assembly, annotation, genome submission to repository and MLSTs. | 4 | CLO1  CLO2 |
| **4.** | **Proteomics:** Concept, function and structure of commonly used peptide. Protein structures, identification and proteome analysis. Peptide mass fingerprinting. | 4 | CLO1  CLO3 |
| **5.** | **Molecular Proteomics:** Factors for protein folding. Constructing bacterial expression plasmids for natural and modified genes. Designing modifications to change the protein’s properties. | 4 | CLO1  CLO2 CLO3 |
| **6.** | **Protein Engineering:** Protein engineering and construction. Proteins analyzing and comparing protein sequence data. Functions of individual amino acids. Protein sorting in *P. falciparum*. | 4 | CLO1  CLO4 |
| **7.** | **Proteomics Applications:** Protein interactions and linkage maps. Quantitative proteomics applied to biomarker detection. Validation and human disease studies. | 3 | CLO2  CLO5 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

**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. Arndt KM, 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 4206**

**Course Title: Genetic Engineering**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**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 mapping and RFLP, AFLP, SSR, RAPD and SNP.

**CLO4:** Acquire knowledge of epigenetic inheritance patterns and applications.

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

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| **CLO3** | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 |
| **CLO5** | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec.**  **No.** | **CLOs** |
| **1.** | **Molecular Tools:** Recombinant DNA production. Amplification of recombinant DNA. Molecular analysis of DNA, RNA and protein. | 2 | **CLO1** |
| **2.** | **Cloning Vector:** Competent cells preparation, Plasmid cloning vector production, Features of a cloning vector-cloning site, selectable marker, reporter gene and elements for expression. Types of cloning vectors. Screening of blue white. | 4 | **CLO1**  **CLO2** |
| **3.** | **Analysis of Cloned Gene:** Recombinant DNA technology for human genes and human diseases. Human gene therapy. Transgenic animal and plant production. Inhibiting gene expression. | 4 | **CLO1**  **CLO2** |
| **4.** | **Gene Expression 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. Studying protein-protein interaction, phage display and yeast to hybrid system. | 4 | **CLO1**  **CLO2** |
| **5.** | **Gene Linkage and DNA Markers:** Gene linkage, chromosomes and gene mapping of human. Applications of RFLP, AFLP, SSR, RAPD and SNP. | 4 | **CLO1**  **CLO2**  **CLO3** |
| **6.** | **Epigenetic:** Definitions, molecular basis, mechanisms, functions and consequences. Epigenetic and health. | 4 | **CLO4** |
| **7.** | **Metagenomics:** Definition, types and importance. Tools and programs for genomic and metagenomics study. Basic linux commands, Anaconda, programs installation and maintenance, programs repository. Study of SARSCoV-2, Chikungunya, Dengue and Monkey pox. | 4 | **CLO1**  **CLO3**  **CLO5** |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-5** | Lecture, group discussion, open discussion and assignment | Assignment, tutorial, class test, quiz, presentation, CIE and SEE. |

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

* + - 1. Old RW, Primrose SB. Principle of Gene Manipulation. Univ. of California Press, 2012.
      2. Watson JD, Baker TA. Molecular Biology of the Gene SP. H. 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, Smith JA. Current Protocol in Molecular Biology. JW and Sons. 2019.

**Course Code: BMIC 4207**

**Course Title: Diagnostic Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Handling and processing of clinical samples.

**CLO2:** Conducting diagnostic tests.

**CLO3:** Predicting and validating the result.

**CLO4:** Post processing of sample.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Molecular diagnosis of microbial diseases.  Specimen collection and management methods.  Techniques of drugs quality control.  Handling and processing blood, pus, sputum, and urine.  Culture specimen’s management. | 26 | CLO1  CLO2  CLO3  CLO4 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

David H.P, Thomas FS, Teaver T.J.W. Diagnostic Molecular Microbiology.

Fischbach F. A Manual of Laboratory and Diagnostic Tests.

Ronald, JH, Petricia C.G. Diagnostic immunology Laboratory Manual.

**Course Code: BMIC 4208**

**Course Title: Analytical Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Operate spectrophotometer.

**CLO2:** Electrophoresis apparatus and centrifuge machine.

**CLO3:** Interpret different machines used in analysis of unknown samples.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.** | Familiarization of instruments used for biophysical methods.  Spectroscopic techniques for detection of turbidity.  Electrophoresis techniques for detecting nucleic acids.  Centrifugation technique for separation of particles. | 26 | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

Moo-Young M. Comprehensive Biotechnology, 12.

Wilson K, Goulding K.H. A Biologist’s Guide to Principles and techniques of practical Biochemistry, 3rd edition.

**Course Code: BMIC 4209**

**Course Title: Pharmaceuticals Microbiology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Determine the microbiological quality of solids, ointments, creams and oral liquids.

**CLO2:** Learn how to assay different pharmaceutical raw materials.

**CLO3:** Determine the potency of antibiotics and test the sterility of some products.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Drugs test.  Clinical trials of selected drugs.  Bioassay of potency of antibiotics.  Sterility and endotoxin test.  Pharmaceutical industry visit and products processing | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Hugo W.B, Russel A.D. Pharmaceutical microbiology.
2. Denyer SP, Barid RM. Guide to Microbiological control in Pharmaceuticals and Medical device. 2nd Ed.

**Course Code: BMIC 4210**

**Course Title: Nanobiotechnology Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Determine the biosensor activities.

**CLO2:** Learn how to synthesis NPs and characteristics.

**CLO3:** Determine the potency of green synthesis in agriculture and microbial control.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | Introduce in nano-substrate and tools.  Measurement of blood glucose using biosensor.  Different NPs synthesis and characterizations.  Study of NPs in agricultural.  Effects of green synthesis NPs on microbes. | 26 | CLO1  CLO2  CLO3 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Niemeyer M, Mirkin CA. Nanobiotechnology: Concepts, Applications and Perspectives.
2. Wiley-VCH, Zuccheri G. DNA Nanotechnology: Methods and Protocols. Humana, 2nd Edition. 2018.
3. Poinern GEJ. A Laboratory Course in Nanoscience and Nanotechnology. 2014.

**Course Code: BMIC 4211**

**Course Title: Genomics and Proteomics Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Determine the genomic browsers and databases.

**CLO2:** Learn how to search transcription factor binding sites and computational prediction.

**CLO3:** Determine the microarray and protein structural and functional domains.

**Mapping of Course Outcomes to Program Outcomes-**

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|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 1 |

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

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| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.** | 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. | 26 | CLO1  CLO2  CLO3 |

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| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

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.

**Course Code: BMIC 4212**

**Course Title: Genetic Engineering Practical**

**Course Type: Major**

**Credits: 1**

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

**Academic Session: 2023-2024**

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

**Contract Hours: Minimum 26**

**Total Marks: 25**

**Course Learning Outcomes (CLOs):**

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

**CLO1:** Determine the bacterial transformation efficiency.

**CLO2:** Learn how to DNA and RNA isolate and cDNA and RT- PCR prepare.

**CLO3:** Determine the DNA digestion and ligation in a vector.

**CLO4:** Identify restriction mapping and a ligated insert.

**Mapping of Course Outcomes to Program Outcomes-**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 |
| **CLO3** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 |
| **CLO4** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |

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

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Course Contents** | **Lec. No.** | **CLOs** |
| **1.**  **2.**  **3.**  **4.**  **5.**  **6.** | Bacterial transformation efficiency study.  Methods of DNA and RNA isolation.  Preparation of cDNA and RT- PCR.  DNA digestion by restriction enzymes.  Ligation of DNA to appropriate vector.  Restriction mapping and orientation of a ligated insert. | 26 | CLO1  CLO2  CLO3  CLO4 |

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| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-4** | Theoretical teaching and laboratory work. | Class attendances, practical report, viva voce, CIE and SEE. |

**Learning Resources:**

1. Primrose SB, Twyman RM. Principles of Gene Manipulation and Genomics. 7th Edition. Blackwell Publishing. 2006.
2. Sambrook J. Russell D.W. Molecular Cloning: a laboratory manual, NY. 2008.
3. Hubert R. Protein Biochemistry and Proteomics. Academic Press, USA, 2006.

**Course Code: BMIC 4213**

**Course Title: Research Project/ Industrial Internship**

**Course Type: Major**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

In professional life, microbiologists need to develop different project profiles. This course was designed to make the students compatible to develop a target-oriented research project.**Course Learning Outcomes (CLOs):**

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

**CLO1:** Formulate a research-project on a specific topic.

**CLO2:** Write-up a project paper, implement existing theoretical knowledge

**CLO3:** Learn how to present their work in scientific seminar and laboratory work in a team.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| **CLO3** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 |

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

|  |  |  |
| --- | --- | --- |
| **SI No.** | **Course Contents** | **CLOs** |
| **1.** | The students will undertake a project involving literature survey, an experimental investigation, and the final preparation of a thesis on a selected topic.Research projects planned by researcher and supervised by the assigned supervisor/s or the following tropics- Food microbiology, Microbial biotechnology, Industrial microbiology, Fermentation technology, Molecular biology and genetics, Environmental microbiology, Clinical microbiology, Immunology, Virology, Bacteriology, Phycology, Mycology, Plant pathology, Animal pathology, Pharmaceutical microbiology, Bioinformatics, Drug designing, Antimicrobial and antibiotics resistance etc. | CLO1  CLO2  CLO3 |

|  |  |  |
| --- | --- | --- |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | |
| **CLOs** | Teaching-Learning Strategy | Assessment Strategy |
| **1-3** | Workshop on research proposal writing, discussion and feedback. Supervision, discussion and feedback. Group presentation, question session and feedback. | Synopsis presentation, research proposal writing, and lab works. Thesis paper submission. Defense of the research. |

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

Relevant journals and books/book chapter of the renowned publisher such as-

Nature, Elsevier Publisher, Springer Publisher, Taylor and Francis Publisher, SAGE Publisher, ACS Publisher, Wiley, Cell Press, MDPI etc.

**Course Code: BMIC 4214**

**Course Title: Viva voce**

**Course Type: Major and GEd**

**Credits: 2**

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

**Academic Session: 2023-2024**

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

**Full Marks: 50**

**Rational of the Course:**

The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board. This course also gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies

**Course Learning Outcomes (CLOs):**

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

**CLO1:** To learn the way of how to prepare and face a viva board, how to present thyself and how to communicate with others.

**CLO2:** The students will acquire the ability to link ideas together to build their own way of expression.

**CLO3:** They also will learn brainstorming to solve a given problem.

**Mapping of Course Outcomes to Program Outcomes-**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO8** |
| **CLO1** | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| **CLO2** | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 |
| **CLO3** | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 1 |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SI No.** | **Course Contents** | | | **CLOs** |
| **1.** | Oral viva will be conducted by a panel of examiners at the end of theory courses. Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire semester. The examiners will aim to assess whether the student has acquired the essence of their yearlong learnings through the expression of their understanding. The questionnaire usually will be linked with one another to investigate whether the student have achieved the level of understanding to solve a given problem from the information they have gathered during their course of study. | | | CLO1  CLO2  CLO3 |
| **Mapping CLOs with Teaching –Learning and Assessment Strategy** | | | | |
| **CLOs** | | Teaching-Learning Strategy | Assessment Strategy | |
| **1-3** | | Problem-based learning and team works | Viva voce | |

**Learning Resources:**

Text Books, Reference Book, Online Resources and Others

**Academic Ordinance for Undergraduate Program**

**Faculty of Biological Sciences**

**University of Rajshahi**

**Bangladesh**

**1. The Faculty of Biological Sciences is consist of the following Departments**

|  |  |  |  |
| --- | --- | --- | --- |
| a) | Psychology | d) | Genetic Engineering and Biotechnology |
| b) | Botany | e) | Clinical Psychology |
| c) | Zoology | f) | Microbiology |

Besides the new department(s) that may be established by the University from time to time and as assigned to the Faculty by the Academic Council.

**2.** The Faculty or Biological Sciences is constituted according to the Statutes, Ordinances and Regulations of the University governing the constitution of the Faculties.

**3.** There shall be a course of study of Bachelor of Science with Honors hereinafter referred to as **B.Sc. (Honors)** Degree.

**4. Subject code**

4.1 Psychology (PSY)

4.2 Botany (BOT)

4.3 Zoology (ZOOL)

4.4 Genetic Engineering and Biotechnology (GEB)

4.5 Clinical Psychology (CPSY)

4.6 Microbiology (MIC)

5. **Course Designation:** The courses will bedesignated by the following criteria:

5.1 The first letter ‘**B**’ denotes for **Bachelor of Science**

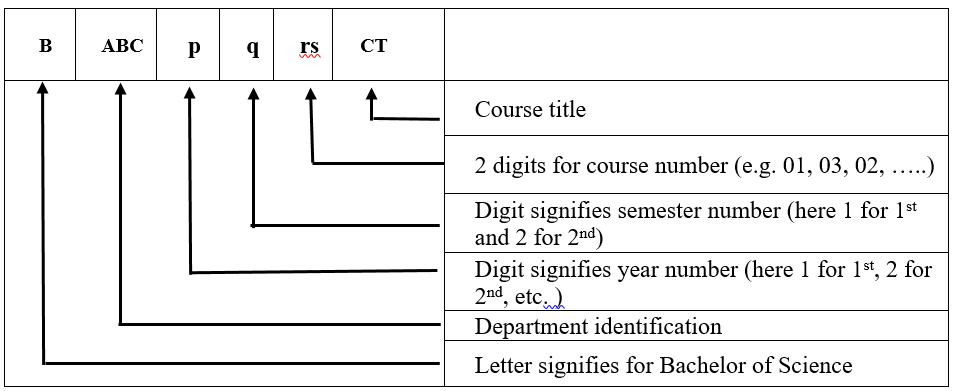
5.2 The following three/four letters signify the department identification.

5.3 Next digit signifies to the year number.

5.4 Next digit signifies to the semester number.

5.5 Next two digits signify to the course number

For example: Plant Taxonomy course of Botany Department is included in second year first semester. This will be designated by course code: **BBOT 2101**



**6. Academic years and semester:** There will be four academic years. Each academic year will be divided into two semesters. Academic years and semesters will be designated as the First Year: First & Second Semester; Second Year: First & Second Semester, and so on.

**7. Admission Requirements**

**7.1** 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 programme of study leading to the degree of B.Sc. Honors on recommendation of the academic committee of the department concerned.

**7.2** To be eligible for admission to B.Sc. Honors program, as per rules of Rajshahi University Admission Committee.

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

**8. 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.

**9. Academic Schedule**

**9.1** 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. The schedule may be prepared according to the following guidelines:

|  |  |
| --- | --- |
| **Each Semester (24 weeks)** | **Number of weeks** |
| Teaching | 14 |
| Preparatory Leave | 2 |
| Examination Period | 2 - 4 |
| Result Publication | 2 - 4 |
| **Total** | **24** |

**9.2** Distribution of Marks, Units and Credits:The marks shall be distributed as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Semesters** | **Marks** | **Units** | **Credits** |
| First | First | 375-550 | 3.75-5.5 | 15 - 22 |
| Second | 375-550 | 3.75-5.5 | 15 - 22 |
| Second | First | 375-550 | 3.75-5.5 | 15 - 22 |
| Second | 375-550 | 3.75-5.5 | 15 - 22 |
| Third | First | 375-550 | 3.75-5.5 | 15 - 22 |
| Second | 375-550 | 3.75-5.5 | 15 - 22 |
| Fourth | First | 375-550 | 3.75-5.5 | 15 - 22 |
| Second | 375-550 | 3.75-5.5 | 15 - 22 |
|  | **Total** | **4000** | **40.0** | **160** |

**9.3** Marks: The program of study for the B.Sc. Honors degree shall carry a total of 4000 marks (40 units and 160 credits), 25% of which are for the GEd Education (GEd) courses, and 30-40% for the practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ research project etc. The GEd courses shall have to be completed within the Fourth Year: First Semester of the programme.

**9.4** Class hours (Theory and Practical/Sessional): Theory Class: 1 Credit = 1 class/week (1 hour), and so on. Practical/Sessional Class: 1 class/course/week (2-4 hours), and so on.

**9.5** Marks distribution: The Semester-wise distribution of marks among the theory, practical, viva-voce, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ research project, etc. shall be as follows:

**(i)** B.Sc. Honors First Year: First Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150-250 | 1.5-2.5 | 6-10 |
| Theory (GEd) | 100-150 | 1.0-1.5 | 4-6 |
| Practical (Major) | 50-150 | 0.5-1.50 | 2-6 |
| Practical (GEd) | 25-100 | 0.25-1.0 | 1-4 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| English (Non-credit) | 50 | - | - |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**(ii)** B.Sc. Honors First Year: Second Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 100-200 | 1.0-2.0 | 4-8 |
| Theory (GEd) | 50-150 | 0.50-1.5 | 2-6 |
| Practical (Major) | 50-150 | 0.5-1.50 | 2-6 |
| Practical (GEd) | 25-100 | 0.25-1.0 | 1-4 |
| Viva-voce | 50 | 0.50 | 2 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**(iii)** B.Sc. Honors Second Year: First Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150-250 | 1.5-2.5 | 6-10 |
| Theory (GEd) | 50-150 | 0.50-1.5 | 2-6 |
| Practical (Major) | 50-150 | 0.5-1.50 | 2-6 |
| Practical (GEd) | 25-100 | 0.25-1.0 | 1-4 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**(iv)** B.Sc. Honors Second Year: Second Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150-250 | 1.5-2.5 | 6-10 |
| Theory (GEd) | 50-150 | 0.50-1.5 | 2-6 |
| Practical (Major) | 50-75 | 0.50-0.75 | 2-3 |
| Practical (GEd) | 25-100 | 0.25-1.0 | 1-4 |
| Viva-voce | 50 | 0.5 | 2 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**v)** B.Sc. Honors Third Year: First Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200-300 | 2.0-3.0 | 8-12 |
| Theory (GEd) | 50-100 | 0.5-1.0 | 2-4 |
| Practical (Major) | 50-150 | 0.50-1.5 | 2-6 |
| Practical (GEd) | 25-100 | 0.25-1.0 | 1-4 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**(vi)** B.Sc. Honors Third Year: Second Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150-250 | 1.5-2.5 | 6-10 |
| Theory (GEd) | 0-100 | 0-1.0 | 0-4 |
| Practical (Major) | 50-150 | 0.50-1.5 | 2-6 |
| Practical (GEd) | 0-50 | 0-0.5 | 0-2 |
| Viva-voce | 50 | 0.5 | 2 |
| Field work/Excursion, etc. | 25 | 0.25 | 1 |
| Total (credit courses) | **375-550** | **3.75-5.50** | **15-22** |

**(vii)** B.Sc. Honors Fourth Year: First Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 200-400 | 2.0-4.0 | 8-16 |
| Theory (GEd) | 0-100 | 0-1.0 | 0-4 |
| Practical (Major) | 100-200 | 1.0-2.0 | 4-8 |
| Practical (GEd) | 0-50 | 0-0.5 | 0-2 |
| **Total (credit courses)** | **375-550** | **3.75-5.50** | **15-22** |

**(viii)** B.Sc. Honors Fourth Year: Second Semester Examination

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Course** | **Marks** | **Units** | **Credits** |
| Theory (Major) | 150-400 | 1.5-4.0 | 6-16 |
| Practical (Major) | 100-200 | 1.0-2.0 | 4-8 |
| Viva-voce | 50 | 0.50 | 2 |
| Research Project/Internship | 50 | 0.50 | 2 |
| **Total (credit courses)** | **375-550** | **3.75-5.50** | **15-22** |

**9.6** Marks on class attendance/participation: Marks on class attendance will be 10% of the total marks of theory and practical courses. The marks will be distributed as follows:

**Table for awarding marks for attendance**

|  |  |
| --- | --- |
| **Attendance** | **% of total marks** |
| 90% and above | 10 |
| 85% to below 90% | 9 |
| 80% to below 85% | 8 |
| 75% to below 80% | 7 |
| 70% to below 75% | 6 |
| 65% to below 70% | 5 |
| 60% to below 65% | 4 |
| Less than 60% | 0 |

**10. Examination Committee**

**10.1** There shall be separate examination committee for each academic year (for both semesters) proposed by the Departmental Academic Committee. The examination committee will consist of the five members: i. Chairman of the committee and three members among the teachers of the department concerned, ii. One external member from outside of the department or university.

**10.2** There will be one to three additional committee members for the GEd courses from the relevant department (if applicable).

**10.3** Viva-Voce:At the end of second semester of each academic year, viva-voce examination will be conducted by Examination Committee in presence of the external member from outside of the Department/University. The viva-voce will be 1-2 credit(s) in each academic year.

**11. Examinations**

**11.1** The B.Sc. Honors examination shall be held semester-wise and shall consist of the First Year: First Semester to Fourth Year: Second Semester**.** A student, for obtaining the degree, shall have to pass all the examinations within 6 (six) academic years from the date of his/her first admission, and shall not be allowed to stay more than 2 (two) consecutive terms in the same semester/year. 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.

**11.2** Class Test/ Class Assessment/Mid Term/Quiz: The individual course teacher will take 20% marks of each theory course as Class Test / Class Assessment /Mid Term/Quiz. The course teachers will evaluate it. Average of all class assessment of theory courses with scripts shall have to be submitted by the course teacher(s) concerned in sealed envelope to the Chairman of the relevant Examination Committee before the commencement of the final examination. A course teacher failing to submit the assessment marks before the commencement of the final examination, shall not be allowed to act as an examiner of the course examination. In such case the decision shall be taken by the relevant Examination Committee with the approval of the Departmental Academic Committee.

**11.3** Duration of Examination: The duration of examinations of the theory courses shall be 3 hours for 2 credit, and 4 hours for 3/4 credit courses. The duration of practical examination shall be 6-12 hours and 12-24 hours (6 hours per day) per 2 credit and 3/4 credit practical courses respectively.

**11.4** Submission of Marks: Consolidated average marks of the theory courses, class assessment, viva-voce, laboratory assessment, practical courses etc. shall have to be converted to the letter grade by the relevant examination committee and submitted to the Controller of Examinations before finalizing the result.

**12. Eligibility for Examination**

**12.1** Percentage of Attendance: A student with 75% class attendance will be allowed to participate in the semester final examination as regular. But a student with 60% to less than 75% class attendance will be declared non-collegiate and allowed to sit for the semester final examination with a fine of Tk.1000/-. A student with less than 60% class attendance will be considered as dis-collegiate, and will not be allowed to sit for the semester final examination.

**12.2** Re-admission: A student who failed to appear at the examination or fails to pass the examination, may on the approval of the relevant Department be readmitted to same semester/year in the next academic year/session.

**13. Appearing to the Examinations**

For appearing to B.Sc. Honors examination a candidate shall have to submit his/her application in the prescribed form together with certificates of attendance and fulfill all other conditions prescribed by the University. The application shall be submitted through the Chairman of the Department and Provost of the Hall concerned so as to reach the Controller of Examinations at least 2 (two) weeks before the date fixed for the commencement of the examination.

**14. Question Setter and Script Examiners**

**14.1** For the B.Sc (Honors) examination there will be two Question Setters (First and Second setters) in each of the theory course, two script examiners (First and Second Examiners) in each theory course.

**14.2** Field Reports/Excursion Reports/Internship Report/Research Project Reports, and the likes will be examined by the two examiners (Preferably other than the examination committee) selected by the examination committee. Total 2-8 credits will be allocated in the entire undergraduate program.

**14.3** In case, the marks awarded by the two examiners differ by 20% or more, the examination committee will recommend a third examiner, and the arithmetic mean of the two nearest marks will be counted. In case both the extreme marks differ from the middle marks by exactly by same margin, the arithmetic mean of the two higher marks (advantage to the students) will be taken. If the number of scripts to be third examined is 50% or more of the total number of scripts of a course, all scripts of that course will have to be re-examined by the third examiner.

**14.4** Practical/ Sessional examination: Examiners for practical/sessional examination will be internal with an external from outside the department or university from the enlisted panel. 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. One copy of the marks of the laboratory assessment examination will be sent to the Chairman of the concerned Examination Committee before the practical/sessional examination.

**14.5 Non-credit Courses:** Non-credit courses like English and/or others will be considered as Attended/Not-Attended.

**15. Medium and Nature of Questions and Answers**

Question shall be made in English and /or a translated version in Bangla. The medium of answers in the examination of all courses shall be either English or Bangla. However, a mixing of English and Bangla shall never be allowed in an answer-script.

**16. The Grading Systems**

Out of 4 scale, the grading systemshall be awarded in accordance with provisions shown below:

|  |  |  |
| --- | --- | --- |
| **Marks obtained** | **Letter Grade (LG)** | **Grade Point (GP)** |
| 80% or its above | A+ (A plus) | 4.00 |
| 75% to less than 80% | A (A regular) | 3.75 |
| 70% to less than 75% | A-(A minus) | 3.50 |
| 65% to less than 70% | B+ (B plus) | 3.25 |
| 60% to less than 65% | B (B regular) | 3.00 |
| 55% to less than 60% | B- (B minus) | 2.75 |
| 50% to less than 55% | C+ (C plus) | 2.50 |
| 45% to less than 50% | C (C regular) | 2.25 |
| 40% to less than 45% | D (regular) | 2.00 |
| Less than 40% | F (fail) | 0.00 |

**17. Award of Degree**

In order to obtain the Bachelor (Honors) Degree, a student must fulfill the following conditions:

(i) Bachelor (Honors) Degree program must be completed within a minimum period of 4 and maximum of 6 academic years from the date of admission. No student will be allowed to stay for more than two consecutive terms in the same semester/year.

(ii) The minimum CGPA for awarding Bachelor (Honors) Degree is 2.50 out of 4.0.

(iii) The minimum Credit Point required for awarding Bachelor (Honors) Degree is 152 (Total credits 160) after exemption of maximum 8 credits.

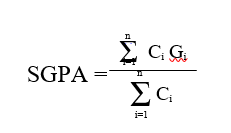
(iv) The minimum passing letter grade will be 'D' (GP 2.00) in each course.

**18. Annual/Semester Promotion**

In order to be promoted to next semester/year, a student will fulfill, the following requirements:

a. The minimum Semester Grade Point Average (SGPA) will be 2.00, 2.25, 2.50 and 2.50 for First Year: First & Second Semester; Second Year: First & Second Semester, and so on, respectively.

|  |  |
| --- | --- |
| **Year and Semester** | **Minimum SGPA** |
| First Year First Semester | 2.00 |
| First Year Second Semester | 2.00 |
| Second Year First Semester | 2.25 |
| Second Year Second Semester | 2.25 |
| Third Year First Semester | 2.50 |
| Third Year Second Semester | 2.50 |
| Fourth Year First Semester | 2.50 |
| Fourth Year Second Semester | 2.50 |

A **Semester wise Grade Point Average (SGPA**) shall be computed for each semester. The SGPA will be calculated as:

where. n is the number of courses offered during the semester, C, is the number of credits allotted to a i'th course, and G is the i'th grade point corresponding to the grade awarded for that course.

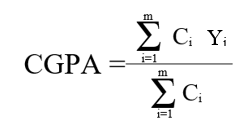
The minimum **Year Grade Point Average (YGPA)** will be 2.00, 2.25, 2.50 and 2.50 for First Year Second Year, and so on, respectively.

|  |  |
| --- | --- |
| **Year** | **Minimum YGPA** |
| First Year | 2.00 |
| Second Year | 2.25 |
| Third Year | 2.50 |
| Fourth Year | 2.50 |

The **Year Grade Point Average (YGPA)** shall be computed at the end of second semester of each year in the following way:

Where, TCP is Total Credit Point, and GPA Grade Point Average.

A **Cumulative Grade Point Average (CGPA)** shall also be computed at the end of Fourth Year: Second Semester in the following way:



where. m is the total number of year being considered, Y is the YGPA of a i'th year, C is the total number of credits in i'th year.

SGPA, YGPA and CGPA will be rounded off as per the Ordinance of the University.

b. A maximum of 4 and 8 credits can be relaxed in theoretical courses to be promoted to the next semester or year, respectively. If a student fails to be promoted to the next semester/year, s(he) will be re-admitted in the same semester/year in the next academic year.

**19. Course Improvements**

i. A promoted student will only be allowed to appear in the theoretical course improvement examination in the immediate next academic year for one time in order to improve a maximum of two theoretical courses up to 6 credits whichever is applicable. To clear F-grade the candidate will be allowed to appear in the examination for maximum two times in immediate consecutive similar semesters. This will be applicable up to **fourth year first semester** for semester result system or third year second semester for yearly result system.

ii. Theoretical course improvement will only be allowed if the earned grade is less than letter grade B minus (B-, <2.75).

iv. In practical course a student will not be allowed to appear in clearing F grade or improvement examination.

v. A student will carry his/her previous marks on continuous assessment (CA).

vi. In case of student's failure to improve course grade at the course improvement examination, the previous grade will remain valid.

**20. Final Result (CGPA) Improvements**

A student obtaining Bachelor (Honors) Degree within 4 or 5 academic years will only be allowed to improve result in the immediate next regular examination after publication of result. A student will only be allowed to take part in result improvement examination for a maximum of two theoretical courses (maximum 6 credits) of the last semester (fourth year second semester). Result improvement in theoretical courses will only be allowed if the earned grade (CGPA) is less than letter grade B (<3.00).

**21. Teaching Feedback**

All students will be allowed to express their own opinion regarding course teaching performance through prescribed form and it should be evaluated confidentially by the Departmental Academic Committee or Special Evaluation Committee or by the Central Evaluation Committee.

**22. Class Attendance Record for Students**

It will be recorded electronically in every class and finally be handed over to the Chairman and will be preserved as examination record to the Examination Committee.

**23. Examination Ethics**

23.1 Everyone involved in the process of examination has to ensure the security of examination and follow the examination rules of the University.

23.2 An examinee never be asked any question that hurt his/her religious or ethnic background.

23.3 If someone (teacher or employee) is involved in examination process has the following relatives as examinee(s) he/she should inform the Chairman of concerned Examination Committee or the Controller of Examinations immediately: (i) husband/wife, (ii) son/daughter, (iii) brother/sister (iv) brother-in law/sister -in- law, (v) son in- law/daughter-in-law. (vi) nephew/niece. (vii) first cousins, (viii) father/mother (ix) Uncle/aunt and (x ) father-in-law/ mother-in-law.

**24. Enforcement of the Ordinance**

This Ordinance will be implemented from the academic session 2023-2024 (examination- 2023) onwards. Students under the previous ordinance shall have to complete their programme as implied Ordinance. Special consideration may be taken if such students remain in the programme after the due date.

**25. Amendment**

Any proposal to amend this ordinance shall be processed through the Faculty of Biological   
Sciences and shall have to be passed by the Academic Council of the Rajshahi University. There will be an Academic Ordinance Review Committee for the University. If any Faculty or Institute needs any modification/change in their Academic Ordinance have to submit it to the authority at least one month before the date of academic council.

**N.B.:**

* During course coding for all Departments in the Faculties should follow the BNQF Common Classification System for Subject.
* If any changes is occurred in the central ordinance, those changes will be applicable for this ordinance.