North South University

Department of Biochemistry & Microbiology

Curriculum

for

Bachelor of Science in Microbiology
(120 credits)

Bachelor of Science in Microbiology (BS MIC)
Department of Biology and Chemistry
School of Health & Life Sciences
North South University
Bashundhara, Dhaka 1229

Minimum credit requirement: 120 CREDITS

About the program:

Microbiology is emerging as the key biological science. 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 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. 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 in home and abroad.

Curriculum:

BS in Microbiology degree program requires minimum of 120 CREDITS in about 4 years/12 semesters to complete. The breakdown of the 120 CREDITS are given below:

Category	**CREDITS**
University Core	37
School of Health & Life Sciences Core	36
MIC Major Core	29
MIC Major Electives	9
Open Electives	9
Project work/Intern	Non-credit
Total	**120 CREDITS**

BS Microbiology (MIC) (120 CREDITS)

UNIVERSITY CORE (37 CREDITS)

Languages			(12 CREDITS)
ENG102/ENG103, ENG105	English composition		6
ENG111	English speech/Professional Communication		3
ENG115	Literature		3
Humanities			(9 CREDITS)
PHI101	Philosophy/Ethics		3
LBA101/LBA102	History (World/Indo-Bangladesh/Islamic)		6
Social Sciences			(9 CREDITS)
POL101/POL104	Political Science/Government		3
ECO101/ECO104	Economics (Micro/Macro Principles)		3
SOC101/GEO205/ANT101	Soc./Geog./Anthropology		3
Computer & Math skills			(3 CREDITS)
MIS105	Introduction to Computers		3
MAT112/MAT116	College Algebra/Pre-calculus	in SHLS core	3
BUS172	Statistics I	in SHLS core	3
Sciences (*with Lab)*			(4 CREDITS)
BIO103	*Biology I*	in SHLS core	4
CHE101	Chemistry I	in SHLS core	4
PHY107L	Physics I		4

Science/School of Health & Life Sciences core (36 CREDITS)

MAT112/MAT116	College Algebra/Pre-calculus	GE	3
BUS172	Statistics I	GE	3
MAT120	Survey of Calculus		3
BBT230	Statistics II (Biostatistics)		3
With Lab			
BIO103	Biology I	GE	4
BIO201	Biology II		4
CHE101	Chemistry I	GE	4
CHE201	General Chemistry II		4
CHE202	Organic Chemistry I		4
CHE301	Organic Chemistry II		4

MICROBIOLOGY CORE **(29 CREDITS)**

MIC302	Molecular Biology	3
MIC303	Microbial Chemistry and Metabolism	3
MIC304	Microbial Genetics	3
MIC305	Food Microbiology and Quality Control	3
MIC306	Virology	3
MIC307	Bacterial Pathogenesis	3
MIC422	Senior Seminar	3

With Lab

MIC301	Basic Microbiology	4
MIC309	Infectious Diseases & Diagnostic Microbiology	4

ELECTIVE COURSES **(9 CREDITS)**

MIC401	Immunology	3
MIC402	Agricultural microbiology & Plant pathology	3
MIC403	Microbial Biotechnology	3
MIC404	Environmental Microbiology & Bioremediation	3
MIC405	Bioinformatics	3
MIC406	Microbial Taxonomy	3

FREE ELECTIVE COURSES **(9 CREDITS)**

Course Syllabus:

UNIVERSITY CORE (37 CREDITS)

Languages	**(12 CREDITS)**
English composition	6
English speech/Professional Communication	3
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. 3 CREDITS

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 **Public Speaking:** 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

ENG115 **Literature**: This course introduces students to the rich literary tradition of poetry, drama, and fiction. Drawing on a wide range of writings in English, students will learn to read and respond to literature and learn the fundamentals of literary analysis. Prerequisite: ENG 103. 3 CREDITS

Humanities	**(9 CREDITS)**
Philosophy/Ethics	3
History (World/Indo-Bangladesh/Islamic)	6

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

LBA101 **Bangladesh Culture and Heritage:** 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

LBA102 **Introduction to World Civilization:** Focuses on the values and importance of the study of the history of human civilization, especially in Egypt, Mesopotamia, and Babylonia; Harappa civilization and the Gandhara civilization, ancient Chinese culture and civilization; ancient Greek civilization, Muslim civilization and their influence over European Renaissance, scientific innovations, cultural progress and religious reformation. The rise of powerful nation states in Europe and North America and the impact of scientific and technological supremacy of the west over the so-called 'backward communities' are also studied here. 3 CREDITS

Social Sciences	**(9 CREDITS)**
Political Science/Government	3
Economics (Micro/Macro Principles)	3
Soc./Geog./Anthropology	3

POL101 **Introduction to 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

ENV203/ GEO205 **Introduction to Bangladesh Geography:** Basic geographic concepts and fundamental themes. Geophysical and socio economic characteristics of Bangladesh; introduction to physical geography; landforms; weather and climate; population geography; cultural and political context; natural resources; economic geography and urban - regional concepts; spatial interaction between human and natural environment. 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, Mathematics and Science

Introduction to Computers	3
College Algebra/Pre-calculus	3
Statistics I	3
Science (with Lab)	
Biology I	4
Chemistry I	4
Physics I	4

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

MAT112 **Elementary Mathematics:** Topics include sets, real numbers system, algebraic expressions, systems of equations, functions and relations matrices, determinant applications), exponents and radicals, exponential and logarithmic functions, functions of integers, permutations, combinations, and binomial theorem. Prerequisite: High School Mathematics. 3 CREDITS

MAT116 **Precalculus**: 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

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

BUS172 **Statistics I: 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. Cross-listed as BBT203, ECO 172 & ENV 172. 3 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

SCIENCE/SCHOOL OF HEALTH & LIFE SCIENCES CORE (36 CREDITS)

MAT116 College Algebra/Pre-calculus	GE	3
BBT203 Statistics I	GE	3
MAT120 Survey of Calculus (Calculus I)		3
BBT230 Statistics II (Biostatistics)		3
BIO103 Biology I	GE	4
BIO201 Biology II		4
CHE101 Chemistry I	GE	4
CHE201 Chemistry II		4
CHE202 Organic Chemistry I		4
CHE301 Organic Chemistry II		4

MAT120 **Calculus I:** A first course in calculus and analytic geometry. Coordinates, Graphs and Lines; Functions and Limits; Differentiations; Application of Differentiation; Integration; Logarithmic and Exponential Functions. 3 CREDITS

BBT230 **Statistics II (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

BIO201 **Biology II:** 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

CHE201 **Chemistry II** : 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 ?G and Keq, 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 Spetrophotometry, 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. 4 CREDITS

CHE202 **Organic Chemistry I:** This course is a comprehensive introduction in fundamental aspects of biological chemistry, for freshmen (first year) 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

CHE301 **Organic Chemistry II**: The course starts with a review of organic functional group's structure & functions and stereochemistry. Later, the discussion will continue with the structures of small bio-molecules, e.g. carbohydrates, amino acids, nucleotides, and lipids. Next, the formation of large bio-molecules from these building blocks is described with reaction mechanisms in terms of the RNA world hypothesis. The chemistry behind the formation and degradation of these compounds both *in vitro* and *in vivo* will be covered with emphasis on learning about complex biological systems from simpler chemical ones. The curriculum covers: carbohydrate chemistry, amino acids chemistry, lipids, lipoproteins, cholesterol and nucleic acid chemistry, introduction to bioorganic synthesis of secondary metabolites.

Laboratory Work: The organic chemistry laboratory section includes detection of different bio-molecules from various sources, determination of chemical properties of representative organic molecules, and detection of organic contents of representative biological samples. 4 CREDITS

MAJOR REQUIRED COURSES (29 CREDITS)

MIC302	Molecular Biology	3
MIC303	Microbial Chemistry and Metabolism	3
MIC304	Microbial Genetics	3
MIC305	Food Microbiology and Quality Control	3
MIC306	Virology	3
MIC307	Bacterial Pathogenesis	3
MIC422	Senior Seminar	3
With Lab		
MIC301	Basic Microbiology	4
MIC309	Infectious Diseases & Diagnostic Microbiology	4

MIC302 **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. 3 CREDITS

MIC303 **Microbial Chemistry and Metabolism:** Chemical structure and function of different macromolecules i.e. Proteins, Lipids, Carbohydrates and Nucleic acids; Composition and structure of prokaryotic, eukaryotic and archaeal cell organelles i.e. cell walls, cell membranes, nucleoid/nucleus, inclusion bodies, ribosomes, pigments and endospores; Elemental composition of microbial cells and their importance; Glycolysis in bacteria and archaea i.e. Embden-Meyerhof-Parans (EMP), Entner-Doudoroff (ED) and phosphoketolase pathway; Tricarboxylic Acid (TCA) Cycle, electron transport and oxidative phosphorylation; Heterotrophic metabolism of hexose and pentose sugars other than glucose; Metabolic diversity among organisms; Metabolic pathways of energy use i.e. amino acids, lipids and nucleic acids biosynthesis. 3 CREDITS

MIC304 **Microbial Genetics:** Microbial Genetics and Genetic Materials; Bacterial transformation: Mechanisms, transformation analysis, Mapping by transformation, Bacterial conjugation: Lederberg and Tatum's Experimental Design, Mapping Genes by Conjugation Analysis, F' Conjugation; Bacterial transduction: Analysis of Gene Transfer in Bacteria, Specialized Transduction, Generalized versus Specialized Transduction; Gene Cloning and the Polymerase Chain Reaction: Importance, Cloning Vector; Purification of DNA from Living Cells : Preparation of Total Cell DNA, Plasmid DNA and Bacteriophage DNA; Manipulation of Purified DNA: Restriction Endonucleases and ligation; Introduction of DNA into Living Cells : Transformation, Identification of Recombinants , Introduction of Phage DNA into Bacterial and non bacterial Cells; Vectors for Gene Cloning: E. coli Plasmids, M13 Bacteriophage, λ Bacteriophage; Identification of a Clone from a Gene Library: Clone Identification , The Problem of Gene Expression. 3 CREDITS

MIC305 **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. 3 CREDITS

MIC306 **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; Pathogensis 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. 3 CREDITS

MIC307 **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

MIC422 **Senior Seminar:** The objective of this course is to give students the confidence to make oral presentations before small and large audiences and to train students in basic skills in preparing and delivering audio visual presentations, including audience interaction and effective use of visual aids. Students will prepare and present on various topics throughout the semester, which will be evaluated by the faculty. They will also be expected to answer questions and tackle problems during the presentation. Through this course, students will be able to perform presentations and different types of scientific papers compatible with the world class recognized standards and formats. 3 CREDITS

MIC301 **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, Ultrasturcture, 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: Staining techniques: positive staining, negative staining, differential staining, endospore staining, flagella staining and capsule staining; Culture methods: pour plate, spread plate and streak plate methods; Presumptive Identification of Unknown Bacteria Based on their Biochemical Activities. 4 CREDITS

MIC309 **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: Culture methods: Isolation, identification and antibiotic sensitivity pattern of normal flora and pathogenic microorganism from clinical specimens; (a) skin (b)throat (c) urinary tract (d) dental caries, Spreading of the infectious agent, Isolation of enteric pathogens from stool by direct plating method. Molecular methods: Isolation of crude and purified genomic DNA from bacteria and onions, Plasmid profiling, Polymerase Chain Reaction (PCR), Immunological methods: lipid profiling, estimation of total bilirubin concentration in blood serum, determination of blood group, HBsAg assay in patient serum sample by ELISA, Diagnosis of typhoid fever by tube dilution agglutination test (widal test). 4 CREDITS

ELECTIVE COURSES (9 CREDITS)

MIC401	Immunology	3
MIC402	Agricultural microbiology & Plant pathology	3
MIC403	Microbial Biotechnology	3
MIC404	Environmental Microbiology & Bioremediation	3
MIC405	Bioinformatics	3
MIC406	Microbial Taxonomy	3

MIC401 **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 pathogens. 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. 3 CREDITS

MIC402 **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,, Animal- Microbe Interaction, 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

MIC403 **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

MIC404 **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

MIC405 **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 include 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

MIC406 **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

FREE ELECTIVE COURSES (9 CREDITS)