No.	Information of the subject	
1.	Unit name:	Cell Biology I
2.	Code:	BioT-21011
3.	Classification:	Core subject
4.	Credit value:	3.5
5.	Semester/Year Offered:	1/2
6.	Pre-requisite:	Basic Science
7.	Mode of delivery:	Presentations, Lectures, Practical, Discussion
8.	Assessment system and breakdown of marks:	Practical and Assignments
	Practical and Assignments	30%
	Mid-term exam	35%
	Final exam	35%
9.	Academic staff teaching unit:	Department of Biotechnology
10.	Course outcome of unit: the students are able: 1. To explain the fundamental unit of life 2.To compare the structures and purposes of basic components of prokaryotic and eukaryotic cells 3.To explain the functions of cellular organelles. 4.To classify and to write chemical bonds in living organisms 5.To examine the main classes of small molecules found in cells and theirbiological roles 6.To explain macromolecules in cells and to describe the molecules from which cells are made and their structures, shapes and chemical properties	
11.	Synopsis of unit: Cell Biology is the basic subject for undergraduate Biotechnology students. The study of basic components of prokaryotic and eukaryotic cells support in any field of Biotechnology. This course provides the background knowledge of the cell biology. We firstly introduce what is the cell and their unity and diversity. After that, the students will study the structural illustration pictures of different kinds of cells that were taken under the light microscope and electron microscope. This course will explain how the cells are organized and the function of each cellular components and	

	how to classify the living things according to their structure and chemical requirements. The second chapter will explain the chemical molecules from which cells are made and how these molecules determine the size, structure, and functions of living cells. By understanding how they interact, we can begin to see how cells exploit the laws of chemistry and physics to survive, thrive and reproduce.
12.	Topics 1. Unity and Diversity of Cells 2. Prokaryotic and Eukaryotic Cells 3. Cellular Components 4. Model Organisms 5. Chemical Components of Cells 6. Small Molecules in Cells 7. Macromolecules in Cells
13.	Main reference: • Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, 'Essential Cell Biology', 4th Edition, Garland Science, Taylor & Francis Group.
14.	Additional references: • Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Peter Walter, "Molecular Biology of THE CELL", 6th Edition, Garland Science, Taylor & Francis Group.

No.	Information of Subject	
1	Unit name:	Microbiology I
2	Code:	Bio T 21021
3	Classification:	Core subject
4	Credit value:	3.5
5	Semester/ Year Offered:	1/2
6	Pre-requisite:	
7	Mode of delivery:	Lectures and discussion
8	Assessment system and breakdown of marks:	Multiple choice questions, short question, short notes, long question and practical exam
	Practical	30 %
	Mid-term examination	35%
	Final examination	35%
9	Academic staff teaching unit:	Department of Biotechnology
10	Course outcome of unit: After completion of this course, students will able to 1. Generalize within multiple microbiology disciplines the core theories and practices 2. Identify the theoretical basis of the technical methods on common microbiology 3. Solve the practical skills in the use of tools, technologies and basic methods common microbiology 4. Recognize knowledge of the interaction between humans and microorganisms and introduce the fundamental characteristics of various microorganisms 5. Apply the appropriate microbiological lab equipment and methods, in order to conduct and analyze experimental measurements relevant to microbiology	
11	Synopsis of unit: The course covers the introduction to the world of microorganisms through about some of the general areas such as medicine, environmental science, food and drink production, fundamental research, agriculture, pharmaceutical industry, and genetic engineering. And then there are the understanding cells and cell membranes; differences between prokaryotes and eukaryotes. And it includes about the classification and taxonomy of prokaryotes, systematics, identification of bacteria, other methods of identification. Finally, it describes the major characteristics of the four groups of microorganisms; describes as a result of observations, the structures and reproduction; general structure and life circle of viruses including a named bacteriophage and a named retro-viruses.	
12	Topics: 1. Microbiology: What, Why and How? 2. Differences Between Prokaryotes and Eukaryotes 3. Systematics 4. Microbiology and Biotechnology	
13	Main references:	

	• **Essential Microbiology;** Second Edition, © 2013 by John Wiley & Sons, Ltd; Stuart Hogg • **BIOS INSTANT NOTE ON MICROBIOLOGY**; Fourth edition, Simon Baker, Caroline Griffiths, Jane Nicklin, © 2011 by Garland Science, Taylor & Francis Group, LLC • **Microbiological Applications**; Benson, Eighth Edition: Laboratory Manual in General Microbiology; © The McGraw-Hill Companies 2001
14	Additional references: • **Essential of Microbiology**; First Edition, 2016; Surinder Kumar, Maulana Azad Medical College, India • **PRESSCOTT, HARLEY, AND KLEIN'S MICROBIOLOGY**, 7th Edition, 2008, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton

Bio T 21021 Microbiology I
Course Outcomes and Indicators

No.	Course Outcomes	Indicators
1	General within multiple microbiology disciplines the core theories and practices	Excellent: Fail = 0% & A ≥ 20% Good Fail ≤ 15 % Fair Fail ≤ 25% Poor : Fail > 25%
2	Identify the theoretical basis of technical methods on common microbiology	
3	Solve the practical skills in the use of techniques and basis methods microbiology	
4	Recognize and knowledge of the interaction between humans and microorganisms and introduce the fundamental characteristics of the various microorganisms	
5	Apply the appropriate microbiological lab equipment and methods, in order to conduct and analyze experimental measurements relevant to microbiology	

Matrix of CO and PO

CO	Program Outcomes											
	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
a	C2											
b					C1							
c					P3							
d	C2											
e	C3								P3			

Assessment Scheme

Rubric for Class Activity

Dimension	Marks		
	2	**4**	**6**
Participation	Less participate	More participate	Participate actively

** Act in leading role will earn 4 marks extra.

Department of Biotechnology
Microbiology I (Bio T 21021)
Practical timetable (2019-2020, semester I)
Microbiology laboratory, Room- 2/ 1- 5

Sr.	Date	Title	Subtitle	Chemicals	Equipment	Remark
1	13.12.2019	Welcome to Microbiology Laboratory	-	-	- Projector - Computer	- Power Point presentation
2	27.12.2019	Microbiology Safety and Rules	-	-	- Projector - Computer	- Power Point presentation
3	10.01.2020	Introduction to Microscope	- Compound Light Microscope - Compound Light Microscope Parts & Functions	-	-Compound Light Microscope	
4	31.01.2020	Good microbiological laboratory practice (GMLP)	Resources – Equipment and use	-	- Projector - Computer	- Power Point presentation
5	14.02.2020	Good microbiological laboratory practice (GMLP)	Apparatus and Use	-	- Projector - Computer	- Power Point presentation
6	28.02.2020	Staining procedure	Gram positive and Gram negative	- Crystal violet solution - Iodine solution - Spirit - Safranin solution	- Glass slides - Pipette	- Power Point presentation

Course Specification

Bio T 21021 & 22021 Microbiology

(2019 – 2020)

Microbiology: What, Why and How? What is microbiology? Why is microbiology important? How do we know? Microbiology in perspective: to the Golden Age and beyond; Light microscopy; Electron microscopy; Differences Between Prokaryotes and Eukaryotes; Understanding cells and cell membranes; Prokaryotes; Eukaryotes; Prokaryotic systematics; Classification and taxonomy: Identification of prokaryotes; Phylogeny of prokaryotes; Identification of Bacteria; Identification from growth characteristics; Other methods of identification; Identification of pathogens; Inference of phylogeny from rRNA gene sequence; Bacterial phylogeny; The molecular clock concept; Ribosomal RNA (rRNA); Acquisition of 16S rRNA gene sequence; 16S rRNA gene bioinformatics; Kingdom Prokaryotae; Bacteria; The bacterial cell wall; Shapes of bacteria; Reproduction; Binary fission in Escherichia coli; Conjugation, transformation and transduction; Plasmids; the economic importance of bacteria; Cyanobacteria (blue-green bacteria); Structure of cyanobacteria; Nitrogen fixation; The economic importance of blue-greens; Kingdom Protoctista; The economic importance of protozoa; Kingdom fungi; Phylum Zygomycota (zygomycetes); Phylum Ascomycota (ascomycetes); Phylum Basidiomycota (basidiomycetes); Fungal spores; Viruses; Structure of viruses; Shapes of viruses; The life cycle of a virus; Viruses as disease-causing agents; Retroviruses; Laboratory safety and aseptic technique; Nutritional requirements; Culture media; Selective media; The production of sterilized nutrient media; To prepare sterile nutrient agar plates; Inoculating solid and liquid media; Growth in bacteria; Total counts; Viable counts; Constructing a growth curve; Continuous cultures; Growth in fungi; Growth curve for a filamentous fungus; Factors affecting microbial growth; Growth of bacteriophages

No	Information of the subject	
1	Unit name:	Organic chemistry
2	Code:	BioT21031
3	Classification:	Core subject
4	Credit value:	3
5	Semester/ Year Offered:	1/2
6	Pre-requisite:	Ten Standard Chemistry, Che 11011 Engineering Chemistry
7	Mode of delivery:	Explain by Drawing structure and equations, Solving problems, computer application, Practical, Quiz, Discussion
8	Assessment system and breakdown of marks:	Fill in the blanks, Multiple choice, short questions,problems, short notes,practical
	Fill in the blanks, Multiple choice, problems , short questions, Short notes	70%
	practical results, practical exam, Animation and viva test	30%
9	Academic staff teaching unit:	Department of Biotechnology
10	Course outcome of unit: After completion of this course, students will be able To rank increasing or decreasing order of boiling points, melting points, and solubility of organic compounds To assign the stereoisomers of compounds To differentiate SN1, SN2, E1, or E2 mechanism the reactions of alkyl halides To write preparation and reaction mechanisms of alcohol, ether, and epoxides To classifythe reactions must be oxidation or reduction To determine the structure of the compounds by using general features of mass spectrometry and IR spectroscopy	
11	Synopsis of unit: All biomolecules are organic compounds; therefore organic chemistry is the core supplements for the biotechnologist and researchers. The valuable information from this subjectwill fulfillthe variable requirements of human.Organic chemistry is the basic for further study of biochemistry that is important for biotechnology. Organic molecules with different functional groups can give different physical and reactive	

	properties. These effects are occurred in nylon production, soap solubility, and solubility of vitamins. The role of stereochemistry occur in chiral drugs productions, determination of odor of leaves, nerve impulse transmission etc. In cells adrenaline are produced by nucleophillic substitution reactions. Both nucleophillic and elimination reactions are used in industrial products productions such as aspirin synthesis, quinine synthesis, pesticide, plastic, and fruit ripening.Bronchodilators from epoxide are used to treat asthma. Oxidation reduction reactions are the main role in biochemical reactions of the cells. Oxidation reduction reactions are applied in green chemistry. Mass spectrometry, and IR methods are very useful for research areas such as protein structure determination, molecular weight identification, and functional group determination.
12	Topic: 3 Introduction to Organic Molecules and Functional Groups 3.1 Functional Groups 3.2 An Overview of Functional Groups 3.3 Intermolecular Forces 3.4 Physical Properties 3.5 Application: Vitamins 3.6 Application of Solubility: Soap 3.7 Application: The Cell Membrane 3.8 Functional Groups and Reactivity 3.9 Biomolecules 5 Stereochemistry 5.1 Starch and Cellulose 5.2 The Two Major Classes of Isomers 5.3 Looking Glass Chemistry—Chiral and Achiral Molecules 5.4 Stereogenic Centers 5.5 Stereogenic Centers in Cyclic Compounds 5.6 Labeling Stereogenic Centers with R or S 5.7 Diastereomers 5.8 Meso Compounds 5.9 R and S Assignments in Compounds with Two or More Stereogenic Centers 5.10 Disubstituted Cycloalkanes 5.11 Isomers—A Summary 5.12 Physical Properties of Stereoisomers 5.13 Chemical Properties of Enantiomers **7** Alkyl Halides and Nucleophilic Substitution 7.1 Introduction to Alkyl Halides 7.2 Nomenclature 7.3 Physical Properties 7.4 Interesting Alkyl Halides 7.5 The Polar Carbon–Halogen Bond 7.6 General Features of Nucleophilic Substitution

	7.7 The Leaving Group 7.8 The Nucleophile 7.9 Possible Mechanisms for Nucleophilic Substitution 7.10 Two Mechanisms for Nucleophilic Substitution 7.11 The SN2 Mechanism 7.12 Application: Useful SN2 Reactions 7.13 The SN1 Mechanism 7.14 Carbocation Stability 7.15 The Hammond Postulate 7.16 Application: SN1 Reactions, Nitrosamines, and Cancer 7.17 When Is the Mechanism SN1 or SN2? 7.18 Vinyl Halides and Aryl Halides 7.19 Organic Synthesis 8 Alkyl Halides and Elimination Reactions 8.1 General Features of Elimination 8.2 Alkenes—The Products of Elimination Reactions 8.3 The Mechanisms of Elimination 8.4 The E2 Mechanism 8.5 The Zaitsev Rule 8.6 The E1 Mechanism 8.7 SN1 and E1 Reactions 8.8 Stereochemistry of the E2 Reaction 8.9 When Is the Mechanism E1 or E2? 8.10 E2 Reactions and Alkyne Synthesis 8.11 When Is the Reaction SN1, SN2, E1, or E2? 9 Alcohols, Ethers, and Epoxides 9.1 Introduction 9.2 Structure and Bonding 9.3 Nomenclature 9.4 Physical Properties 9.5 Interesting Alcohols, Ethers, and Epoxides 9.6 Preparation of Alcohols, Ethers, and Epoxides 9.7 General Features—Reactions of Alcohols, Ethers, and Epoxides 9.8 Dehydration of Alcohols to Alkenes 9.9 Carbocation Rearrangements 9.10 Dehydration Using POCl3 and Pyridine 9.11 Conversion of Alcohols to Alkyl Halides with HX 9.12 Conversion of Alcohols to Alkyl Halides with SOCl2 and PBr3 9.13 Tosylate—Another Good Leaving Group 9.14 Reaction of Ethers with Strong Acid 9.15 Reactions of Epoxides 9.16 Application: Epoxides, Leukotrienes, and Asthma 9.17 Application: Benzo[*a*]pyrene, Epoxides, and Cancer 12 Oxidation and Reduction 12.1 Introduction 12.2 Reducing Agents 12.3 Reduction of Alkenes 12.4 Application: Hydrogenation of Oils 12.5 Reduction of Alkynes 12.6 The Reduction of Polar C–X σ Bonds

	12.7 Oxidizing Agents 12.8 Epoxidation 12.9 Dihydroxylation 12.10 Oxidative Cleavage of Alkenes 12.11 Oxidative Cleavage of Alkynes 12.12 Oxidation of Alcohols 12.13 Green Chemistry 12.14 Application: The Oxidation of Ethanol 12.15 SharplessEpoxidation 13 Mass Spectrometry and Infrared Spectroscopy 13.1 Mass Spectrometry 13.2 Alkyl Halides and the M + 2 Peak 13.3 Other Types of Mass Spectrometry 13.4 Electromagnetic Radiation 13.5 Infrared Spectroscopy 13.6 IR Absorptions 13.7 IR and Structure Determination
14	Main references: Organic Chemistry Second EditionJanice Gorzynski Smith University of Hawai'i at Manoa
5	Additional references: Organic Chemistry Third EditionJanice Gorzynski Smith University of Hawai'i at Ma-noa

No.	Information of the subject	
1.	Unit name:	Bioprocess Engineering I
2.	Code:	BioT21051
3.	Classification:	Core subject
4.	Credit value:	3.5
5.	Semester/Year Offered:	1/2
6.	Pre-requisite:	-
7.	Mode of delivery:	Presentations, Lectures, Discussion
8.	Assessment system and breakdown of marks:	Class work, Tutorials
	Practical	30%
	Mid-term exam	35%
	Final exam	35%
9.	Academic staff teaching unit:	Department of Biotechnology
10.	Course outcome of unit: After completion of this course, students will be able to 1. to study the basic principles and calculation techniques used in the field of chemical and bioprocess engineering 2. to explain process variables and their importance in real-world engineering problems 3. to explain the fundamentals of material balanceas applied to chemical and bioprocess engineering andsolve the material balance problems	
11.	Synopsis of unit: Biotechnology is an inter-disciplinary applied science and those scientists trained in molecular biology and cell manipulation shall fulfil only a part of complete picture of biotechnology. Bringing out the full benefits of biotechnology requires sustainable manufacturing capability involving large-scale processing of biological material. In that sense, this course will fill the gap of the engineering knowledge and practices which are becoming a norm in the current trend of biotechnology in Myanmar.	
12.	Topics 1. System of units 2. Conversion of units 3. Significant Figures 4. The Mole and Molecular weight 5. Density and Specific gravity 6. Temperature	

	7. Pressure and Hydrostatic head 8. Introduction to Material balance 9. General strategy for solving material balance problems
13.	Main reference: • David M. Himmelblau and James B.Riggs, "Basic Principles and Calculations in Chemical Engineering", 8th Edition. Prentice Hall International Series.
14.	Additional references: • Pauline M. Doran, "Bioprocess Engineering Principles", Academic Press, An Imprint of Elsevier • Richard M. Felder and Ronald W. Rousseau, " Elementary Principles of Chemical Processes", 3rd Edition, John Wiley and Sons, Inc.

No.	Information of the subject	
1.	Unit name:	Molecular Genetic
2.	Code:	BioT 22041
3.	Classification:	Core subject
4.	Credit value:	3.5
5.	Semester/Year Offered:	2/2
6.	Pre-requisite:	NA
7.	Mode of delivery:	Presentations, Lectures
8.	Assessment system and breakdown of marks:	Tutorial
	Tutorial	20%
	Mid-term exam	40%
	Final exam	40%
9.	Academic staff teaching unit:	Department of Biotechnology
10.	Course outcome of unit: After completion of this course, students will be able to 1. learn the structure of DNA and chromosome organization 2. Recognize the mechanism of DNA replication in both prokaryotes and eukaryotes 3. Realize the different types of RNAs and their functions produced in prokaryotes and eukaryotes and transcription mechanisms in both cell types 4. Describe the general structure of amino acids, levels of protein structure and translation mechanisms in both prokaryotes and eukaryotes 5. Realize the different types of mutations and their causes	
11.	Synopsis of unit: This module of molecular genetics is designed to give the knowledge and comprehension of the structure of DNA and chromosome, DNA replication, gene expression and control in both prokaryotes and eukaryotes and mutations.	
12.	Topics 1. DNA Structure and Chromosome Organization 2. DNA Replication 3. Gene Expression – Transcription 4. Gene Expression – Translation 5. Mutations	
13.	Main reference: • David R Hyde: “Introduction to Genetic Principles”	
14.	Additional references: • Waston et al., “Molecular Biology of the Gene”	