



North South University

Department of Biochemistry & Microbiology

School of Health & Life Sciences

North South University

Bashundhara, Dhaka 1229

Revised (updated) Curriculum

**Bachelor of Science in Microbiology
(120 credits)**

Revised Curriculum (updated)
Bachelor of Science in Microbiology (BS MIC)
Department of Biochemistry & Microbiology

Minimum credit requirement: 120 CREDITS

About the program:

Study of microorganisms known as microbiology has been the key to understanding of how a cell works. Microorganisms are extremely important in our everyday lives being responsible for a significant proportion of the diseases affecting not only humans, but also plants and animals, while others are vitally important in the maintenance and modification of our environment and others play an essential role in industry, where their unique properties have been harnessed in the production of food, beverages and antibiotics.

Microorganisms provide the models used in molecular biology for research. This research at the molecular level has provided and continues to provide, the answers to numerous fundamental questions in genetics, metabolism, and cell forms and functions. Recombinant DNA technology, commonly referred to as genetic engineering, is one of the principal thrusts of the emerging high technologies in the biological sciences. Recombinant DNA technology makes it feasible to consider genetically manipulated microorganisms for commercial production of new and valuable products for a variety of purposes, e.g., medicinal, fuel, and food.

The Bachelor of Microbiology is a 4 years degree program, which will be offered as a dual semester basis. In this curriculum, principal emphasis is placed on understanding microorganisms and their interrelationships with other organisms in nature, the application of microbiology in health and medicine, environment, agriculture and industry, and the study of fundamental life processes as exemplified by microorganisms. Undergraduate study in the department is designed to provide sound preparation for graduate study, training for bachelors-level employment, and admission into graduate and postgraduate studies in universities at home and abroad.

Curriculum:

BS in Microbiology degree program requires a minimum of 120 CREDITS in about 4 years/8 semesters to complete. The breakdown of the 120 CREDITS are given below:

Category	CREDITS
University Core	28
School of Health & Life Sciences Core	25
MIC Major Core	49
MIC Major Electives	9
Open Electives	9
Total	120 CREDITS

BS Microbiology (MIC) (120 CREDITS)

UNIVERSITY CORE (28 CREDITS)

Languages (9 CREDITS)

ENG102; ENG103	Introduction/Intermediate Composition	3/6
ENG105	Advanced Composition	3
ENG111	English Speech/Professional Communication	3
BEN205	Bengali language & Literature	3

Humanities (3 CREDITS)

HIS101	Bangladesh History & Culture	3
HIS103	Emergence of Bangladesh	3
PHI101	Introduction to Philosophy	3

Social Sciences (3 CREDITS)

POL101/POL104	Political Science/ Governance	3
ECO101/ECO104	Micro-/Macro-Economics	3
SOC101/ANT101	Sociology/Anthropology	3

Computer & Math skills (9 CREDITS)

MIS105	Introduction to Computers	3
MAT116	Pre-calculus	in SHLS core 3
BUS172	Introduction to Statistics	in SHLS core 3

Sciences (*with Lab*) (4 CREDITS)

BIO103	Biology I	4
CHE101	Chemistry I	in SHLS core 4
PHY107	Physics I	4

Science/School of Health & Life Sciences core (25 CREDITS)

MAT116	Pre-calculus	GE	3
BUS172	Introduction to Statistics	GE	3
BBT203	Biostatistics		3
CHE201	Biophysical Chemistry		3
MIC203	Chemistry of Microorganisms		3

With Lab

MIC110/BBT101/BIO201	Introduction to Biochemistry& Biotechnology		4
MIC101/BIO202	Basic Microbiology		4
CHE101	Chemistry I	GE	4
CHE202	Bio-Organic Chemistry		4

Major Required Courses		(49 CREDITS)
MIC202	Basic techniques in Microbiology	3
MIC206	Microbial Taxonomy	3
MIC207	Bacterial Physiology and Metabolism	3
MIC307	Microbial Genetics	3
MIC314	Environmental Microbiology & Bioremediation	3
MIC401	Microbial Biotechnology	3
MIC412	Bacterial Pathogenesis	3

With Lab

MIC315	Infectious Diseases & Diagnostic Microbiology	4
MIC316	Molecular Biology	4
MIC317	Immunology	4
MIC413	Virology	4
MIC414	Food Microbiology and Quality Control	4
MIC415	Mycology	4
MIC498	Research methodology and project	4

ELECTIVE COURSES		(9 CREDITS)
MIC201	Microbial Ecology	3
MIC309	Enzymology	3
MIC311	Bioinformatics	3
MIC318	Agricultural microbiology & Plant pathology	3
MIC404	Pharmaceutical Microbiology	3
MIC416	Cell Biology	3
MIC417	Applied Immunology & Immunogenetics	3
MIC418	Algology	3

FREE ELECTIVE COURSES		(9 CREDITS)
------------------------------	--	--------------------

Course Syllabus:

UNIVERSITY CORE (28 CREDITS)

Languages

(9 CREDITS)

ENG102/ENG103	Introduction/Intermediate Composition	3/6
ENG105	Advanced composition	3
ENG111	English speech/Professional Communication	3
BEN205	Bengali language & Literature	3

- ENG102** **Introduction to Composition:** Development of integrated language skills with special focus on the mechanics of the writing process and the study of grammar with an emphasis on syntax. Writing unified, coherent paragraphs with topic sentences and controlling ideas. 3 CREDITS
- ENG103** **Intermediate Composition:** The practice of academic reading and especially writing, focusing on expository essays. Emphasis will be placed on essay structure and editing. Essay types include narrative, descriptive, process, cause and effect, and comparison and contrast. Prerequisite: ENG 102/Waiver. 3CREDITS
- ENG105** **Advanced Composition:** Continued work on analytic reading and on fluency and control of the writing process. Emphasis on sentence structure, organization, paragraphing, coherence and cohesion. Development of expressive, persuasive and referential writing with emphasis on planning, organization, cohesion and coherence. Participating in small group discussions and seminars. Employing appropriate mechanics of formal speech. Further practice in research techniques. Project work. Considered as GED requirement for students other than students of English. 3 CREDITS
- ENG111** **English speech/Professional Communication:** This course introduces students to the fundamental principles and practices of rhetoric. They will learn the art of public speaking which involves persuasion, creative analysis and synthesis of topics, organization, language, delivery, audience awareness and adaptation and the use of supporting materials. Types of speeches will include informative, persuasive, impromptu, inspirational, and special occasion speeches. Prerequisite: ENG 103. 3 CREDITS
- BEN205** **Bengali Language & Literature:** Styles of prose, standard, colloquial and dialect are taught. Review and practice of basic grammar and syntax and introduction to language skills; and development of integrated language skills with special focus on the mechanics of the language, important aspects of grammar and vocabulary. This course will aim to show the trend of Bengali literature in the last 100 years by exposing the students to the popular work of major Bengali poets, short story writers, novelists and essayists. 3 CREDITS

Humanities**(3 CREDITS)**

HIS101	Bangladesh History & Culture	3
HIS103	Emergence of Bangladesh	3
PHI101	Introduction to Philosophy	3

HIS101 **Bangladesh History & Culture:** Deals with the cultural and political heritage of Bangladesh from ancient times to the present and familiarizes students with the cultural milieu of the people to make them aware of Bangladesh's national identity. Topics include ethnic origin of the people in Bangladesh, religious faiths, festivals, colonial legacy; baul culture; creativity in the arts and crafts; evolution of nationalism in the pre and post-partition East Bengal, Language Movement, struggle for autonomy, and the independence of Bangladesh. 3 CREDITS

HIS103 **Emergence of Bangladesh:** This course traces the historical roots of Bangladesh as an independent state. The emergence of Bangladesh indicates the development of the ideas of Bangladeshi nationalism and the desire of regional freedom from an earlier date. The political, economic, social and cultural vicissitudes which led to the manifestation of provincial autonomy and finally to independence, developed over several decades; these elements in the emergence of Bangladesh will be explored in great depth. At the end of the course, students will be able to understand the inner significance of the rise of Bangladesh and will attain a closer understanding of the manifold issues surrounding the liberation of Bangladesh through an historical perspective. 3 CREDITS

PHI101 **Introduction to Philosophy:** An exploration of some basic philosophical topics such as the nature of the mind and its relationship to the brain, knowledge, freewill, justice, the existence of God, and mortality. It focuses specially on the nature and function of philosophy. Part or all of the focus of the course may be on the work of one or two philosophers. 3 CREDITS

Social Sciences**(3 CREDITS)**

POL101/POL104	Political Science/Governance	3
ECO101/ECO104	Micro-/Macro-Economics	3
SOC101/ANT101	Sociology/Anthropology	3

POL101 **Political Science:** Provides students with some of the core concepts of political science, such as state, sovereignty, constitutionality, political culture, democracy, political party, civil society and the functioning of major political systems including Bangladesh. It addresses issues, institutions and structures that correspond to our everyday life and shape our political behavior and perceptions as 'political animal'. 3 CREDITS

- POL104** **Introduction to Governance:** Introduces students with the concept and various aspects of public governance and their relevance in Bangladesh. Topics include: accountability, transparency, participation, freedom of information, sound judicial system, capacity building; major governance problems of Bangladesh; role of civil society (including media, NGOs etc.); relationship between better governance and the growth of private sector; donor's agenda in governance; public sector corruption; implications of e-governance. 3 CREDITS
- ECO101** **Introduction to Microeconomics:** An introduction to the methods and principles of microeconomics. Topics include: markets; theory of consumer behaviour; production theory; costs of production, and market structure; efficiency in allocation and production. 3 CREDITS
- ECO104** **Introduction to Macroeconomics:** This course introduces the principles of macroeconomic analysis, its analytical methods with current institutional and empirical issues. Topics include different methods of national income accounting with special emphasis on Bangladesh Economy; issues relating to unemployment, inflation; determination of output, price level, money and banking. It also gives an introductory account of the monetary and fiscal policies; budget and trade deficits; and exchange rate. 3 CREDITS
- SOC101** **Introduction to Sociology:** Provides students with an understanding of the primary phenomena, concepts, issues and practices associated with sociology. Topics include explanation of how societies grow and change; reciprocal effects of economic, political, familial, and scientific institutions on each other and on individual life; changes and social conflict, problems of bureaucratic growth and planned and unplanned social change. 3 CREDITS
- ANT101** **Introduction to Anthropology:** Explains the origin of human culture and society and addresses the concepts of fundamental phenomena and procedures of cultural change, impact of culture on personality development, structures of human relationships etc. Students are also introduced to basic research methods that help them develop the primary skills to study human behaviors. 3 CREDITS

Computer & Math skills

(9 CREDITS)

MIS105	Introduction to Computers	3
MAT116	Pre-calculus	3
BUS172	Introduction to Statistics	3

- MIS105** **Introduction to Computers:** Provides a general understanding of computer applications and functions of the components of a computer system. Topics include components of computer systems; concepts of software; introduction to operating systems; history of computer languages; programming fundamentals; basics such as constant, variables, data

type, operators and expressions, pointer; concepts of database; internet technology and World Wide Web. Course is conducted in a lab setting and provides functional orientation to word processing, spreadsheet, presentation, and database and WebPages design. Students also learn some basic skills in searching and evaluating online resources. Cross listed with BBt103. 3 CREDITS

MAT116 **Pre-calculus:** Topics includes sets, real number system, algebraic expressions, systems of equations, functions and relations, quadratic functions, synthetic division, the zeros of a polynomial function, exponential and logarithmic functions, trigonometric functions, graphs of trigonometric functions, analytic trigonometry, additional applications of trigonometry, mathematical induction, the binomial theorem, sequences. Prerequisite: High School Mathematics. MAT112/waiver. 3 CREDITS

BUS172 **Introduction to Statistics:** Introduces modern theory and methodology of statistics and their application in economics and business. Topics include descriptive statistics, probability theory, sampling theory and methodology, sampling distributions and hypothesis testing. Computer application is a compulsory component for the course. 3 CREDITS

Science (with Lab)		(4 CREDITS)
BIO103	Biology I	4
CHE101	Chemistry I	4
PHY107	Physics I	4

BIO103 **Biology I:** Introduction to Biology: Scope, Biology, What is life? and Characteristics of living things; Chemistry of life: Atoms & elements, Molecules & bonds, Electronegativity, Polar & non-polar bonds, Diffusion & osmosis, pH; Biological Macromolecules: Carbohydrate, Lipid, Protein and Nucleic acids, Central dogma of molecular biology; Cell structure and function: Organelles description & level of organization; Cellular Reproduction: Cell cycle, Cell Division, Mitosis, Meiosis; Energy of Life: Cellular respiration (anabolism & catabolism); Enzymes definition and characterization; Photosynthesis; Biological Diversity: Evolution and natural selection, the origin and diversification of life on earth; Evolution of microbes & animals, Classification; Human Physiology: Homeostasis, digestive system, circulatory (blood), excretory and respiratory systems; Health and disease: Food & nutrition; diabetics, cancer and heart disease.

Laboratory Work: Determining the pH of given food/juice/beverage samples, Observing a single cell under light microscope and identification of organelles, Observing bacterial growth from microbial plating, Observing antibiotic activity of saliva/tears, Blood grouping, Determination of serum glucose by glucose oxidase method. 4 CREDITS

CHE101 **Chemistry I:** This course covers fundamental principles of chemistry. Topics include measurement, atomic and molecular structure, periodicity, chemical reactions, chemical

bonding, stoichiometry, thermochemistry, Chemical Equilibrium and Kinetics, gas laws and solutions. This course is appropriate as a basic chemistry course or as a science elective for students who have science, engineering, or mathematics majors. Upon completion, students will be able to- Define chemistry as the study of matter, can apply the basic concepts in their future studies and apply safe laboratory skills to solve problems in a cooperative environment.

Laboratory Work: Introducing analytical balance, proving the law of definite proportions, estimation of Avogadro's number, standardization of HCl, acid-base titration, determination of density. 4 CREDITS

PHY107L **Physics I:** Vectors, Kinematics, Newton's Law, Conservation of Energy and Momentum, Rotational Kinematics, Conservation of Angular Momentum, Collision, Compton Effect, Nuclear Theory, DeBroglie, Oscillations and Waves, Gravitation. *The lab component includes:* Measurement of length area and volume of solids of regular shapes using vernier caliper, micrometer screw gauge and spherometers. This simple experiment will introduce the students to precision in measurements, error and propagation of error. This knowledge is of fundamental importance, which will be applied in all subsequent experiments, Free fall experiment. To find the time of fall through a given distance and to determine the acceleration of free fall. Apparatus required: Light gates and timer, To study equilibrium of a rigid body. Apparatus needed: force table, pulleys, and weights, To study rectilinear motion on an inclined plane. Apparatus: board, electronic timers or ticker tape timers, light gate etc. Plot of v-t and a-t graphs, To find acceleration of free fall using Atwood's machine. Apparatus: pulley, known masses and electronic timer, Measurements of the coefficients of static and dynamic friction. Apparatus: wooden blocks, spring balance, known weights etc, Motion of a ball bearing through a resistive medium. To measure the viscosity of glycerin by Stokes' law. Apparatus: measuring cylinder, stop watch, steel ball bearings, meter rule, and thermometer, Simple harmonic motion 1. Measurement of g by simple pendulum, Simple harmonic motion 2. Vibration of a vertical spring-mass system, measurements of the spring constant and the acceleration of free fall, Study of damped and forced harmonic oscillator. Apparatus: carts, motor, springs, motion sensors etc, Rotational motion. Measurement of moment of inertial of a flywheel, Foucault's pendulum and the effect of Earth's rotation, To study the rotational motion of a cylinder down an incline. The objective of this experiment is to become familiar with the relationships involving angular acceleration and moments of inertia, Conservation of momentum and kinetic energy in elastic collisions. Apparatus: air track, gliders, light gates, timers etc, Study of one-dimensional inelastic collisions. Apparatus: air track. Prerequisite: MAT 120 and Physics in HSC/A Level. 4 CREDITS

SCIENCE/SCHOOL OF HEALTH & LIFE SCIENCES CORE**(25 CREDITS)**

MAT116	Pre-calculus	GE	3
BUS172	Introduction to Statistics	GE	3
BBT203	Biostatistics		3
CHE201	Biophysical Chemistry		3
MIC203	Chemistry of Microorganisms		3

With lab

MIC110/BBT101/BIO201	Introduction to Biochemistry and Biotechnology		4
MIC101/BIO201	Basic Microbiology		4
CHE101	Chemistry I	GE	4
CHE202	Bio-Organic Chemistry		4

MAT116 (GE) **Pre-calculus:** Topics includes sets, real number system, algebraic expressions, systems of equations, functions and relations, quadratic functions, synthetic division, the zeros of a polynomial function, exponential and logarithmic functions, trigonometric functions, graphs of trigonometric functions, analytic trigonometry, additional applications of trigonometry, mathematical induction, the binomial theorem, and sequences. Prerequisite: High School Mathematics. MAT112/waiver. 3 CREDITS

BUS172 (GE) **Introduction to Statistics:** Introduces modern theory and methodology of statistics and their application in economics and business. Topics include descriptive statistics, probability theory, sampling theory and methodology, sampling distributions and hypothesis testing. Computer application is a compulsory component for the course. 3 CREDITS

BBT203 **Biostatistics:** This class presents fundamental concepts in data analysis and statistical inference, focusing on one and two independent samples. Students having taken this class should be able to summarize samples, perform relevant hypothesis tests and perform a collection of two sample comparisons. Classical non-parametric methods and discrete data analysis methods are discussed. The topics cover: Hypothesis Testing; Power and sample size and two group tests; Tests for binomial proportions; Two sample binomial tests, delta method; Fisher's exact tests, Chi-squared tests; Simpson's paradox, confounding; Retrospective case-control studies, exact inference for the odds ratio; Methods for matched pairs, McNemar's, conditional versus marginal odds ratios; Non-parametric tests, permutation tests; Inference for Poisson counts; and Multiplicity. 3 CREDITS

CHE201 **Biophysical Chemistry :** Thermodynamics - First law, Second law and Introduction, definitions, Thermodynamic terms and basic concepts; Thermochemistry, Exothermic and endothermic reactions, standard enthalpy of formation, thermochemical equations; The nature of chemical equilibrium, law of mass action, equilibrium constant, relationship between ΔG and K_{eq} , effect of temperature and pressure, Le Chatelier's principle,, Chemical Kinetics and it Definition, reaction rate, rate laws, order reactions, molecularity of a reaction, pseudo first order reaction, half-life, Catalysis, Photochemistry and

Spectrophotometry, Transmittance and absorbance, Beer-Lambert law, Properties of liquids, Acids and bases.

Laboratory Work: The laboratory section includes following experiments: Calibration of the calorimeter, determining the heat of fusion of ice, determination of specific heat of an unknown metal, determination of heat of solution and heat of neutralization, determination of second order reaction: iodination of aniline by measuring the optical density of reaction medium. 3 CREDITS

MIC203 **Chemistry of Microorganisms:** Biomolecules and Biopolymers - Structure and function of different macromolecules i.e. Nucleic acids, Proteins and Carbohydrates; Chemical composition and function of Prokaryotic and Eukaryotic cell walls and cell membranes; Chemical composition and function of capsules, slime layers, pili and fimbriae, cytoplasmic matrix, cilia, flagella, inclusion bodies and pigments; Structure of ribosomes and mechanism of protein synthesis in prokaryotic cells; Endospores- structure & biological function, Antimicrobial agents and their mode of actions - i) Control of microorganisms by physical and chemical agents, Antibiotics and their mode of actions, Mechanisms of antibiotic resistance in bacteria.3 CREDITS

**MIC110/
BBT101/
BIO201** **Introduction to Biochemistry and Biotechnology:** This course introduces history, scope and future of Biochemistry and biotechnology. Students learn the basic logics of living organisms, the role of bio-molecules and their interrelationship. The course provides following introductory concepts: i) define and explain the basic concepts in biochemistry; ii) various biochemical pathways; iii) define the biological macromolecules and their subunits; iv) basic applied concepts in biochemistry to biotechnology; v) explain the underlying concepts in biotechnology; and vi) relate the biochemical properties and their principles as tools of biotechnology.

Laboratory work: Main objective of the laboratory section is to bring experience in solving practical problems in biochemistry laboratory, to acquire applicable skills and to teach students to derive conclusions from experiments. Biochemistry part also demonstrates methods of clinical biochemistry and their significance for diagnosis of diseases. 4 CREDITS

**MIC101/
BIO202** **Basic Microbiology:** The History and Scope of Microbiology; Classification of Microorganisms: Taxonomy, Naming and Classifying Microorganisms, The Genus and the Species Concepts, The Main Classification Groups, The Study of Phylogenetic Relationships; Functional Anatomy of Prokaryotic and Eukaryotic Cells: The structures of Prokaryotic cells, The structures of Eukaryotic cells, Comparison of both Prokaryotic and eukaryotic cell; Introduction to the Archaea: Salient Features, Extreme Environment and Extremophiles; Survey of Prokaryotic Groups with Unusual Characteristics; An Introduction to the Viruses: Novel Properties of Viruses, General Structure of Viruses, Viral Multiplication, Viroids and Prions; The Kingdom of the Fungi: General Structure, Nutrition, Reproduction; Algae: Distribution, Nutrition, Ultrastructure, Reproduction; The Growth of Bacterial Cultures: Bacterial Division, Generation Time, Logarithmic Representation of Bacterial Populations, Phases of Bacterial Growth, Growth requirements- physical and

chemical; Microscope and Microscopy: Brightfield microscopy, Darkfield microscopy, Phase contrast microscopy, Fluorescence microscopy, Electron microscopy, Preparation and staining of specimens for microscopy; Methods of Culturing Microorganisms: Inoculation, Incubation, Isolation, Inspection and Identification of Microorganism, Types of Media, Pure Culture Techniques, Preservation of Pure Cultures

Laboratory work: Different staining techniques, Media for the Routine cultivation of Bacteria: Serial Dilution, Pour plate, Spread Plate, Streak plate Drop plate methods. Fermentation of Glucose, Sucrose, Lactose; Methyl red test; Voges-Proskauer test; Oxidase test; Catalase test; Indole Production, Citrate utilization test, Gelatin hydrolysis, Urea hydrolysis. Presumptive Identification of Unknown Bacteria Based on their Biochemical Activities. 4 CREDITS

**CHE101
(GE)**

Chemistry I: This course covers fundamental principles of chemistry. Topics include measurement, atomic and molecular structure, periodicity, chemical reactions, chemical bonding, stoichiometry, thermochemistry, Chemical Equilibrium and Kinetics, gas laws and solutions. This course is appropriate as a basic chemistry course or as a science elective for students who have science, engineering, or mathematics majors. Upon completion, students will be able to- Define chemistry as the study of matter, can apply the basic concepts in their future studies and apply safe laboratory skills to solve problems in a cooperative environment.

Laboratory Work: Introducing analytical balance, proving the law of definite proportions, estimation of Avogadro's number, standardization of HCl, acid Base titration, determination of density. 4 CREDITS

CHE202

Bio-Organic Chemistry: This course is a comprehensive introduction in fundamental aspects of biological chemistry, for freshmen students. Knowledge of structure, functionality and reactivity of the organic molecules is vital for understanding the mechanism of numerous biological processes and biochemical reactions. This course provides a foundation of organic chemistry, i.e. the understanding of structure, properties, interactions, transformations and nomenclature of organic compounds. Major topics included: Structure & Properties of the Organic Compounds & Bonding; Saturated Hydrocarbons: Alkanes and Cyclic Alkanes; Unsaturated Hydrocarbons: Alkenes & Alkynes; Introduction to Isomerism; Alkyl Halides; Introduction to Aromaticity: Benzene and its derivatives; Alcohol, Phenols & Ethers (-OH group/derivatives); Chemistry of Carbonyl (-CO-) compounds and carboxylic acid derivatives.

Laboratory Work: The students will get practical experiences on the detection of an unknown organic compound based on their physical and chemical properties. Emphasis will be given on the nature of different laboratory solutions and how to prepare them accurately. Moreover students will also get basic idea how to detect specific organic compound present in biological sample. A number of specific organic reactions will also be demonstrated in this lab. 4 CREDITS

MAJOR REQUIRED COURSES**(49 CREDITS)**

MIC202	Basic techniques in Microbiology	3
MIC206	Microbial Taxonomy	3
MIC207	Bacterial Physiology and Metabolism	3
MIC307	Microbial Genetics	3
MIC314	Environmental Microbiology & Bioremediation	3
MIC401	Microbial Biotechnology	3
MIC412	Bacterial Pathogenesis	3

With Lab

MIC315	Infectious Diseases & Diagnostic Microbiology	4
MIC316	Molecular Biology	4
MIC317	Immunology	4
MIC413	Virology	4
MIC414	Food Microbiology & Quality Control	4
MIC415	Mycology	4
MIC498	Research Methodology and Project	4

MIC202 **Basic techniques in Microbiology:** Microscope and Microscopy: Brightfield microscopy, Darkfield microscopy, Phase contrast microscopy, Fluorescence microscopy, Electron microscopy, Preparation and staining of specimens for microscopy, Nutritional types of microorganisms, Physical requirements for microbial growth, Chemical requirements for microbial growth, Culture media: Chemically defined media, Complex media, Anaerobic growth media and methods, Selective and differential media, Enrichment culture, Isolation of pure cultures, Preservation of pure cultures, The growth of bacterial cultures, Direct measurement of microbial growth, Indirect measurement of microbial growth, The control of microbial growth: i) Physical methods , ii) Chemical methods. 3 CREDITS

MIC206 **Microbial Taxonomy:** Introduction to Diversity and Taxonomy, Origin and Diversification of life: Formation and Early History of Earth, Photosynthesis and the Oxidation of Earth, Endosymbiotic Origin of Eukaryotes; Living Fossils: DNA Records the History of Life, Molecular Phylogeny: Obtaining DNA Sequences, Sequence Alignment, Phylogenetic Trees; Microbial Evolution: The Evolutionary Process, The Evolution of Microbial Genomes; Microbial Taxonomy: Taxonomic ranks, Nomenclature rules and Identification; Classification systems; Methods of Classifying and Identifying Microorganisms: phenotypics methods, Genotypics methods; Divisions of Life; Classification of bacteria based on Bergey's manual.3 CREDITS

MIC207 **Bacterial Physiology and Metabolism:** Introduction to metabolisms: Overview, types of metabolic reactions, classification of microorganisms based on carbon and energy sources; Bioenergetics: Biological Energy Transformation- laws of Thermodynamics, Entropy, Enthalpy, Gibbs free energy and related mathematics; Carbohydrate metabolism:

Glycolysis- Embden-Meyerhof-Parsons (EMP) Pathway, Entner-Doudoroff (ED) pathway, Tricarboxylic Acid (TCA) Cycle, Gluconeogenesis, Metabolism of fructose, gluconate, lactose. Hexose Mono-phosphate (HMP) pathway, Glyoxalate cycle; Membrane transport system; Amino acid biosynthesis: Biosynthetic pathways of alanine, valine, leucine, aspartate, asparagine, lysine, methionine, isoleucine, glutamate, glutamine, arginine, proline, serine, glycine, cysteine; Nucleic acid biosynthesis: De novo and Salvage pathways of nucleotide biosynthesis and their regulation; Anaerobic metabolic processes: Carbohydrate fermentation by bacteria and yeast under anaerobic condition; Lipid biosynthesis: Structure and biological function of lipids. Fatty acid and phospholipid biosynthesis; Biological nitrogen fixation; Carbon di-oxide fixation by plants (Photosynthesis). 3 CREDITS

MIC307 **Microbial Genetics:** In this course students will understand some of the most basic concepts of molecular genetics: how genetic information is stored and organized in the DNA molecule, the way in which DNA is replicated, gene structure, and how genes function (i.e., gene expression). Students will also learn about the nature of mutation, DNA repair, and genetic recombination. This is expected that the lessons will be learned from this course will provide the background needed for understanding the material on recombinant DNA technology and microbial genomics. 3 CREDITS

MIC314 **Environmental Microbiology and Bioremediation:** The microbial environment; Biofilms and Microbial mats; The terrestrial environment; Freshwater and Marine environments; Culture dependent analyses of microbial communities; Culture independent microscopic analyses of microbial communities; Biodeterioration, Microorganisms and some novel pollution problems; persistence and biomagnifications of xenobiotic molecules; recalcitrant halocarbons, polychlorinated biphenyls (PCBS), alkyl benzyl sulfonates, synthetic polymer; Biosensors, Waste treatment technologies, Bioremediation technologies. 3 CREDITS

MIC401 **Microbial Biotechnology:** Overview of Microbial Biotechnology; Bioprocess/fermentation technology: The bioreactor, Scale-up, Media design for fermentation processes, Sterilization, Downstream processing; Enzyme technology: The nature of enzymes, The application of enzymes, Production of industrial enzymes using microorganisms, methods of enzyme immobilization; Biomining; Biotechnology and medicine: Pharmaceuticals and biopharmaceuticals, Antibiotics, Vaccines, monoclonal and recombinant antibodies, Therapeutic Hormones; Food and beverage biotechnology: Food and beverage fermentations, Microorganisms as food, Enzymes and food processing, Amino acids, vitamins and sweeteners, Organic acids and polysaccharides; Stem cell biotechnology: The nature of stem cells, Stem cell cultivation, Human-animal embryos, Commercial potential for stem cell therapies; Safety in biotechnology: Concepts of hazard and risk, Problems of organism pathogenicity, Problems of biologically active biotechnology products, Biowarfare and bioterrorism. 3 CREDITS

- MIC412** **Bacterial Pathogenesis:** Principles of bacterial cell biology, including genome plasticity, mobile genetic elements, intracellular signaling, membrane biogenesis; concepts of prokaryotic cell signaling including chemotaxis/motility, cell-cell signaling (quorum sensing, biofilms); bacterial virulence strategies, such as LPS synthesis and expression of carbohydrate receptors; bacterial exploitation of host cell biology: mucosal cell entry, transcytosis, intracellular trafficking and survival, Role of bacterial community with respect to intestinal flora and health, key players of host cell defense: innate receptors, innate effectors (collectins, defensins, sIgA mucus) mechanisms of action of antibiotics and resistance mechanism, integrons, plasmids and efflux pumps , protein secretion systems, pathogenicity islands, bacterial adhesion, immune evasion strategies and novel antibiotics/phage therapy.3 CREDITS
- MIC315** **Infectious Diseases and Diagnostic Microbiology:** Concept of infection and diseases; The spread of infections; Normal resident microflora of human body and their role; Determinants of bacterial pathogenicity and virulence; Mechanisms of bacterial pathogenesis and host defenses with special focus on nosocomial and emerging infectious diseases. Detection of infectious agents of diseases by cultural, molecular and immunological methods; determining appropriate therapy for infectious agents, and processing clinical specimens for optimal recovery of infectious agents.
Laboratory work: Spreading of the infectious agent, Isolation of normal microflora from human skin, Isolation of normal microflora from human throat, Isolation and identification of microorganisms from urine sample, Determination of antibiotic sensitivity of urinary tract infection (UTI) causing microorganisms, Isolation of enteric pathogens from stool by direct plating method. 4CREDITS
- MIC316** **Molecular Biology:** Molecular biology course deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline. This course will emphasize the molecular mechanisms of DNA replication, repair, transcription, protein synthesis, and gene regulation in different organisms. The topics cover in the courses are Introduction to genetics, Basic principles of Heredity, Chromosomal basis of inheritance, The chemical nature of the gene, DNA replication, RNA molecules, Transcription, Post transcriptional modification, Genetic code, Translation and Plasmid features.
Laboratory work: Molecular methods: Isolation of crude and purified genomic DNA from bacteria and onions, Plasmid profiling, Polymerase Chain Reaction (PCR), Assessment of DNA purity by spectrophotometry. 4 CREDITS
- MIC317** **Immunology:** The purpose of this course is to provide a basic knowledge of immunology. This course will provide in-depth understanding of the cells, molecules and organs of the immune system and how they work together to protect us from pathogen. The principal focus of the course will be on studying structural features of the components of the immune system and their functions, innate and adaptive branches of both humoral and cellular responses of the immune system. The course will also assign emphasis on learning the

major mechanisms by which immune cells protect us from different types of pathogens or from cancer cells, how immune cells detect the presence of pathogens and cancer cells, processes that lead to the elimination of pathogens. Studying the structure and function of key immune recognition molecules including antigens, antibodies, antigen receptors, MHC proteins, and cytokines are covered. The course will introduce some immunological assays to detect antigen-antibody interactions.

Laboratory Work: This laboratory part will concentrate on the immunological methods used to evaluate human disease and will include the theoretical basis for tests of immune function, practical laboratory application of assays based on these principles and case-based study. The learning objectives of this unit are to understand the immunological basis for infection and immunity and how these concepts are applied in the diagnostic pathology laboratory. 4 CREDITS

MIC413 **Virology:** Historical development and scope of virology; Basic concepts of viral structure; Nomenclature, classification, cultivation and detection of viruses; The virus replication cycle; Fundamentals of Bacteriophages, Viroids and Prions i.e. structure, replication cycle (lytic/and lysogenic); Pathogenesis and control of viral diseases with special focus on viral diseases of skin, respiratory system and the central nervous system; Human tumor virus i.e. Epstein-Bar virus; Mechanism of viral oncogenesis; Pathogenesis and control of Human papilloma virus (HPV), Hepatitis B virus (HBV) and Human immunodeficiency virus (HIV); Host defenses against viral infection i.e. innate and adaptive immune response, interferon; Antiviral vaccines; Retroviruses as tool for Genetic Engineering. 4CREDITS

Laboratory work: Processing of sewage sample for detection of bacteriophages, Isolation and Enumeration of bacteriophages from sewage sample. Tissue culture techniques.

MIC414 **Food Microbiology and Quality Control:** History and important historical developments in food microbiology; Overview of food borne pathogens and industrially important microorganisms; Factors (intrinsic and extrinsic) affecting growth of microorganisms in foods; Contamination and spoilage of foods by microorganisms. Microorganisms in food i.e. Meat and poultry products, fish and seafood products, cereal, flour and dough products and fermented food products; Methods for detection of microorganisms and/or their metabolic products in food; Food preservation techniques i.e. high temperature, low temperature, drying, radiation and modified atmosphere; Indicators of food safety and quality; Principles of quality control; Hazard analysis and critical control point (HACCP) system; Good manufacturing practice (GMP); Good hygiene practice (GHP); Microbiological risk assessment and management policy; Food laws and regulations.

Laboratory work: Quantitative analysis of water: Membrane Filter Method, Determination of the quality of raw and pasteurized milk by methylene blue reductase test, Determination of total coliforms and other bacteria in fruit juice samples, Detection of *Salmonella* spp. in poultry samples. 4CREDITS

MIC415 **Mycology:** History of Mycology, Fungi: General Characteristics, Fungal habitat and human-fungus interactions, Taxonomy, Nomenclature and classification of fungi, Class :

Oomycetes, Class Zygomycetes: Fermented Foods, Class: Basidiomycetes, Cultivation of mushrooms & other fungi, Spore release and dispersal, Poisonous and hallucinogenic mushrooms, Mycotoxins in the grain and other food products, Class: Ascomycetes: Apothecial, Perithecial, Pseudothecial, Cleistothecial, and Unicellular Ascomycota and Allies, Ergot & ergotism; Mycotoxins in Food, Alcoholic fermentations, cheeses and fungal metabolites, Class Deuteromycetes- The Imperfect fungi: Symbiotic and Parasitic relations, Allergies and Fungal Diseases of Animals & Humans, Antifungal agents, Fungal diseases, Industrial Applications of fungi.

Laboratory work: Estimation of the Total Number of Yeast Cells in a Suspension by Total Cell Count with an "Improved Neubauer" Counting Chamber, Preparation of basic solid media (PDA) agar, slants and agar deep tubes for routine cultivation of fungi. Observation of morphology of molds using slide culture technique. Mold cultivation on solid surfaces, Isolation of yeast from sugary/ starchy materials. 4 CREIDTS

MIC498

Research Methodology and Project

This undergraduate course provides a comprehensive introduction to research proposal writing, research methodologies, and foundational research theories and protocols. Students in this course learn about the cyclical nature of applied research and the iterative process of research writing. The course teaches students how to write a proposal, engage in independent studies, and work collaboratively with a mentor-mentee relationship with a faculty advisor. The curriculum is sequential, helping students to identify a study topic, formulate inquiry questions, organize a literature review, and select appropriate research designs and methodologies. Finally students **establish** the research idea about a given topic in the laboratory. At the end of the course students will convert this proposal into a full research and project work which will include the following sections: findings, discussion, conclusions, and references. 4CREDITS

ELECTIVE COURSES**(9 CREDITS)**

MIC201	Microbial Ecology	3
MIC309	Enzymology	3
MIC311	Bioinformatics	3
MIC318	Agricultural microbiology & Plant pathology	3
MIC404	Pharmaceutical Microbiology	3
MIC416	Cell Biology	3
MIC417	Applied Immunology & Immunogenetics	3
MIC418	Algology	3

MIC201 **Microbial Ecology:** Topics covered in this course are-Basic concept of Microbial Ecology, Microbial Evolution: Origin of life, chemical evolution, evolution of organelle, evolution of biochemical pathways. Biodiversity: Archae, Eukarya, Bacteria. Microbial interaction: Microbe-microbe interaction, Animal - Microbe Interaction. Quantitative ecology: Sample collection, processing and determination of microbial number and biomass. Microorganism on their natural habitat: Hydrosphere, Lithosphere and Atmosphere. Effect of physical factors on microorganisms. 3 CREDITS

MIC309 **Enzymology:** Enzymes as catalyst- Structure, function and importance of enzymes; Enzyme characteristics, catalytic power and specificity of enzymes, Enzyme-substrate interactions: lock and key model, induced-fit model; Enzymes as proteins and protein structure: primary, secondary, tertiary and quaternary structure; protein folding and domains, molecular chaperons; Nonprotein cofactors- metal ions, organic cofactors, Vitamins; Enzyme nomenclature/classification; Mechanism of enzyme catalysis, Conditions affecting enzyme activity and enzyme formation; Inhibition of enzyme action- Irreversible inhibition, Reversible inhibition: Competitive, Un-competitive, Mixed and non-competitive inhibition; Enzyme kinetics- Michaelis-Menten equation, Lineweaver-Burk Double-Reciprocal Plot, Eadie-Hofstee Plot, First-order and zero-order kinetics, Problems and solutions; Allosteric regulation: Sigmoidal kinetics, Symmetry model, Concerted model; Kinetics and functions of allosteric enzymes; Enzyme isolation, purification and assays; Enzyme units of activity, Turnover number and properties. 3 CREDITS

MIC311 **Bioinformatics:** The course provides a broad overview of bioinformatics and computational biology as applied to biological research. Course material will be geared towards answering specific biological questions ranging from detailed analysis of a single gene through whole-genome analysis. The course includes topics: Biological Databases; BLAST and Sequence Alignment; Protein Bioinformatics; Prokaryotic & Eukaryotic Genome analysis, Human variation (SNP) analysis, Phylogenetic tree construction and plasmid (both cloning & expression vector) designing. 3 CREDITS

- MIC318** **Agricultural Microbiology and Plant pathology:** The soil environment, Soil microbial flora, Microbial interaction, Plant -Microbe interaction: interaction with plant roots, interaction with aerial plant structures, Biogeochemical cycling: Carbon cycle, Nitrogen cycle, Phosphorus cycle, Sulfur cycle, Biodegradation of complex carbohydrates: Cellulose, hemicellulose and lignin, Microbiology and biochemistry of nitrogen fixation, Biofertilizer technology, Biopesticides, Fungal Pathogens of Plants, Bacterial and viral plant diseases, Control of Plant diseases. 3 CREDITS
- MIC404** **Pharmaceutical Microbiology:** Pharmaceuticals, Biologics and Biopharmaceuticals; Microbial Spoilage of Pharmaceutical Products and Contamination Control; Sterile Pharmaceutical Products; Antimicrobial Compounds; How Bacteria Become Resistant to Antibiotics; Therapeutic Hormones; Nucleic Acids as Therapeutic Agents; and Monoclonal Antibodies and Recombinant Antibodies. 3 CREDITS
- MIC416** **Cell Biology:** The cell is a fascinating, complex, and dynamic unit that is constantly interacting with the surrounding environment and making active decisions, by an enormous number of biochemical and biophysical process. A sound knowledge of cell biology is required to understand the diverse cellular components (structure and function) at a molecular level that compose multicellular organisms. Cell biology forms the core of basic scientific investigations and current bio-medical research. Major topics included in this course are: membrane structure and function, intracellular compartments and protein sorting, intracellular vesicular traffic (secretion and endocytosis), mechanism of cellular communications, cytoskeleton, the cell cycle and cell death. Skills and knowledge from this course will be a great advantage for the students' future research carrier. 3 CREDITS
- MIC417** **Applied Immunology & Immunogenetics:** This course will enable understanding of the genetic aspects of the immune response and the role of the immune system in health and disease. Genetics of immune recognition molecules and its knowledge in research and therapy will be discussed. Current experimental approaches in immunology, including production of monoclonal antibodies, antibody engineering and their application are covered. This course will provide understanding of how excessive, inappropriate and defective immune responses can lead to hypersensitivity reactions, autoimmune and immunodeficiency diseases. Topics of current immunological interest, including immune tolerance, transplantation, vaccines and tumor immunology will be studied. 3 CREDITS
- MIC418** **Algology:** Introduction to algae, classification of algae, Distribution of algae: Freshwater algae, Brackish Water algae and marine algae. Classification of Algae: Divisions of algae and their important features. Major criteria for algal classification and characteristic features of the classes such as Cyanophyceae, Chlorophyceae, Phaeophyceae, Bacillariophyceae and Rhodophyceae. Ultrastructure of prokaryotic and eukaryotic algal cells, Thallus organization among algae, Vegetative and asexual reproduction in algae, .Use of algae for human welfare: Algae as a source of single cell protein, pigments and

biofertilizers; Diatomites; Utilization of agarophytes, carragenophytes and alginophytes; toxic algae. 3 CREDITS

FREE ELECTIVE COURSES

(9 CREDITS)

List of books for the courses

Courses	Recommended text books
ENG 102 Introduction to Composition	Course Reader” provided by the concerned department
ENG 103 Intermediate Composition	Course Reader” provided by the concerned department
ENG 105 Advanced Composition	Course Reader” provided by the concerned department
ENG 111 Public Speaking	Course Reader” provided by the concerned department
BEN 205 Bengali language & Literature	Course Reader” provided by the concerned department
Humanities	
PHI 104 Introduction to Ethics	Lee Archie, John G. Archie, Reading for Philosophical Inquiry: A Brief Introduction to Philosophical Thinking, version 0.21, Open Source Reader.
HIS 101 Bangladesh Culture and Heritage	Course Reader” provided by the concerned department
HIS 103 Emergence of Bangladesh	Course Reader” provided by the concerned department
Social Sciences	
ECO 101 Introduction to Microeconomics / ECO 104 Introduction to Macroeconomics	i. Roger A. Arnold; Microeconomics; 12th Edition; ISBN-13: 978-1305399433; Cengage Learning; January 27, 2015
POL 101 Introduction to Political Science / POL 104 Introduction to Governance	i. Nigel Jackson, Stephen D Tansey; Politics: The Basics; 5th Edition; ISBN-13: 978-0415841429; Routledge; September 28, 2014 ii. Alan R. Ball, B. Guy Peters; Modern Politics and Government; Seventh Edition; ISBN-13: 978-0333961612; Palgrave Macmillan; March 24, 2005
SOC 101 Introduction to Sociology / ANT 101 Introduction to Anthropology	i. Richard T. Schaefer; Sociology: A Brief Introduction; 10th Edition; ISBN-13: 978-0078026720; McGraw-Hill Humanities/Social Sciences/Languages; September 13, 2012 ii. Conrad Kottak; Cultural Anthropology: Appreciating Cultural Diversity; 15th Edition; ISBN-13: 978-0078035005; McGraw-Hill Education; October 11, 2012

Computer and Math Skills	
MIS 105 Introduction to computers	i. Peter Norton; Peter Norton's Introduction to Computers; 6th Edition; ISBN-13: 978-0071117166; McGraw Hill Higher Education; September 1, 2005
BUS 172 Introduction to statistic	i. Prem S. Mann; Introductory Statistics; 8th Edition; ISBN-13: 978-0470904107; Wiley; November 19, 2012
MAT 116 Pre-calculus	i. Michael Sullivan; Precalculus; 10th Edition; ISBN-13: 978-0321979070; Pearson; February 27, 2015
Sciences (with Lab)	
BIO 103 Biology	i. Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson; Campbell Biology; 10th Edition; ISBN-13: 978-0321775658; Pearson; November 10, 2013 ii. Kathleen A. Ireland; Visualizing Human Biology; 4th Edition; ISBN-13: 978-1118169872; Wiley; September 11, 2012 iii. Michele Shuster, Janet Vigna, Matthew Tontonoz, Gunjan Sinha; Biology for a Changing World; 2nd Edition; ISBN-13: 978-1464126734; W. H. Freeman; March 7, 2014
PHY 107 Physics I	i. David Halliday, Robert Resnick, Jearl Walker; Fundamentals of Physics; 10th Edition; ISBN-13: 978-1118230718; Wiley; August 5, 2013
CHE 101 Chemistry I	i. Martin Silberberg, Patricia Amateis; Chemistry: The Molecular Nature of Matter and Change; 7th Edition; ISBN-13: 978-0073511177; McGraw-Hill Education; January 6, 2014 ii. Raymond Chang, Kenneth A. Goldsby; Chemistry, 11th Edition; ISBN-13: 978-0077666958; McGraw-Hill Education; January 17, 2012 iii. Darrell Ebbing, Steven D. Gammon, General Chemistry; 10th Edition; ISBN-13: 978-1285051376; Brooks Cole; April 20, 2012

Courses	Recommended text books
School of Health and Life Sciences (SHLS) Core	
BUS 172 Introduction to statistic	i.Prem S. Mann; Introductory Statistics; 8th Edition; ISBN-13: 978-0470904107; Wiley; November 19, 2012
MAT 116 Pre-calculus	i. Michael Sullivan; Precalculus; 10th Edition; ISBN-13: 978-0321979070; Pearson; February 27, 2015
BBT 203 Bio-statistic	<p>i.Wayne W. Daniel, Chad L. Cross; Biostatistics: A Foundation for Analysis in the Health Sciences; 10th Edition; ASIN: B00ZE0KGUA; Wiley India; 2013</p> <p>ii. Michael C. Whitlock and Dolph Schluter; The Analysis of Biological Data; ISBN-13: 978-1936221486, ISBN-10: 1936221489; Roberts and Company Publishers/2014</p> <p>iii. Jerrold H. Zar; Biostatistical Analysis; ISBN: 0131008463, 9780131008465; Prentice Hall/ 2010</p>
CHE 201 Biophysical Chemistry	<p>i. Julio de Paula, Peter Atkins; Atkins' Physical Chemistry; 10th ed; ISBN-10: 019969740X, ISBN-13: 978-0199697403; Oxford University Press; January 1, 2014</p> <p>ii. Arun Bahl, B.S. Bahl,G.D. Tuli; Essentials of Physical Chemistry; ISBN 10: 8121929784 / ISBN 13: 9788121929783; S. Chand & Company Ltd, 2014</p> <p>iii. James P. Allen; Biophysical Chemistry; ISBN: 978-1-4051-2436-2; Wiley-Blackwell; September 2008</p> <p>iv. Ignacio Tinoco Jr., Kenneth Sauer, James C. Wang, Joseph D. Puglisi, Gerard Harbison, David Rovnyak; Physical Chemistry: Principles and Applications in Biological Sciences; 5th Edition; ISBN-13: 978-0136056065; Pearson; January 13, 2013</p>
MIC 203 Chemistry of Microorganism	<p>i. Microbiology: Concepts and Application, International Edition, 1993 – Pelczar MJ Jr, Chan ECS & Krieg NR McGraw-Hill, Inc., New York.</p> <p>ii. Prescott, Harley, and Klein. Microbiology, 7th Edition, 2008 – Willey J, Sherwood LM & Woolverton CJ McGraw-Hill Higher Education, Boston.</p> <p>iii. Microbiology. An Introduction. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 10th edition.</p>

	<p>iv. David LN, Michael MC. Lehninger Principles of biochemistry. Fifth edition. W. H. Freeman and Company New York.</p>
<p>MIC 101 /BIO 202 Basic Microbiology (with lab)</p>	<p>i. Foundations in Microbiology, Eighth Edition. 2011. Kathleen Park Talaro and Arthur Talaro. The McGraw–Hill Companies, Inc., New York.</p> <p>ii. Prescott's Microbiology, Eighth Edition. 2010. Joanne Willey, Linda Sherwood and Chris Woolverton. The McGraw–Hill Companies, New York.</p> <p>iii. Microbiology: An Introduction, Tenth Edition. 2010. Gerard J Tortora, Berdell R Funke and Christine L Case. 2010. Pearson Benjamin Cummings, San Francisco.</p> <p>iv. Microbiology, Fifth Edition. 1993. Michael J Pelczar Jr, ECS Chan and Noel R Krieg. McGraw-Hill, Inc., New York.</p> <p>v. Essential Microbiology. 2005. Stuart Hogg. John Wiley & Sons Ltd., West Sussex.</p> <p>vi. Brock Biology of Microorganisms, 12th edition, 2009, Benjamin Cummings , San Francisco</p>
<p>MIC 110/ BIO 201 Introduction to Biochemistry and Biotechnology (with lab)</p>	<p>i. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry; 6th edition; ISBN-13: 978-1429234146; W.H. Freeman; November 21, 2012</p> <p>ii. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Lubert Stryer; Biochemistry; 8th Edition; ISBN-13: 978-1464126109; W. H. Freeman; April 8, 2015</p> <p>iii. William J. Thieman, Michael A. Palladino; Introduction to Biotechnology; 3rd Edition; ISBN-13: 978-0321766113; Pearson; January 23, 2012</p> <p>iv. John L. Tymoczko, Jeremy M. Berg, Lubert Stryer; Biochemistry: A Short Course; 3rd Edition; ISBN-13: 978-1464126130; W. H. Freeman; April 24, 2015</p> <p>v. Alexander J. Ninfa, David P. Ballou, Marilee Benore; Fundamental Laboratory Approaches for Biochemistry and Biotechnology; 2nd Edition; ISBN-13: 978-0470087664; Wiley; May 26, 2009</p>

CHE 101 Chemistry I (with lab)	<p>i. Martin Silberberg, Patricia Amateis; Chemistry: The Molecular Nature of Matter and Change; 7th Edition; ISBN-13: 978-0073511177; McGraw-Hill Education; January 6, 2014</p> <p>ii. Raymond Chang, Kenneth A. Goldsby; Chemistry, 11th Edition; ISBN-13: 978-0077666958; McGraw-Hill Education; January 17, 2012</p> <p>iii. Darrell Ebbing, Steven D. Gammon, General Chemistry; 10th Edition; ISBN-13: 978-1285051376; Brooks Cole; April 20, 2012</p>
CHE 202 Bio-organic chemistry (with lab)	<p>i. Julio de Paula, Peter Atkins; Atkins' Physical Chemistry; 10th ed; ISBN-10: 019969740X, ISBN-13: 978-0199697403; Oxford University Press; January 1, 2014</p> <p>ii. Arun Bahl, B.S. Bahl, G.D. Tuli; Essentials of Physical Chemistry; ISBN 10: 8121929784 / ISBN 13: 9788121929783; S. Chand & Company Ltd, 2014</p> <p>iii. James P. Allen; Biophysical Chemistry; ISBN: 978-1-4051-2436-2; Wiley-Blackwell; September 2008</p> <p>iv. Ignacio Tinoco Jr., Kenneth Sauer, James C. Wang, Joseph D. Puglisi, Gerard Harbison, David Rovnyak; Physical Chemistry: Principles and Applications in Biological Sciences; 5th Edition; ISBN-13: 978-0136056065; Pearson; January 13, 2013</p>

Courses	Recommended text books
Microbiology Core Courses	
MIC 202 Basic techniques in Microbiology	<p>i. Microbiology: an introduction / Gerard J. Tortora, Berdell R. Funke, Christine L. Case. - 10th ed., 2010, Benjamin Cummings , San Francisco</p> <p>ii. Microbiology: Concepts and Application, International Edition, 1993- Pelczar MJ Jr, Chan ECS and Krieg NR, McGraw-Hill, Inc., New York.</p> <p>iii. Microbiology 5th edition, Prescott, Harley, Klein, McGraw-Hill companies, 2002.</p> <p>iv. Brock Biology of Microorganisms, 12th edition, 2009, Benjamin Cummings , San Francisco</p>
MIC 206 Microbial Taxonomy	<p>i. Brock Biology of Microorganisms, 14th edition, 2015, Benjamin Cummings , San Francisco</p> <p>ii. Microbiology: an introduction / Gerard J. Tortora, Berdell R. Funke, Christine L. Case. - 10th ed., 2010, Benjamin Cummings , San Francisco</p> <p>iii. Microbiology 7th edition, Prescott, Harley, Klein, McGraw-Hill companies, 2002.</p> <p>iv. Bacterial Systematics, Niall A. Logan, 1994, Blackwell Scientific Publications, UK, USA, Canada, Australia</p> <p>v. Microbiology: Concepts and Application, International Edition, 1993- Pelczar MJ Jr, Chan ECS and Krieg NR, McGraw-Hill, Inc., New York.</p>
MIC 207 Bacterial Physiology and Metabolism	<p>i. Bacterial Metabolism, Second Edition by Gerhard Gottschalk</p> <p>ii. Bacterial Physiology and Metabolism by Geoffrey Michael Gadd</p> <p>iii. David LN, Michael MC. Lehninger Principles of biochemistry. Fifth edition. W. H. Freeman and Company New York.</p>
MIC 307 Microbial Genetics	<p>i. Genetics: A Conceptual Approach, Benjamin A. Pierce, 4th edition,</p> <p>ii. Principles of Genetics, Seventh Edition by Robert H Tamarin. 2001. The McGraw-Hill Companies, New York.</p> <p>iii. Prescott, Harley, and Klein. Microbiology, 7th Edition, 2008 – Willey J, Sherwood LM & Woolverton CJ McGraw-Hill Higher Education, Boston.</p>

	iv. David LN, Michael MC. Lehninger Principles of biochemistry. Fifth edition. W. H. Freeman and Company New York.
MIC 314 Environmental Microbiology & Bioremediation	i. Microbial Ecology: Fundamentals and Applications; Fourth edition by Atlas Bartha. ii. Brock Biology of Microorganisms; 14th Edition.
MIC 315 Infectious Diseases & Diagnostic Microbiology (with lab)	i. Laboratory Diagnosis of Infectious Diseases: Essentials of Diagnostic Microbiology.2007. Paul G. Engelkirk, Janet L. Duben-Engelkirk. Lippincott Williams and Wilkins. ii. Bacterial Pathogenesis: A Molecular Approach, Third Edition by Brenda A Wilson, Abigail A Salyers, Dixie D Whitt and Malcolm E Winkler. 2011. ASM Press, American Society of Microbiology, Washington DC.
MIC 316 Molecular Biology (with lab)	i. Genetics: A Conceptual Approach, 4th Edition. 2012. Benjamin A. Pierce. WH Freeman & Company, New York, USA. ii. Molecular Biology of the Gene, 7th Edition, 2014, James D. Watson & Others. Cold Spring Harbor Laboratory Press, New York, USA. iii. Principles of Genetics, Sixth Edition. 2012. Snustad P and Simmons MJ. John Wiley and Sons Inc., New York. iv. Molecular Biology, Fifth Edition, Rebert F. Weaver v. Gene Cloning and DNA Analysis: An Introduction, Sixth Edition. 2010. Brown TA. John Wiley & Sons, Ltd., Oxford vi. Genetics: Analysis of Genes and Genomes, Sixth Edition. 2005. Daniel L Hartl and Elizabeth W Jones. Jones & Bartlett Publishers Inc., Boston.
MIC 317 Immunology (with lab)	i. Judith A. Owen, Jenni Punt, Sharon A. Stranford; Kuby Immunology, 7th Edition; ISBN-13: 978-1464119910; W. H. Freeman; January 25, 2013 ii. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt; Roitt's Essential Immunology; 12th Edition; ISBN-13: 978-1405196833; Wiley-Blackwell; May 6, 2011 iii. Mary Louise Turgeon EdD MLS(ASCP)CM; Immunology & Serology in Laboratory Medicine, 5th

	<p>Edition; ISBN-13: 978-0323085182; Mosby; March 1, 2013</p> <p>iv. 4. Carl A. Burtis PhD, David E. Bruns MD; Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics; 7th Edition; ISBN-13: 978-1455741656 Saunders; May 8, 2011</p>
MIC 401 Microbial Biotechnology	<p>i. Industrial Microbiology: An Introduction. 2001. Michael J Waites, Neil L Morgan, John S Rockey and Gary Higton. Blackwell Science Ltd., London</p> <p>ii. Biotechnology, 4th Edition. 2004. by John E Smith, Cambridge University Press, Cambridge</p> <p>iii. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition by Bernard R Glick, Jack J Pasternak and Cheryl L Patten. ASM Press, American Society for Microbiology, Washington DC.</p> <p>iv. Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition by Alexander N Glazer and Hiroshi Nikaido. 2007. Cambridge University Press, Cambridge.</p> <p>v. Gene Cloning and DNA Analysis: An Introduction, Fourth Edition. Brown TA. Blackwell Science Ltd., Oxford.</p>
MIC 413 Virology (with lab)	<p>i. Fundamental of Molecular Virology, 2nd Edition, Nicholas H. Acheson, John Wiley & Sons, Inc.</p> <p>ii. Jawetz, Melnick & Adelberg's Medical Microbiology: 21st and 22nd edition.</p> <p>iii. Fields Virology, Fifth edition. Lippincott Williams & Wilkins</p>
MIC 414 Food Microbiology and Quality Control (with lab)	<p>i. Food Microbiology, M.R. Adams & M.O. Moss, Royal Society of Chemistry, UK, 2000</p> <p>ii. Modern Food Microbiology, Seventh Edition, J.M. Jay, Aspen Publishers, Inc., Gaithersburg, Maryland, 2005.</p> <p>iii. Food Microbiology, Frazier William C & Westhoff Dennis C., TMH, New Delhi, 2004</p>
MIC 415 Mycology (with lab)	<p>i. Introductory Mycology, C.J. Alexopoulos, C.W. Mims, M. Blackwell, 4th ed. 1996, John Wiley & Sons, USA.</p> <p>ii. Topics in Mycology and Pathology, L. N. Nair, 2007, New Central Book Agency, Kolkata</p>

	<p>iii. Fungi: Biology and Applications, Kevin Kavanagh, 2005, John Wiley and Sons, England</p> <p>iv. Tropical Mycology, Vol. 1, Macromycetes, Roy Walling, Juliet C. Frankland, A.M. Ainsworth, Susan Isaac & Clare H. Robinson, 2002, CABI Publishing, UK</p> <p>v. Molecular Identification of fungi, Youssuf Gherbawy, Kerstin Voigt, 2010, Springer-Verlag. Berlin Heidelberg</p>
MIC 498 Research methodology and project	<p>i. C. R. Kothari; Research Methodology: Methods and Techniques; 3rd edition; ISBN-13: 978-8122436235; New Age International Pvt. Ltd Publishers; September 1, 2013</p> <p>ii. Nicholas Walliman; Research Methods: The Basics; 1st edition; ISBN-13: 978-0415489942; Routledge; December 20, 2010</p> <p>iii. Ranjit Kumar; Research Methodology: A Step-by-Step Guide for Beginners; 4th edition; ISBN-13: 978-1446269978; SAGE Publications Ltd; February 4, 2014</p>
Microbiology Electives	
MIC201 Microbial Ecology	<p>i. Atlas Bartha, Microbial Ecology: Fundamentals and Applications; 4th Edition, 2005, Pearson education Inc.</p> <p>ii. Brock Biology of Microorganisms, 14th edition, 2015, Benjamin Cummings , San Francisco</p> <p>iii. Microbiology: an introduction / Gerard J. Tortora, Berdell R. Funke, Christine L. Case. - 10th ed., 2010, Benjamin Cummings , San Francisco</p> <p>iv. Microbiology 7th edition, Prescott, Harley, Klein, McGraw-Hill companies, 2002.</p> <p>v. Microbiology: Concepts and Application, International Edition, 1993- Pelczar MJ Jr, Chan ECS and Krieg NR, McGraw-Hill, Inc., New York.</p>
MIC309 Enzymology	<p>i. Lehninger (2005) Principles of Biochemistry, 4th edition, W.H. Freeman & Co., publ. 2005.</p> <p>ii. Donald Voet & Judith Voet (1995) Biochemistry, J. Wiley & Sons, New York (Chapters 12 through 15).</p> <p>iii. Biochemistry, 7th edition, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer.</p>
MIC311 Bioinformatics	<p>i. Michael Agostino; Practical Bioinformatics; ISBN-0815344562, 978-0815344568; Garland Science/2012</p>

	<p>ii. Marketa Zvelebil, Jeremy Baum; Understanding Bioinformatics; ISBN: 978-0815340249, 0815340249; Garland Science/2007</p> <p>iii. Pavel Pevzner , Ron Shamir; Bioinformatics for Biologists; ISBN: 1107648874, 978-1107648876; Cambridge University Press/2011</p>
MIC318 Agricultural microbiology & Plant pathology	<p>i. Soil Microbiology, Ecology, and Biochemistry, 3rd Edition, (ed. E. Paul 2007)</p> <p>ii. Fundamentals of Soil Ecology, 2nd Edition, Elsevier Academic Press (Coleman et al. 2004)</p> <p>iii. Microbial Ecology: Fundamentals and Applications, 4th Edition, Pearson Education (Atlas & Bartha,1998)</p> <p>iv. Plant Pathogenesis, 5th Edition, Elsevier Science (George N. Agrios, 2004)</p>
MIC404 Pharmaceutical Microbiology	i. Hugo and Russell's Pharmaceutical Microbiology, 8th edition.
MIC416 Cell Biology	<p>i. Bruce Alberts et al.; Molecular Biology of the Cell; 6th edition; ISBN-13: 978-0815344322; Garland Science; December 1, 2014</p> <p>ii. Harvey Lodish, Arnold Berk, Chris A. Kaiser; Molecular Cell Biology; Seventh Edition; ISBN-13: 978-1429234139; W. H. Freeman/ May 2, 2012</p> <p>iii. Geoffrey M. Cooper, Robert E. Hausman; The Cell: A Molecular Approach, Sixth Edition; ISBN-13: 978-0763739058; Sinauer Associates, Inc; February 1, 2013</p>
MIC417 Applied Immunology & Immunogenetics	<p>i. Judith A. Owen, Jenni Punt, Sharon A. Stranford; Kuby Immunology, 7th Edition; ISBN-13: 978-1464119910; W. H. Freeman; January 25, 2013</p> <p>ii. Kenneth Murphy, Casey Weaver; Janeway's Immunobiology; 9th Edition; ISBN-13: 978-0815345053; Garland Science; March 29, 2016</p> <p>iii. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai; Cellular and Molecular Immunology; 8th Edition; ISBN-13: 978-0323222754; Saunders; August 28, 2014</p>
MIC418 Algology	i. Sze, P. (1998). A Biology of the Algae, WCB/McGraw-Hill.

**Reorganized to Dual Semester System, Tentative Course Planning for the
Syllabus of BS in Microbiology, Department of Biochemistry & Microbiology,
School of Health and Life Sciences, North South University, Dhaka**

Tentative 4-Year Plan for a Bachelor of Science Degree in Microbiology

Year 1	
Semester 1	Semester 2
Total Credits:14	Total Credits:17
Total credits in Year 1: 14+ 17= 31	
Year 2	
Semester 1	Semester 2
Total Credits:15	Total Credits: 16
Total credits in Year 2: 15+ 16= 31	
Year 3	
Semester 1	Semester 2
Total Credits: 14	Total Credits: 14
Total credits in Year 3: 14+ 14= 28	
Year 4	
Semester 1	Semester 2
Total Credits: 16	Total Credits: 14
Total credits in Year 4: 16+ 14= 30	
Total credits in 4 years: 31 + 31+ 28 +30 = 120	

Course Distribution

YEAR 1, SEMESTER 1 (Duration 6 Months)	Course code	Course name	Credits
Languages, Social Sciences, SHLS core courses	CREDITS TO BE COMPLETED		14.0
	ENG102/ENG 103	Introduction /Intermediate composition	3/6*
	POL101/ POL104, ECO101/ECO104, SOC101/ANT 101	Political science/Governance, Micro/ Macroeconomics, Sociology/ Anthropology	3
	BIO103	Biology I (with lab)	4
	CHE101	Chemistry I (with lab)	4

*If ENG102 is being waived then credit hours will be 3; if ENG 102 is not being waived then total credit will be 6 (ENG 102 and ENG 103)

YEAR 1, SEMESTER 2 (Duration 6 Months)	Course code	Course name	Credits
Languages, SHLS core courses	CREDITS TO BE COMPLETED		17.0
	ENG105	Advanced Composition	3
	BEN205	Bengali Language & Literature	3
	CHE201	Biophysical Chemistry	3
	BIO202/ MIC101	Basic Microbiology (with lab)	4
	BIO201/MIC 110	Introduction to Biochemistry & Biotechnology (with lab)	4

YEAR 2, SEMESTER 1 (Duration 6 Months)	Course code	Course name	Credits
Computer and Math skills, SHLS core course, Major courses, Elective course, *HIS103 is a mandatory GED from batch 163 and onwards.	CREDITS TO BE COMPLETED		15.0
	MAT116	Pre-calculus	3
	HIS101/HIS103/PHI 101	Bangladesh History and Culture/Emergence of Bangladesh/ Introduction to Philosophy	3
	Elective -1	<i>Will select from the elective courses</i>	3
	MIC202	Basic techniques in Microbiology	3
	MIC203	Chemistry of Microorganisms	3

YEAR 2, SEMESTER 2 (Duration 6 Months)	Course code	Course name	Credits
Computer and Math skills, SHLS core course, Major courses	CREDITS TO BE COMPLETED		16.0
	CHE202	Bioorganic Chemistry (with lab)	4
	BUS172	Introduction to Statistics	3
	MIC207	Bacterial Physiology and Metabolism	3
	MIC307	Microbial Genetics	3
	MIS105	Introduction to Computers	3

YEAR 3, SEMESTER 2 (Duration 6 Months)	Course code	Course name	Credits
If a student takes BIO103 and CHE 101; then s/he does not need to take PHY107 Major courses, Elective course	CREDITS TO BE COMPLETED		18.0^s
	PHY107 (with lab)	Physics I (with lab)	4
	MIC316	Molecular biology (with lab)	4
	Elective -3	<i>Will select from the elective courses</i>	3
	MIC401	Microbial Biotechnology	3
	MIC413	Virology (with lab)	4

YEAR 3, SEMESTER 1 (Duration 6 Months)	Course code	Course name	Credits
§If a student takes ENG102/103, ENG 105 and BEN 205; then s/he does not need to take ENG111, SHLS core course, Major courses, Elective course	CREDITS TO BE COMPLETED		17.0^s
	ENG111	English Speech/ Professional Communication	3
	BBT203	Biostatistics	3
	MIC315	Infectious Diseases & Diagnostic Microbiology (with lab)	4
	MIC317	Immunology (with lab)	4
	Elective -2	<i>Will select from the elective courses</i>	3

YEAR 4, SEMESTER 1 (Duration 6 Months)	Course code	Course name	Credits
Major courses, Free Elective course	CREDITS TO BE COMPLETED		16.0
	MIC206	Microbial Taxonomy	3
	Free Elective-1		3
	MIC314	Environmental Microbiology & Bioremediation	3
	MIC414	Food Microbiology and Quality Control (with lab)	4
	MIC412	Bacterial Pathogenesis	3

YEAR 4, SEMESTER 2 (Duration 6 Months)	Course code	Course name	Credits
Major courses, Free Elective course	CREDITS TO BE COMPLETED		14.0
	Free Elective-2		3
	Free Elective-3		3
	MIC415	Mycology (with lab)	4
	MIC498	Research methodology and project	4