Chapter 1
General Information

1.1 Title of the Academic Program: MS(Masters) in Microbiology

1.2 Name of the University: Gono Bishwabidyalay

1.3 Vision of the Gono Bishwabidyalay

Gono Bishwabidyalay (GB), a University with a difference has been established with a vision to create a new consciousness and commitment in the field of education, particularly to foster social development and human welfare.

1.4 Mission of the Gono Bishwabidyalay

A very special mission of **Gono Bishwabidyalay** to help the female members of the society, students from the low-income families, children of martyrs and ethnic minorities through teaching and related activities. **Gono Bishwabidyalay** aims at achieving the following goals:

i. To bring cohesion between scientific ideas and people's aspiration as well as to ensure equal opportunity for men and women.
ii. To foster consciousness about scientific queries and welfare of mankind.
iii. In building a bridge between modern science and experience of traditional socio-economic concepts.
iv. Generating the feeling for the backward population and wish for their welfare, active participation in program to eradicate poverty.
v. To work toward sustaining and modernizing indigenous art and crafts.
vi. To work for effective solutions for the problems of the people by applying local experiences.
vii. To learn lessons from the struggles of the people for establishing their rights as well as from the history of the wars of liberation of Bangladesh and other countries of the world.
viii. To learn in depth about the country, the people, the village life, and to take steps for improvement of the country and of its people.

Chapter 2
The Department of Microbiology

2.1 Name of the program
Masters (MS) in Microbiology under the faculty of Health Sciences.

2.2 Vision of the Department
The vision of the department is going towards international excellence to be recognized as preeminence department with quality education, innovative research, and service emphases.

2.3 Mission of the Department
The mission of the Department of Microbiology is to provide a conducive learning environment and a student-friendly atmosphere that allows students to achieve academic excellence in all aspects of Microbiology. The Department also considers its mission as to produce personnel with expertise of the highest standard in the field of Microbiology to cater the increasing demand in the country for Microbiologist.

2.4 Objective of the Department
Gono Bishwabidyalay opened the MS program course in Microbiology under the faculty of Health and Medical Science. The goals of the department are to provide and continue to develop a rich environment of interdisciplinary activity and academic freedom for faculty and students. The specific objectives of the department are-

- ✓ To enrich students' knowledge and skill in the different courses of Microbiology
- ✓ To introduce the concepts of application and research in Microbiology
- ✓ To inculcate sense of scientific responsibilities and social and environment awareness
- ✓ To help student's build-up a progressive and successful career
- ✓ To produce highly qualified and competent Microbiologist who will be able to contribute in the different fields of Microbiology.

2.5 Name of the Degree: MS Masters in Microbiology.

2.6Description of the Program
Overview:

Gono Bishwabidyalay is the pioneer for the establishment of department of Microbiology in private sector. In this century Microbiology is a vital subject. Microbiology is immensely involved with fermentation technology, genetic engineering, food technology, diagnostic technology and many other subjects. Microbiology is the study of microorganisms including their habitat, nature, function, effects and exploitation for the benefit of human beings and the environment. Bacteria, Viruses, Actinomycetes, Cyanobacteria, Mycoplasmas, Rickettsia, Chlamydia, Spirochetes, Fungi, Algae and Protozoa are subjected to study in this science.

The department of Microbiology prepare students for highly demandable positions in academia, top national research laboratories and industry like icddr,b, CHRF, Pharmaceuticals, BCSIR, NIB, Food Safety Authority, WASA etc.

2.7Graduate attributes

In-Depth Knowledge: Has a broad integrated knowledge of Microbiology, including the disciplines of genetics and immunology.

Global Perspective: An awareness of current and emerging worldwide Microbiological technologies, issues, and perspectives.

Interdisciplinary Perspective: Demonstrate a multi-disciplinary perspective on Microbiology, an awareness of core concepts from genetics and immunology, and an ability to integrate knowledge from these core areas.

Lifelong Learning: An awareness of the dynamic nature and limits of current Microbiological knowledge, limits of own knowledge and a commitment to life-long learning.

Communication: Able to accurately and effectively communicate information on Microbiology using written, visual and oral reporting formats.

Critical Thinking: An understanding of the need for independent critical data evaluation and formation of evidence-based opinions.

Ability to apply the scientific process, including ability to acquire, assimilates, synthesize, analyze and critique Microbiological information.

Ethics: An awareness of the ethical implications of Microbiology, immunology, biotechnology and scientific research into the same.

Environmental Literacy: An awareness of environmental implications of biotechnology and Microbiological research.

Self-Motivation: Has self-discipline, planning, organizational and time management skills and the ability to work independently.

Teamwork: Ability to work effectively as both a member and leader within a team.

2.8 Program Education Objectives

Program Educational Objectives (PEO)

PEO-1: The program will provide in-depth knowledge about core areas of Microbiology and biotechnology through post-graduation.

PEO-2: The program will be able to facilitate, motivate and promote knowledge and technical skills in core areas of biological sciences including advanced tools and techniques like genomics, proteomics and transcriptomics on immunology aspirant.

PEO-3: Graduates will achieve the knowledge to create and develop trained human resource in the field of advanced translational research and development.

PEO-4: Graduates will be developed with a strong professional ethics and moral duties that will positively affect their professionalism and international level.

2.9 Program Learning Outcome

Program Learning Outcomes (PLO)

Department of Microbiology offers MS (Masters) degree in Microbiology. Upon graduation, students of Microbiology will be able to:

PLO-1: Demonstrate skills and techniques required for higher study and research, professional development as well as self-confidence in the field of biological/ life science.

PLO-2: Demonstrate knowledge and have a solid foundation in advance of molecular genetics, hands on experience on different analytical tools and Microbiological techniques, in-depth knowledge of immunology and vaccine development and diagnostic medicine.

PLO-3: Understand the role of advanced biotechnology in environment and Microbiological safety management, laws and regulation in aspects of food and beverages.

PLO-4: Demonstrate knowledge and understanding the engineering of protein, application of enzymes in industries and acquainted with the basis of bioinformatics and its application on advance research filed.

PLO-5: Build their knowledge and understanding of the pathogenesis of bacterial and viral diseases at the molecular level with their epidemiology, introduction to oncology and cancer study.

PLO-6: Demonstrate knowledge and understanding of public health and its implementation to prevent chronic disease, biomedical waste management, and treatment with the fundamental knowledge of biomass and biofuel and also understanding advanced technology in bioprocess and its application in aspects of extremophiles.

PLO-7: Trained students regarding design and formulated a plan for a smaller research project, execution, and seminar presentation as well as communication skills in aspects of the scientific field.

2.10 Mapping mission of the University with PEOs

PEOs	M1	M2	M3	M4	M5	M6	M7	M8
PEO 1		m	m			m		m
PEO 2	m	m	m			m		m
PEO 3	m	m	m		m	m		
PEO 4		m	m		m			m

(Note: "m" =matched)

2.11 Mapping PLOs with the PEOs

PLOs	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5	PEO-6
PLO-1	m	m				m
PLO-2		m			m	
PLO-3		m	m	m		m
PLO-4		m	m	m	m	
PLO-5	m		m	m	m	m
PLO-6		m		m	m	m
PLO-7	m			m		m

(Note:" m" = matched)

2.12 Mapping courses with the PLOs

Curriculum of the Department of Microbiology is aligned with courses and program learning outcome through proper skill mapping.

Course Code	Courses Name	Program Learning Outcomes (PLOs)						
		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
MIC-5101	Molecular Genetics (Core)	m	m					
MIC-5102	Analytical Microbiology (Core)	m	m					m
MIC-5103	Immunopathology and Vaccine Development (Core)		m					
MIC-5104	Environmental Biotechnology (Core)			m				
MIC-5105 MIC-5106	Genomics and Bioinformatics (Optional) / Microbiological Safety of Foods and Beverages (Optional) / Enzyme and Protein Engineering (Optional) / Microbiological Techniques (Optional).	m	m	m	m			
MIC-5201	Bacterial Pathogenesis and					m	m	

	Molecular Epidemiology (Core)							
MIC-5202	Molecular Virology and Oncology (Core)					m	m	
MIC-5203	Public Health Microbiology (Core)						m	
MIC-5204	Bioprocess Technology (Core)						m	
MIC-5205 MIC-5206	Extremophiles (Optional)/ Research Methodology and Scientific Communication Skills (Optional)/ Biomass and Biofuel (Optional)/ Biomedical Waste Management and Treatment (Optional).	m	m				m	m
MIC-5301	Research proposal and Presentation	m	m					m
MIC-5302	Thesis Evaluation	m						m
MIC-5303	Thesis Defense	m						m

(Note: "m" = matched)

Chapter 3
Structure of the Curriculum

3.1 Duration of the program: Years: 1.6 Semesters: 3

3.2 Admission Requirements:

University follows the rules and regulation of Bangladesh University Grand Commission for students' admission. Students who have completed the four years B.Sc. in Microbiology course from any approved institute and other biological science related subjects (based on an oral examination) are eligible to apply in MS (Masters) in Microbiology.

3.3 Total Minimum credit requirement to complete the program:

When a student enrolls in the Microbiology Department for the degree of MS in Microbiology he/she has to earn **40** academic credits. In case of theoretical course, one lecture per week per semester (18 weeks) is equivalent to one credit i.e. for a 2-credit course, there are two lectures per week and for 3-credit course; there are three lectures per week. In case of practical course one practical class consist of two hours.

3.4 Total Class week in a semester: The duration of a semester is as follows;

Classes (lectures, tutorial and practical)	18 weeks
Mid-term examinations	01 week
Semester break and revision classes before semester final	02 weeks
Semester final examinations including practical and oral test	03 weeks
Vacation	02 weeks
Total	26 weeks

3.5 Minimum CGPA requirements for post-graduation: CGPA 2.5

3.6 Maximum academic years of completion: 1.6 years/3 semesters

3.7 Category of courses:

i. Core Courses:

SL	Course Code	Course Title	Credit
1	MIC-5101	Molecular Genetics	3.0
2	MIC-5102	Analytical Microbiology	3.0
3	MIC-5103	Immunopathology and Vaccine Development	3.0
4	MIC-5104	Environmental Biotechnology	3.0

5	MIC-5201	Bacterial Pathogenesis and Molecular Epidemiology	3.0
6	MIC-5202	Molecular Virology and Oncology	3.0
7	MIC-5203	Public Health Microbiology	3.0
8	MIC-5204	Bioprocess Technology	3.0
9	MIC-5301	Research proposal and Presentation	2.0
10	MIC-5302	Thesis Evaluation	4.0
11	MIC-5303	Thesis Defense	2.0

iii. Elective course:

SL	Course Code	Course Title	Credit
1	MIC-5105 MIC-5106	Genomics and Bioinformatics	2.0
		Microbiological Safety of Foods and Beverages	
		Enzyme and Protein Engineering	
		Microbiological Techniques	
2	MIC-5205 MIC-5206	Extremophiles	2.0
		Research Methodology and Scientific Communication Skills	
		Biomass and Biofuel	
		Biomedical Waste Management and Treatment	

iv. Capstone course/ thesis/ projects/ internship: Students have to complete a thesis course of 8 Credit in 3rd semester.

SL	Course Code	Course Title	Credit
1	MIC-5301	Research proposal and Presentation	2
2	MIC-5302	Thesis Evaluation	4
3	MIC-5303	Thesis Defense	2

3.8 Year/Level/Semester/Term wise distribution of courses

First Year (First Semester)

Course No.	Course Name	Credits	Marks
Core Courses			
MIC-5101	Molecular Genetics	3.0	100
MIC-5102	Analytical Microbiology	3.0	100
MIC-5103	Immunopathology and Vaccine Development	3.0	100
MIC-5104	Environmental Biotechnology	3.0	100
Elective Courses			
MIC-5105	Genomics and Bioinformatics	2.0	50
MIC-5106	Microbiological Safety of Foods and Beverages	2.0	50
	Enzyme and Protein Engineering	2.0	50
	Microbiological Techniques	2.0	50

First Year (Second Semester)

Course No.	Course Name	Credits	Marks
Core Courses			
MIC-5201	Bacterial Pathogenesis and Molecular Epidemiology	3.0	100
MIC-5202	Molecular Virology and Oncology	3.0	100
MIC-5203	Public Health Microbiology	3.0	100
MIC-5204	Bioprocess Technology	3.0	100
Elective Courses			
MIC-5205	Extremophiles	2.0	50
MIC-5206	Research Methodology and Scientific Communication Skills	2.0	50
	Biomass and Biofuel	2.0	50
	Biomedical Waste Management and Treatment	2.0	50

Second Year (Third Semester)

Course No.	Course Name	Credits	Marks
MIC-5301	Research proposal and Presentation	2	50
MIC-5302	Thesis Evaluation	4	100
MIC-5303	Thesis Defense	2	50

Chapter 4
Description of all courses of the program

YEAR–1, SEMESTER–1, COURSE-01

Course Code: MIC-5101	Course Title: Molecular Genetics	Credits: 03

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of molecular biology.

Course Objectives:

The major objective of the course is to help students learning the advanced concepts in molecular genetics and apply this knowledge in practical field**.**

Course content:

1. DNA Replication: Structures and functions of DNA & RNA, Semiconservative Replication; Meselson and Stahl's Experiment; Modes of Replication; Requirements of Replication; Direction of Replication; The Mechanism of Replication of Bacterial DNA, Mechanism of Replication of Eukaryotic DNA, Replication of RNA.

2. Basic concepts and techniques in gene cloning: Definitions and important terminology. RT-PCR, Cloning vector, Plasmid, Cosmid, Phagemid, DNA fingerprint, DNA isolation and purification, PCR, Agarose gel electrophoresis.

3. Transcription and RNA Processing: Transcription of RNA from DNA; The Process of Bacterial Transcription; The Process of Eukaryotic Transcription; Post-Transcriptional Processing of mRNA, tRNA and rRNA.

4. Translation: The Genetic Code; Stages of Translation Process; The Overall Process of Protein Synthesis; RNA–RNA Interactions in Translation; Polyribosome; The Post-Translational Modifications of Proteins.

5. Control of Gene Expression in Eukaryotes: Control of Transcription Initiation in Eukaryotes; Cis-Acting Regulatory Regions: Promoters and Enhancers; Trans-Acting Proteins: Basal transcription factors and Transcriptional Activators; Epigenetic Regulation of Gene Expression: Histone Modification, Chromatin Remodeling and DNA Methylation; Gene Regulation by RNA Processing and Degradation; RNA Interference (RNAi) Is an Important Mechanism of Gene Regulation; Translational and Post-Translational Gene Regulation.

6. Gene Expression and Chromosome Organization: Molecular organization of transcriptionally active DNA, Gene Splicing, DNA methylation and inactivation of whole chromosome.

7. Human Gene Therapy: Somatic cell therapy and germ-line gene therapy, Gene Function interruption therapy: antisense RNA and ribozymes, Therapeutic use of anti-sense

oligonucleotide: Pre-transcriptional and post-transcriptional inactivation of mRNA, Gene therapy and Cancer, Ethical issues raised in gene therapy.

Course Learning Outcome (CLOs):

CLO1: To describe about genetics, its importance and application.
CLO2: To explain basic concepts on First & Second law of Mendel.
CLO3: To know the extension &exception of Mendes's law.
CLO4: To explain the basics of semi conservative replication.
CLO5: To discuss the basic of bacterial transformation, Conjugation & transformation.
CLO6: To know gene expression & Chromosome organization.
CLO7: To learn diverse mechanisms of human gene therapy.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m	m					
CLO2	m	m					
CLO3	m	m					
CLO4		m					
CLO5		m					
CLO6							
CLO7							

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO 5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO6	Lecture, Interactive discussion,	Class Test, Mid Term, Final Exam,

	Multimedia presentation, Brain storming, Feedback, Assignment	Class attendance, Assignment, Presentation
CLO7	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-02

Course Code: MIC-5102	Course Title: Analytical Microbiology	Credits: 03

Rationale of the course:

The intended course is designed with the purpose of gaining advanced knowledge of analytical techniques for separation of biomolecules, gaining advanced knowledge about culture techniques, genetic engineering techniques to make highly competent researchers in the field of Microbiology.

Course Objective:

The major objective of the course is to help students learning the advanced concepts in analytical Microbiology and to apply this knowledge in practical field.

Course content:

1. **Spectroscopic Techniques**: Principle and instrumentation of UV-visible; infrared spectroscopy; atomic absorption spectrophotometry; NMR spectroscopy; X-ray diffraction spectroscopy; Principle of mass spectrometry - Electrospray ionization MS, MALDI; ICAT-MS.
2. **Centrifugation Techniques**: Principle of sedimentation; Relative centrifugal force; Types centrifuges and their use: Benchtop, Continuous flow, gas centrifuge, Hematocrit, High-speed centrifuge, Microcentrifuges, Refrigerated, Ultracentrifuges, Vacuum, Analytical, and density gradient centrifugation.
3. **Chromatographic Techniques**: Paper chromatography: Principle and applications of thin layer chromatography (TLC), column chromatography (gel filtration, ion exchange and affinity chromatography); Methods of ligand immobilization, immuno-adsorption-hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography, high performance liquid chromatography (HPLC) and gas liquid chromatography (GLC).
4. **Electrophoretic Techniques**: Agarose gel electrophoresis, polyacrylamide gel electrophoresis (native PAGE and SDSPAGE); Western transfer, iso-electric focusing (IEF), 2-Dimensional gel electrophoresis, pulse field electrophoresis; principle and applications of centrifugation, differential centrifugation, density gradient centrifugation and ultracentrifugation; cell separation by flow cytometry.

5. **Protein Characterization**: Determination of molecular weight, amino acid composition and number of subunit, protein sequencing.
6. **Radioisotope Technique**: Nature, detection and measurement of radioactivity, application of radioisotopes in the biological sciences, safety aspects of the use of radioisotopes.
7. **Techniques Used in Genetic Engineering**: PCR, Quantitative Real Time PCR, Blotting Techniques: Southern, Western & Northern, Construction of Genomic & cDNA Libraries, DNA Sequencing, DNA fingerprinting, Protein Engineering: Site Directed Mutagenesis, Reporter Gene Assays, DNA Protein Interactions: DNA Fingerprinting
8. **Cell culture techniques:** Primary, secondary and continuous cell culture- animal cell (Hela, Vero, HK, MDCK, CFC and other cells).

Course Learning Outcome (CLOs)

CLO1: To describe in depth understanding of various spectroscopic techniques.
CLO2: To describe chromatographic and electrophoretic techniques for separation of biomolecules.
CLO3: To know protein characterization and radioisotope techniques.
CLO4: To describe advanced molecular techniques used in genetic engineering.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m	m					m
CLO2	m						m
CLO3	m			m			m
CLO4		m		m			

(Note: m=matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-03

Course Code: MIC-5103 Course Title: Immunopathology and Vaccine development Credits: 03

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of immunology and Vaccine development.

Course Objective:

The major objective of the course is to help students learning the advanced concepts in vaccine developments and inventions in advanced immunology

Course Content

1. Inactivation and Activation of Biologically Active Molecule: Mechanism of antibody mediate inactivation: Hormone, receptor, ligand, Neutralism antibodies-cause and effect, Protective functions of inactivating antibodies.

2. Cytotoxic and Cytolytic Reaction: Mechanism of Cytolytic Reactions, Immunohematology disease: Erythrocyte, leukocytes and platelets, Detection of circulating cytotoxic antibodies, Protective and pathologic effects in infectious disease.

3. Granulomatous Reaction: Nature of glaucomatous, Granulomatous disease (infectious disease, bacterial and parasitic).

4. Inflammation: Non-Immune and Immune Inflammation, Immune specific protection against infections, Interaction of immune mechanism in infectious disease, Evasion of immune defense mechanisms.

5. Antibody Engineering: Antibody gene cloning, Recombinant antibody gene expression, Applications of engineered antibodies; Hybrid Human-Mouse Monoclonal Antibodies: Chimeric and Humanized Antibody; Generation of a Xeno Mouse for Obtaining Human Monoclonal Antibodies; Engineered General Antibody Fragments: Single Chains (scFv) and Immunotoxins.

6. Vaccine development: Designing of vaccine (Attenuated vaccine, Inactivated vaccine, Conjugate vaccine, Subunit vaccine, DNA based and other vaccines).

7. Vaccine Strategy: Different experimental vaccines (Botulism, Anthrax, Malaria, Pneumonia, Cholera, Typhoid, Hepatitis and Tumors).

8. Vaccine safety and efficacy tests: Serological methods of efficacy testing

Course Learning Outcomes (CLOs)

CLO1: To discuss the mechanisms for inactivation and activation of biologically active molecules

CLO2: To explain cytotoxic, cytolytic and granulomatous reactions.

CLO3: To know various processes of inflammations.

CLO4: To discuss advanced knowledge of antibody engineering.

CLO5: To explain vaccine developments designs and current vaccine strategies.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m		m	m			m
CLO2	m		m				
CLO3	m		m				
CLO4	m		m	m			m
CLO5	m		m	m			m

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-04

Course Code: MIC-5104 Course Title: Environmental Biotechnology Credits: 03

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of Environmental Biotechnology.

Course Objective

The major objective of the course is to help students learning the advanced concepts in environmental biotechnology and apply this knowledge in practical field.

Course content:

1. Environmentally transmitted pathogens: Transmission, survival and distribution of various type of bacterial and viral pathogens including opportunistic ones, endemic, emerging and re-emerging bacterial and viral pathogens.

2. Risk Assessment: The concept of risk assessment, The process of risk assessment (Hazard identification, Exposure assessment, Dose-response assessment), Risk characterization, Microbial risk assessment.

3. Microorganisms and Metal Pollutants: Source of Metals, Metal bio-availability in the environment, Metal toxicity effects on the Microbial cells, Mechanisms of Microbial metal resistance and detoxification, the benefits of metal, (Microbial interaction, Innovative Microbial approaches to the remediation of metal, Contaminated aquatic system with special reference to: arsenic, chromium and lead).

4. Biosensor: Recent developments in biosensors and their use, Characteristics of biosensor, Biochemical application of biosensors in environmental pollution detection.

5. Non-culturable Microorganisms in the Environment: Concept of viable but nonculturable cells (VBNC), Molecular genetic methods for detection and identification of VBNC, Implication and significance of VBNC in environment and human health.

6. Pollution Control Biotechnology: Use of commercial blend of microorganisms and enzymes in wastewater treatment, Immobilized cells in the waste treatment, Potential application of recombinant DNA technology in waste treatment.

7. Xenobiotic and Degrading Bacteria and their Catabolic Genes in Bioremediation: In situ Analysis of Microbial community and activity in bioremediation, DNA based methods, RNA based methods Genetic finger-printing techniques, Recent development of methods increasing specificity detection.

Course Learning Outcome (CLOs):

CLO1: To know about various environmentally transmitted pathogens.

CLO2: To discuss the processes of risk assessment

CLO3: To explain metal pollution, toxicity and using microorganism to tackle it

CLO4 To describe various practical applications of biosensors.

CLO5 To know non-cultural microorganisms in environments

CLO6 To discuss pollution control biotechnology, xenobiotic compounds and degrading bacteria with catabolic genes

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m		m				
CLO2	m		m				
CLO3	m						m
CLO4	m						m
CLO5	m						
CLO6	m		m				m

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO6	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-05

Course Code: MIC-5105/5106 Course Title: Genomics and Bioinformatics Credits: 02

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of genomics and bioinformatics

Course Objective

The major objective of the course is to help students learning the advanced concepts in genomics and bioinformatics and apply this knowledge in practical field.

Course content:

1. Introduction: Microbial genome; the human genome, Importance of genome project, Structural and functional genomics, Post - genomics, Bioinformatics, Transcriptome, Proteome and proteomics.

2. Protocols of Detection of Polymorphisms: DNA sequence polymorphisms, RFLP-based protocol, PCR based protocol (ASO protocol, SSCP protocol, RADP protocol), Protocols for detection of micro satellite, Mini-satellite, Deletion, duplication and other insertion, Complex haplotype Karyotype analysis (DNA arrays on microchips).

3. Mapping Genome by Genetic and Physical Techniques: Genetic and physical maps, Markers for genetic maps, approaches to genetic mapping, High density linkage map, RFLP and micro satellite maps, Cytogenetic maps, Clone banks, Restriction mapping (Long-range physical maps, Fish mapping; STS mapping, Positional cloning, Chromosome walks and chromosome jumps).

4. Strategies for Assembly of a Contiguous DNA Sequence: Sequence assembly by the shotgun approach; Sequence assembly by the clone contig approach; the direct shotgun approach:

5. Post Genomics: Locating genes in DNA sequence, Gene location by sequence inspection, Experimental techniques for gene location, Determining the function of an unknown gene, Computer analysis of gene function, assigning gene function by experimental analysis, Activity of a protein coded by an unknown gene, Comparative genomic as an aid to gene mapping in the study of human disease genes.

6. Identification of Gene Function in Bacteria: Transcriptional reporter fusion (replicoori), Mutagenesis strategies (Site directed, Transposon, Viral transduction) Linkage, cloning and rapid sequencing of the gene in question.

7. Bioinformatics: Historical background; Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand-based approaches); Applications of bioinformatics.

8. Introduction to Biological Databases: Primary, secondary and composite databases, Different formats of molecular biology data. NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB).

9. **Similarity, Identity and Homology:** Alignment-local and global alignment, pairwise and

multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTAL omega. Identification of open reading frames (ORF), Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis, maximum parsimony, maximum likelihood and distance methods; creation, evaluation and interpretation of evolutionary trees phylogenetic tree.

Course Learning Outcomes (CLOs)

CLO1: To discuss Microbial and human genome, human genome project, genomics,

CLO2: To explain Protocols of Detection of Polymorphisms.

CLO3: To describe Mapping Genome by Genetic and Physical Techniques.

CLO4: To know Strategies for Assembly of a Contiguous DNA Sequence.

CLO5: To describe post genomics and identification of gene function in bacteria.

CLO6: To explain bioinformatics, databases and sequence homology techniques.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m	m		m			m
CLO2	m	m		m			m
CLO3	m	m		m			m
CLO4	m	m		m			m
CLO5		m		m			
CLO6	m	m		m			m

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain	Class Test, Mid Term, Final Exam, Class attendance, Assignment,

	storming, Feedback, Assignment	Presentation
CLO6	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-06

Course Code: MIC-5105/5106 Course Title: Microbiological Safety of food and Beverage Credits: 02

Rationale of the course:

To prepare and preserve foods and beverages in a safe way for human consumption, the use of these foods and beverages, knowledge about preparing, determining and maintaining its quality in every steps of preparation.

Course Objective

The objective of the course is to prevent illnesses by focusing food-manufacturing attention and activities on preventing or minimizing exposure of the consumer to pathogen and establishment of the food safety rules for safe food and beverage preparations products.

Course content:

1. Introduction: Importance of safe food and beverage for health, Manufacture of hygienic foods, Microbial indicators of safe foods.

2. Factors Influencing Microbiological Safety of Foods: Process equipment and plant design, Sanitation and cleaning, Food ingredients, Personal hygiene, Packaging, Storage, Transportation.

3. Food Poisoning and Spoilage: Poisoning and spoilage problems, Control and monitoring programs, Detection methods (Conventional, Rapid, Rapid end-detection and specific detection technique).

4. Management and Control of Food Safety: Sanitation and hygiene program, Control and inspection, Management of Microbial hazards in -foods (HACCP plans, RC, RM, RA, GMP, GHP and GRAS).

5. Investigation of Food-Borne Disease Outbreaks: Objectives, Personnel involved, Materials and equipment, Field of the investigation, Laboratory testing, Interpretation and application of results, Preventing measure.

6. Food Laws and Regulation: Laws, Enforcement, Impact of regulations, Exports and imports.

Course Learning Outcomes (CLOs)

CLO1. To discuss the importance of safe food, beverages and Manufacturing process

CLO2. To describe the factors of safe food and various industrial tools for making

CLO3. To explain the causes of food Spoilage and various detection method of food

CLO4. To know the application of food safety management and rules.

CLO5. To explain the investigation of food-borne Disease Outbreaks.

CLO6. To know the Food Laws and Regulation.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m		m				m
CLO2	m		m				m
CLO3	m		m				m
CLO4	m		m				
CLO5	m		m				m
CLO6	m		m				

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO6	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-07

Course Code: MIC-5105/5106 Course Title: Enzyme and Protein Engineering Credits: 02

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of enzyme industry in Bangladesh.

Course Objective:

The major objective of the course is to help students learning the advanced concepts in enzyme and protein engineering and apply this knowledge in practical field.

Course Content:

1. **Protein Structures:** Forces stabilizing proteins – Van der waals, electrostatic, hydrogen bonding and weakly polar interactions, hydrophobic effects; Protein folding and stability.
2. **Protein-Protein Interactions:** Techniques and Applications; Phage Display;Yeast two-hybrid (Y2H) system, Yeast three-hybrid (Y3H) system.
3. **Protein Engineering**: Definition and applications; Features or characteristics of proteins that can be engineered; Protein engineering with unnatural amino acids and its applications; Post-translational modifications in protein engineering.
4. **Computational approaches to protein engineering:** sequence and 3D structure analysis, Active site residues and modifying agents; Data mining.
5. **Combinatorial protein engineering** - Applications of combinatorial engineering; rational design -Applications of rational design.
6. **Strategies to Engineering Enzymes:** Single amino acid substitutions – Error prone PCR and site-directed mutagenesis; Chemical and biochemical strategies for the randomization of protein encoding DNA sequences: library construction methods for directed evolution; Mechanism of stabilization of enzymes from psychrophiles, mesophiles and thermophiles**.**
7. **Application of Protein Engineering:** Engineered Insulins with Altered Pharmcodynamic and Pharmacokinetic Properties; Advances in protease engineering for laundry detergents such as proteases, lipases, amylases, mannanases, cellulases, and pectinases; Engineered enzymes in different industries like food, paper, leather, cosmetic, pharmaceutical and chemical industry.

Course Learning Outcome (CLOs):

CLO1: To discuss protein structures and protein interactions technology.
CLO2: To explain various aspects of protein engineering
CLO3 To know computational approaches to protein engineering
CLO4: To describe combinational protein engineering and strategies engineering enzymes overall translation process.
CLO5: To discuss the application of protein engineering.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m			m			
CLO2		m		m			
CLO3		m		m			
CLO4		m		m			
CLO5				m			m

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–1, COURSE-08

Course Code: MIC-5105/5106 Course Title: Microbiological Techniques Credits: 02

Rationale of the course:

The intended course is designed with the purpose of paving the way to make highly competent researchers in the field of Microbial techniques.

Course Objective:

The major objective of the course is to help students learning the concepts in Microbial techniques and apply this knowledge in practical field.

Course content:

1. Microscope and Microscopy: Microscopy, types of microscopes, principles of microscopy, Functions of different types of microscopes, Applications of microscope in higher research.

2. Techniques of Observing Microorganisms: Observation of microorganisms under microscope by- Wet-mount and hanging-drop technique, Staining of Microbial samples, Mechanisms of different types of staining.

3. Cultivation, Isolation and Growth Measurement: Types of cultivation in different conditions, Isolation and pure culture technique, Measurement of growth by different types of measurement techniques, Direct cell counting, Measurement of biomass, Viable counts.

4. Characterization and Identification: Morphological characteristics, cultural characteristics, staining of properties, biochemical characteristics, Antigenic properties, genetic nature.

5. Culture Preservation and Management: Different methods for short-term and long-term preservation of Microbial culture, Monitoring and routine check of cultures, Management of different type culture collections.

6. Methods of Microbial **Control: Concept** of Microbial control, Factors influencing Microbial control, Different physical and chemical methods, Rate of Microbial death, Agents used to control microorganisms.

7. Molecular Techniques: Molecular techniques such as PCR, RT-PCR, CRT-PCR for bacterial and viral agents' detection.

Course Learning Outcomes:

CLO1: To know the basics of microscopes and microscopy.
CLO2: To discuss the techniques for observing microorganisms.
CLO3 To explain cultivation, isolation and growth measurements of microorganisms.
CLO4: To discuss characterization and identification of microorganisms.
CLO5: To know the culture preservation and management of microorganisms.

CLO6 To describe methods of Microbial control and molecular techniques for identifications of bacteria and virus.

CLO7 To know the basics of microscopes and microscopy.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m	m					
CLO2	m	m					
CLO3	m	m					
CLO4	m	m					
CLO5	m	m					
CLO6	m	m					
CLO7	m	m					

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy:

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO6	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO7	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-09

Course Code: MIC-5201 Course Title: Bacterial pathogenesis and Molecular Epidemiology Credits: 03

Rationale of the course:

The course is designed as essential learning for the students with a desire to have a complete study of bacterial pathogenesis and the distribution and determinants of infectious diseases in human populations and animals.

Course Objective

The main objective of the course is to introduce students to the knowledge of bacterial structures, virulence factor and their relation to pathogenesis; understand the public health approaches to prevent bacterial disease, genetically identifying techniques of bacteria and their epidemiology.

Course Content:

1. Pathogenesis with Special Reference to Molecular Basis: Shigellosis and Cholera, Bacterial ulcer in human, Meningitis and epiglottis, Botulism and Gas gangrene, Plague and Pelvic Inflammatory disease (*Haemophilus influenza*, *Listeria monocytogenes*.

2. Bacterial Resistance to Antibiotic: Mechanism of antibiotic resistance, Antibiotic tolerance: Transfer of resistance genes, Trace back of antibiotic resistance genes.

3. Infection control and prevention: Epidemic versus endemic, Steps in epidemiologic evaluation, Role of the laboratory in epidemiologic evaluation (Potential problems related to laboratory activities in epidemiology investigations).

4. Epidemiologic Analysis: Criteria for evaluating typing system, Phenotypic techniques (Biotyping, AntiMIC ial susceptibility testing, Serotyping, Bacteriophage typing, MLEE).

5. Genotypic Techniques: Plasmid analysis, REA of chromosomal DNA, Southern blot analysis of RRLPs, PFGE of chromosomal DNA typing system applying PCR, PCR-based detection of restriction sites, Nucleotide sequence analysis, Molecular typing of specific organisms, Application of Microbial typing system, Implementing a molecular epidemiologic laboratory.

Course Learning Outcomes (CLOs)

CLO1: To Know about bacterial virulence factor and their relation to

CLO2: To describe antibiotic resistance mechanisms, host resistance, and genetic transfer of antibiotic resistance gene.

CLO3: To discuss the public health approaches to prevent and control the bacterial disease.

CLO4: To explain genetically identifying techniques of bacteria and their

CLO5: To discuss the implementation of molecular epidemiology.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLO)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1					m		
CLO2		m		m			
CLO3					m		
CLO4		m					
CLO5					m		

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-10

Course Code: MIC-5202 Course Title: Molecular Virology and oncology Credits: 03

Rationale of the course:

The course is designed to have a complete study of persistent virus infection, pathogenesis, and their epidemics as well as the basic study of oncology with different types of cancer and their causes, cancer development, and the concept of therapeutic intervention in controlling cancer.

Course Objective:

The main objective of the course is to introduce the students to the knowledge of persistence of virus infection, pathogenesis, some special virus infection and their epidemiology, the study of emerging viruses in aspects of Bangladesh, the introduction of oncology and development of cancer, spreading, pathogenesis and their therapy.

Course Content:

1. Persistence of Viruses: Patterns of virus infections, Mechanisms of viral persistence, Persistence of HSV, EPV, and HIV in humans.

2. Viruses of Special Interest: Dengue and Japanese encephalitis virus, Nipah Virus, Ebola virus infection, Severe acute respiratory syndrome (SARS) and SARS corona virus, Other important viruses of recent epidemics.

3. Virus Evolution and Emerging Viruses: How do viruses evolve, Emerging viruses, Emergence of dengue virus infection in Bangladesh.

4. Oncology: Introduction and general terminology of oncology.

5. Cancer: Development of cancer, Spread of cancer, Molecular mechanisms of transformation by DNA and RNA viruses, Physical and chemical factors to cancer development, Cancer therapy

Course Learning Outcomes (CLOs)

CLO1: To Know about virus infection, mechanism and persistence of virus.

CLO2: To discuss importance of some recent viruses and their epidemics.

CLO3: To know the virus evolution and emerging viruses in aspects of

CLO4: To learn about oncology

CLO5: To know development of cancer, spreading, molecular mechanisms, transformation and therapy

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1					m		
CLO2					m		
CLO3					m		

CLO4					m		
CLO5					m		

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-11

Course Code: MIC-5203 Course Title: Public Health Microbiology Credits: 02

Rationale of the course:

The course is designed as essential learning for the students with a desire to have a complete study of epidemiology and epidemic disease, as well as controlling the epidemic disease globally.

Course Objective

The main objective of the course is to learn the occurrence, abundance and distribution of microorganism in the community and their role in the associated with Public health and also learn different methods for their detection and characterization.

Course Content:

1. **Fundamentals:** Definition, Basic concept of epidemiology.
2. **Terminologies:** Mortality, Morbidity, Disease Progression, Endemic, Epidemic, Pandemic, Outbreak.

3. Infectious Diseases: The leading human killers**,** Emerging and resurgent infectious diseases, Transmission, emergence factors.

4. Epidemic Diseases: Agents, sources, reservoirs and control.

5. Public Health Measures for Controlling Epidemics: Controls directly against the reservoirs, Controls directly against Transmission of the pathogens, Vaccination, quarantine, surveillance, environmental control.

6. Global Health Considerations: Infectious diseases in developing and developed countries, Travel to endemic areas.

7. Types of Epidemiological Study: Concepts of cause and risk of diseases, survey and survey methods, Cohort studies, Case-control studies, Intervention studies, Medical demography, Health education and nutrition.

Course Learning Outcomes (CLOs)

CLO1: To Know basic concept of epidemiology, and some terminology.

CLO2: To discuss infectious disease and epidemic disease agents, sources, reservoir and transmission.

CLO3: To know the public health approaches to prevent and control the epidemics.

CLO4: To know different types survey methods to study the epidemiology.

CLO5: To discuss the management, laws and regulations on travelling to endemic area.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1					m	m	
CLO2					m	m	
CLO3					m	m	
CLO4					m	m	
CLO5					m	m	

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-12

Course Code: MIC-5204 Course Title: Bioprocess Technology Credits: 03

Rationale of the course:

The intended course is designed to combining the complete living matter or its components with nutrients to make desired foods, chemicals, reagents, and biotherapeutics

Course Objective

The main objective of the course discusses on the advance knowledge on Microbial growth and product formation, overview of the bioprocess from raw material to product, Upstream and downstream processing, and use of biotechnology in industry

Course Content:

1. **Bioreactor Design:** Microbial growth and death kinetics; Ideal and non-ideal reactors; Residence Time Distribution; Elements in bioreactor design - overview of bioreactor, Construction materials, types of bioreactors, its developments using Microbial processes, mammalian cell culture, and plant cell culture, components of bioreactors and importance.
2. **Analysis of Batch and Continuous Culture:** modifying batch and continuous reactors; fed batch operations; Multiphase bioreactor system; upstream processing: media formulation and optimization; sterilization (medium and air)-thermal death kinetics of microorganisms; aeration, agitation and heat transfer in bioprocess; Translation of laboratory, pilot and plant scale data-scale up and scale down.
3. Separation of insoluble products-filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: liquid-liquid extraction, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration; final purification: drying; crystallization; storage and packaging.
4. **Recent Trend in Vinegar and Citric Acid Production Processes:** Potential raw materials, Fermentation, Recovery, Future prospects of vinegar and citric acid.
5. **Biopharmaceuticals:** Genes for the biosynthesis of secondary metabolites, Antibiotic production and its modification, Metabolic engineering of antibiotic biosynthetic pathways, Bio-transformation of steroids.

Course Learning Outcomes (CLOs)

CLO1: To describe the history and application of Bioprocess in advance level

CLO2: To discuss various biotransformation reactions and uses of biocatalysts

CLO3: To explain the increase of Microbial fermentation process in industrial level

CLO4: To know the Microbial production process of various foods and feeds, some recent trend of fermented products like citric acid and vinegar, process of biocomposting.

CLO5: To discuss the production process of various biopharmaceuticals and their use.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1							
CLO2		m		m			
CLO3							
CLO4			m				
CLO5						m	

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-13

Course Code: MIC-5205/5206	Course Title: Extremophiles	Credits: 02

Rationale of the course:

The course is designed to understand Microbial adaptation to extreme environments, extremophiles as a source of novel enzymes for industrial adaptation.

Course Objective:

The main objective of the course is to educate students with the knowledge of different types of extremophiles and their cultivation

Course Content:

1. **Extreme Environments:** Microbial adaptation to extreme environments, Extreme environment as a resource for novel microorganisms.

2. Biodiversity: Biodiversity at the molecular level, The domains, kingdoms and phyla of life, Microbiological perspective, The primary divisions of life, Domain archaea (Domain bacteria, Domain eukarya), Microbial diversity.

3. Archaea: Phylogenetic overview (Kingdom Euryarchaea, Kingdom Crenarchaea, Hyperthermophilic archaea), Microbial evolution.

4. Different Types of Extremophiles: The extreme Thermophiles, The extreme Acidophiles, the extreme Alkaliphiles, The extreme Halophiles, The extreme Basophiles.

5. Cultivation of Extremophilic Microorganisms: Various strategies applied for cultivation of Extremophiles.

6. Extremozymes: Bio catalysis under extreme conditions, Extremophiles as a source of novel enzymes for industrial application, Screening strategies for novel enzymes, Heat-stable amylase and glucoamylase, Thermostable cellulases, Thermostable xylanases, DNA processing enzymes in PCR, High temperature reverse transcription, Thermostab1e DNA ligase, Thermo active enzymes of biotechnological interest, Thermostable glucose isomerases, Thermostable alcohol de-hydrogenases, Biochemical basis of heat stability.

Course Learning Outcomes (CLOs)

CLO1: To know on microbial adaptation at extreme environments.

CLO2: To learn different domains, kingdom and phyla of life and archae

CLO3: To know the different types of extremophiles, and their cultivation process.

CLO4: To discuss extremophilic enzyme and their application.

CLO5: To explain the screening strategy for novel enzymes.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1						m	
CLO2						m	
CLO3						m	
CLO4						m	
CLO5						m	

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO4	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO5	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-14

Course Code: MIC-5205/5206 Course Title: Research Methodology and Communication Skills Credits: 02

Rationale of the course:

The course is designed to encourage and train the students on a basic foundation for research in their interest area. This course acquaints students with the identification of a research topic, research planning, and its execution as well as develops their communication skills in the scientific field.

Course Objective

To provide knowledge about tools and techniques related with research methodology and scientific communication**.**

Course Content:

1. **Foundations of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process.
2. **Problem Identification & Formulation:** Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.
3. **Research Design control and procedure:** Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4. **Qualitative and Quantitative Research:** Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. **Measurement:** Concept of measurement – what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.
6. **Sampling:** Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.
7. **Data Analysis:** Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association; Interpretation of data.
8. **Technical Writing Skills:** Types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and non-blind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.
9. **Use of Database:** Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.
10. **Use of Tools / Techniques for Research:** methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.
11. **Presentation Skills:** Formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions.

Course Learning Outcomes (CLOs)

CLO1: To understand the existence of scientific knowledge in ancient times.

CLO2: To acquire the skills of scientific reading, writing and presentations.

CLO3: To appreciate the scientific ethics through case studies

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m						m
CLO2				m			m
CLO3							m

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-15

Course Code: MIC-5205/5206 Course Title: Biomass and Biofuel Credits: 02

Rationale of the course:

The course is designed to understand the formation, utilization, and the application of biomass and biofuel in humans and animals as well as environment.

Course Objective:

The main objective of the course is to educate students with the knowledge of the basic concept of biofuel and biomass, its formation, production of various fuels and hydrogen from biomass

Course Content:

1. **Introduction:** Importance of fuel energy, Fuels from nature, Basic bioenergy interconversion, Formation of biomass, Conversion of biomass to fuel.
2. **Potential Biomass for Fuel Production:** Types of natural, biomasses (Land crops,

Aquatic plants, Waste materials), Production of desirable biomass, Advantages and problems in utilization of biomass for fuel generation, Pretreatment of biomass for the fuel production.

3. **Bioconversion of Biomass to Methane:** Biomass composition and methane production, Synthesis of methane under natural conditions, Potential MIC es involved in methane generation, Man-made processes (Methane from sanitary landfills, sewage, farm, industrial waste and crops Reactor design for methane production), Utilization of the methane as fuel.
4. **Production of Fuel-Ethanol from Biomass:** Potential biomass and microorganisms for ethanol production, Problems in production of ethanol from agro - industrial wastes, Development of technology of fermentation, Ethanol production from molasses by yeast, Ethanol production from cellulose by rumen bacteria, Ethanol production by *Zymomonas mobilis,* Future prospects of the industrial alcohol.
5. **Production of Hydrogen from Biomass:** Potential substrates and microorganisms, Natural biosynthesis of hydrogen under natural habitats, Cell free system and combined system for production of hydrogen.

Course Learning Outcomes (CLOs)

CLO1: To know the importance of biomass and biofuel in nature

CLO2: To discuss the potential biomass for fuel and hydrogen production.

CLO3: To explain the production of methane from biomass by conversion process.

Mapping Course Learning Outcomes (CLOs) with the PLOs

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m					m	
CLO2						m	
CLO3						m	

(Note: "m" =matched)

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO3	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–1, SEMESTER–2, COURSE-16

Course Code: MIC-5205/520, Course Title: Biomedical Waste Management, Credits: 02

Rationale of the course:

The course is designed to understand different biomedical waste and its management and practices.

Course Objective:

The main objective of the course is to educate students with the knowledge human health and environment hazardous waste, management as well their practices.

Course content:

1. **Biomedical Waste:** Definition and types, Management strategy and options for different kind of wastes.
2. **Health and Environmental Hazards:** Physical, Chemical and Biological.
3. **Waste Minimization:** Infectious and hazardous waste in pathological laboratories, hospital wards, diagnostic centers, Operation theaters, slaughter-house, and other treatment facilities for humans and animals, Managing sharp waste and injection safety
4. **In-House Management:** Collection, Disposal and Treatment, Technical options of waste treatment, Environmental and health concern of treatment options.
5. **Biomedical Waste Management Practices:** Principles, Good and bad practices, Necessity of treatment and management of biomedical wastes, Situations in developed and developing countries, Project cycle analysis.

Course Learning Outcomes:

CLO1: To discuss various biomedical waste and its hazardous for health and

CLO2: To know about the waste management, treatment and practice.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1						m	
CLO2						m	

Mapping course learning Outcomes (CLOs) with the Teaching-Learning and Assessment strategy:

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation
CLO2	Lecture, Interactive discussion, Multimedia presentation, Brain storming, Feedback, Assignment	Class Test, Mid Term, Final Exam, Class attendance, Assignment, Presentation

YEAR–2, SEMESTER–3, COURSE-17

Course Code: MIC-5302	Course Title: Research proposal and presentation	Credits: 2.0

Rationale of the course:

The intended course is designed with the purpose of paving the way to make research proposals and synopsis presentations for thesis purposes.

Course Objective:

The major objective of the course is to help students fulfilling synopsis presentation in PowerPoint.

Course Content: N/A

Course Learning Outcomes (CLOs):

CLO1: To formulate research strategies; presenting synopsis in PowerPoint format.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m						m

(Note: m= matched)

Mapping Course Learning Outcome (CLOs) with the Teaching-Learning Strategy & Assessment Strategy:

CLOs	Teaching Learning Strategy	Assessment Strategy
CLO1	Power point presentation	Synopsis presentation

YEAR–2, SEMESTER–3, COURSE-18

Course Code: MIC-5302	Course Title: Thesis Evaluation	Credits: 04

Rationale of the course:

The intended course is designed with the purpose of paving the way to make final research thesis.

Course Objective:

The major objective of the course is to help students fulfilling thesis dissertations

Course Content: N/A

Course Learning Outcomes (CLOs):

CLO1: To write a successful thesis work

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m						m

(Note: m= matched)

Mapping Course Learning Outcome (CLOs) with the Teaching-Learning Strategy & Assessment Strategy:

CLOs	Teaching Learning Strategy	Assessment Strategy
CLO1	Writing thesis book	Written thesis

YEAR–2, SEMESTER–3, COURSE-19

Course Code: MIC-5303	Course Title: Thesis Defense	Credits: 02

Rationale of the course:

The intended course is designed with the purpose of paving the way to make final research thesis

Course Objective:

The major objective of the course is to help students fulfilling thesis dissertations

Course Content: N/A

Course Learning Outcomes (CLOs):

CLO1:	To present thesis work in PowerPoint format

Mapping Course Learning Outcomes (CLOs) with the PLOs:

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	m						m

(Note: m= matched)

Mapping Course Learning Outcome (CLOs) with the Teaching-Learning Strategy & Assessment Strategy:

CLOs	Teaching Learning Strategy	Assessment Strategy
CLO1	Thesis Evaluation	PowerPoint

Chapter 5
Grading/Evaluation

1.1 Grading scale:

A student's overall performance in a given course is based on a continuous assessment scheme. A continuous assessment is done through class participation, class test, homework, assignments and midterm examination. Final assessment for evaluation of credit is done through compilation of the marks obtained by the students in the continuous assessment and the semester final examination. The distribution of marks in terms of percentage is as follows:

Grading System		
Numerical Equivalent (%)	Grade	Grade Point (GP)
80 and above	A+(A plus)	4.00
75 to below 80	A(A regular)	3.75
70 to below 75	A-(A minus)	3.50
65 to below 70	B+(B plus)	3.25
60 to below 65	B(B regular)	3.00
55 to below 60	B-(B minus)	2.75
50 to below 55	C+(C plus)	2.50
45 to below 50	C(C regular)	2.25
40 to below 45	D	2.00
Less than 40	F	0.00

'F' means fail.

1.2 Grading Description

The Grades (with numeric values) as described as follows:

A+ Exceptional Performance / Excellent
A Outstanding Performance
A- Brilliant Performance
B+ Very Good Performance; Most of the course objectives achieved; objectives met in a consistently thorough manner
B Good Performance
B- Above Average
C+ Average, At least majority of the course objectives achieved; objectives met satisfactorily
D Minimally Acceptable Performance; Less than the majority but more than the minimum required course objectives achieved; Objectives achieved at a minimally acceptable level
F Unacceptable Performance; minimum required course objectives not met; objectives not met for minimally acceptable level; no credit earned

(a) A Course in which a student has obtained "D" or a higher grade will be counted as Credits earned by him/her. Any course in which a student has obtained "F" grade will not be counted towards his/her earned credit.

(b) Thirty percent (30%) of marks of a theoretical course is allocated for continuous assessment i.e. class participant/attendance, quizzes/assignment and class tests/Mid-term. The remaining (70 %) of the marks is allotted to Semester Final Examination. The distribution of theory marks for a given course is as follows:

Class participation/Attendance	10%
1st class test	10%
2nd class test/ Midterm	10%
Semester Final	70%
Total	**100%**

Controller of examination appoint external examiner to conduct final examinations. External examiners are proposed by the department. Practical examination includes laboratory experiments both written and demonstration, attendance, practical note book and viva voce. Marks for class attendance or participation are as follows;

Percent of class attendance	**Marks (%) for 3/4 credits**	**Marks (%) for 2 credits**
95% and above	10	5
90% to 94%	9	4.5
85% to 89%	8	4
80% to 84%	7	3.5
75% to 79%	6	3
70% to 74%	5	2.5
Less than 70%	0	0

Students having attendance less than 70% in any of the courses is not allowed to the semester final examination, he/she has to repeat the course in the next semester with fresh enrollment.

(c)Teaching-Learning Strategy

The Teaching-Learning Strategy depends mostly on the course teacher or instructor and the duration of the classes. Most of the teaching learning strategies followed in the faculty are as follows-

- Class lecture with multimedia presentation
- Group discussion
- Demonstration
- Practical experiment and result oriented study
- Identification of field problem and find out effective solution
- Assignment
- Brain storming
- Feed back
- Seminar, tutorial, workshop
- Field tour
- Industry visit
- Internship

(d) Assessment Strategy

Assessment strategy is important to meet the objective of the curriculum. Various standard methods are used for the assessment. The assessment methods are reviewed at regular intervals to upgrade and adapt the quality assessment. The followed assessment strategies are;

i. Quizzes
ii. Class test
iii. Term examinations
iv. Short answer
v. Essay type/ broad answer
vi. Experiment demonstration performance
vii. Clinical examination performances
viii. Reports
ix. Assignment
x. Multimedia presentations
xi. Class Attendance
xii. Students are well informed about the assessment process and assessment results are published as soon as possible. Justice and transparency are ensured in the assessment system.

5.3 Grade point Average (GPA) and Cumulative Grade Point Average (CGPA):

GPA Calculation

Grade Point Average (GPA) is the weighted average of the Grade Points obtained by the students in all the courses in the examination of the Semester. For example, if a student passes/ completes, five courses in a semester having credits C1, C2, C3, C4 and C5 and his grade points in these courses are G1, G2, G3, G4 and G5 respectively then –

$$GPA = \frac{\Sigma C_i G_i}{\Sigma C_i} \qquad \text{where, i=1 to 5}$$

For example, if a student takes 6 courses in one semester and obtains the following grades

Course	Credits	Letter Grade	Grade Points
01	4	A+	4.00
02	4	C+	2.50
03	4	A-	3.50
04	2	B-	2.75
05	2	B	3.00
06	2	F	0.00

Then the GPA for the semester, calculated to two digits after decimal point will be –

$$GPA = \frac{4(4.00) + 4(2.50) + 4(3.50) + 2(2.75) + 2(3.00) + 2(0.00)}{(4+4+4+2+2+2)} = 2.86$$

CGPA Calculation

Cumulative Grade Point Average (CGPA) is the weighted average of the GPA secured over the total number of semesters for a course of studies. We can calculate the CGPA of a student using following formula:

$$CGPA = \frac{(Gradepointaverageearnedinsemesteri \times Totalcredithoursinsemesteri)}{(\text{Total credit hours in semester})}$$

For example:

Semester	GPA	Credits
1	4.00	20
2	3.00	30
3	3.50	25
4	3.00	20

The CGPA in this case will be –

$$CGPA = \frac{(20\times4) + (30\times3) + (25\times3.5) + (20\times3)}{20+30+25+20} = 3.34$$

1.4 Course withdrawal: All core courses are compulsory.

1.5 Incomplete courses: If any student failed to obtain 40% marks in any of the courses in a semester, that courses are incomplete courses. He/she has to complete it in the next semester.

1.6 Retake: A student who receives an 'F' grade in a course will be required to retake/supplement that course. When a student repeats a course in which he or she previously received an 'F' grade, he or she is not eligible to receive a grade higher than a 'B+' in that repeated course.

1.7 Grade improvement:

a) If a student obtains a Grade equal to or lower than "B" in a course, he/she will be allowed to repeat the course only once during the following Supplementary Examination but he/she will not be eligible to get a Grade better than "B+" in such a course.

b) If a student fails to improve his Grade then his/her earlier Grade will be retained.

c) If a student likes to improve the Grade earned in a course of 1st year (1st semester), he must apply for such improvement examination before the issuance of transcript. Improvement examination shall not be allowed once the degree is awarded.

1.8 Dropout:

A student must secure at least a GPA of 2.00 in Semester Final Examination for promotion to next higher Semester subject to the condition that he/she has not failed in more than two core courses in Semester. Otherwise, he/she will be considered as detained on that semester.

A Student who (a) is debarred from appearing at the examination due to shortage in class attendance or (b) fails in a Semester Final Examination may seek readmission within two weeks after the announcement of the result of the Semester. The student will have to pay prescribed fees for the Semester and a Readmission Fee as prescribed by the University. After readmission the student has to attend the classes regularly and must obtain 70% attendance from the date of readmission.