North South University

Department of Biochemistry & Microbiology

Updated Curriculum (Corrected)

for

MS in Biotechnology (36 credits)

Updated Curriculum (Corrected)
Master of Science in Biotechnology (MS BBT)
Department of Biochemistry & Microbiology
School of Health & Life Sciences
North South University
Bashundhara, Dhaka 1229

Foundation Courses (12 credits)		
Course Code	**Title**	**Credits**
BBT601	Biochemistry	3
BBT609	Advanced Biochemistry	3
BBT616	Molecular Cell Biology	3
BBT623	Microbial Biotechnology	3
Total		**12**
Core Courses (18 credits, Any six courses)		
Course Code	**Title**	**Credits**
BBT631	Immuno-Biotechnology	3
BBT639	Molecular Virology	3
BBT645	Plant Biotechnology	3
BBT654	Industrial Biotechnology	3
BBT653	Enzymology & Enzyme Technology	3
BBT659	Genes & Disease	3
BBT671	Bioinformatics	3
BBT685	Biostatistics	3
BBT695	Pharmaceutical Biotechnology	3
BBT792	Genomics & Proteomics (Prerequisite: Bioinformatics)	3
Total		**18**
Elective Courses (6 credits): Choose any 2 courses from Core Courses or Elective Courses; Thesis can be substituted with 2 courses		
Course Code	**Title**	**Credits**
BBT745	Quality Control Compliance	3
BBT742	Environmental Biotechnology	3
BBT743	Biosafety & Regulations	3
BBT744	Bioprocess Engineering	3
BBT751	QA/QC for the Pharmaceutical & Biotechnology Industries	3
BBT780	Biotechnology Entrepreneurship	3
BBT702	Thesis	6
Total		**6**

Reorganized to Dual Semester System, Syllabus of MS in Biotechnology, Department of Biochemistry & Microbiology, School of Health and Life Sciences, North South University, Dhaka

The Master of Science in Biotechnology Program will be offered as a dual semester basis which requires 36 credits earned by completing the courses listed below. One course is equivalent to 3.0 credits. Students must take 12 courses from the foundation, core, and electives- within the program. The program is designed for completion within 1.5 years with three semesters. Full-time students can complete an accelerated program in as little as 1.5 years, whereas part-time students can take two or more years to complete the program. After completion of 12 credits of foundation courses, 18 credits are required from core courses and 6 credits from vibrant elective section or Thesis for all MS in Biotechnology students. In most cases, students have maximal flexibility in shaping their future in the field of biotechnology by selecting the courses in the core and elective in which they are most interested.

	COURSE CODE & NAME	Credits
YEAR 1, SEMESTER 1 (Duration 6 Months)	**CREDITS TO BE COMPLETED 12.0**	
The program begins with an emphasis on the fundamental concepts of Biotechnology.	**FUNDAMENTAL COURSES**	
	BBT601 Biochemistry	3.0
	BBT609 Advanced Biochemistry	3.0
	BBT616 Molecular Cell Biology	3.0
	BBT623 Microbial Biotechnology	3.0
YEAR 1, SEMESTER 2 (Duration 6 Months)	**CREDITS TO BE COMPLETED 12.0**	
In the 2nd Semester, student will gain in-depth exposure to biotechnology and its exploitation/ applications in various fields of Biotechnology. They will study 4 out of 6 core courses in 2nd semester completing 12 credits out of 18 Credits.	**ANY 4 CORE COURSES**	
	BBT631 Immuno-Biotechnology	3.0
	BBT639 Molecular Virology	3.0
	BBT645 Plant Biotechnology	3.0
	BBT654 Industrial Biotechnology	3.0
	BBT653 Enzymology & Enzyme Technology	3.0
	BBT671 Bioinformatics	3.0
	BBT685 Biostatistics	3.0
	BBT659 Genes & Disease	3.0
	BBT695 Pharmaceutical Biotechnology	3.0
	BBT792 Genomics (Prerequisite: Bioinformatics)	3.0
YEAR 2, SEMESTER 3 (Duration 6 Months)	**CREDITS TO BE COMPLETED 12.0**	
The unlimited potential of biotechnology comes with complex scientific, business and management challenges. The 4 courses in this final semester will provide an overview of technological application and a solid understanding of the complex management issues that can arise. Students will select remaining two core courses to complete 18 credits from core. To complete last 6 credits, they will choose any 2 courses either from core courses or elective courses or Thesis (equivalent to 2 courses, 6 credits)	**4 COURSES: 2 Core Courses and 2 Courses either from Elective or Core Course or Thesis**	
	BBT745 Quality Control Compliance	3.0
	BBT742 Environmental Biotechnology	3.0
	BBT743 Biosafety & Regulations	3.0
	BBT744 Bioprocess Engineering	3.0
	BBT751 QA/QC for the Pharmaceutical & Biotechnology Industries	3.0
	BBT780 Biotechnology Entrepreneurship	3.0
	BBT702 Thesis	3.0

Course Description

Foundation Courses (12 credits)

BBT601 **Biochemistry:** This course covers basic undergraduate level biochemistry. The course includes i) structural biochemistry: amino acid structure, the three basic building blocks of protein structure (α-helix, β-sheet and loop), the forces and interactions that promote protein folding, evaluation of protein structure, whether a given protein structure model is likely to represent a native physiological protein structure, ii) enzyme kinetics, iii) lipid structure and membrane assembly, iv) tissue-specific metabolism: liver metabolism, brain metabolism and muscle metabolism, and v) nucleic acid metabolism. 3 CREDITS

BBT609 **Advanced Biochemistry:** The course covers introductory level molecular biology and advance technology utilized in molecular biology. The course focuses on replication, transcription, translation, and recombinant DNA technology. The student will be able to design cloning and expression vectors upon completing the course. The course will also cover advanced molecular technology methods like mass spectrophotometer, microarray and NMR techniques. 3 CREDITS

BBT616 **Molecular Cell Biology:** Course will introduce to the experimental techniques used in cell biology to study cell growth, manipulation, and evaluation. Students who successfully complete this course will be able to: i) synthesize the complex processes of signal transduction pathways into a big picture, ii)analyze mechanisms involved in regulation of the eukaryotic cell cycle, iii)summarize the chemical components of cells and compare biosynthetic pathways, iv) explain how proteins and lipids are transported into organelles, membranes and to the extracellular surface, and v)analyze and critique original research articles. Present scientific knowledge in professional setting. 3 CREDITS

BBT623 **Microbial Biotechnology**: This course provides current information on the applications of microbiology and its links with biotechnology. The syllabus will cover the following topics: i) *microbial biotechnology*: sewage and wastewater treatment; microbial transformations of xenobiotic compounds; detection methods for pathogens; biological control; microorganisms and food production microbial killing: pasteurization, disinfection and preservatives; algal biotechnology, ii) *bacterial genetics*: organization of the bacterial chromosome, prokaryotic DNA replication; prokaryotic transcription and translation and regulation of gene expression and extrachromosomal elements, iii) *industrial microbial fermentations:* isolation of microorganisms; strain improvement; fermentable substrates; inoculums production; outline of an industrial fermentation, fermentation of engineered microorganisms, and antibiotic production. 3 CREDITS

Core Courses (18 credits)

BBT631 **Immuno-Biotechnology:** This course covers molecular and cellular immunology, including antigen and antibody structure and function, effector mechanisms, complement, major histocompatibility complexes, B- and T-cell receptors, antibody formation and immunity, cytotoxic responses, and regulation of the immune response. Students are also introduced to the applied aspects of immunology, which include immunoassay design, various formats and detection methods, and flow cytometry. Special topics include immunomodulation, immunosuppression, immunotherapy, autoimmunity, and vaccination. 3 CREDITS

BBT639 **Molecular Virology:** This course is designed to give an extensive knowledge of modern virology and fundamentals of molecular virology. The course includes introduction to virology, classification of viruses; structure of virus particles; virus growth in cell; the process of infection; virus interaction with whole organism; mechanism of viral latency; transmission of viruses; the evolution of viruses; genetic analysis of viruses. Genome replication strategies of DNA viruses; genome replication and RNA production by RNA viruses. An overview of Human viral diseases; HIV and AIDS; carcinogenesis and tumor viruses; polyomaviruses, adenoviruses, retroviruses and human cancer, vaccines, and antiviral. Horizons in human virology; technical advances; recombinant viruses as gene therapy vectors. Some methods for studying animal viruses. Emerging virus infections; influenza virus; SARS; dengue virus. Virology and society: For Good and ill. 3 CREDITS

BBT645 **Plant Biotechnology:** In this course, students are introduced to the application of recombinant DNA technology to agriculture. Methods for the introduction of foreign DNA into plant and animal cells and generation of stably transformed plants and animals. Examples of the use of transgenic plants and animals in biotechnology, which can provide protection against insects, diseases, and tolerance to specific herbicides. Recombinant growth hormones for leaner meat, greater milk yield, better feed utilization, how transgenic plants and animals can serve as bioreactors for the production of medicinal or protein pharmaceuticals, methods of introducing foreign genes to plants, inducible control of gene expression, and use of different/suitable promoters for tissue specific expression. Because recombinant agricultural products are released into the environment or consumed as foods. The course will also cover the ethical point of GM agriculture along with biosafety issues. 3 CREDITS

BBT654 **Industrial Biotechnology:** The course primarily associates with the commercial exploitation of microorganisms and involves processes and products that are of major economic, environmental and social importance throughout the world. This course will provide an overview of industrial microbiology/biotechnology as an applied biological science. Students will be able to discuss how different types of industry may obtain, handle, and maintain microorganisms. Fermenters will be considered as a major part of this subject. Students will be able to utilize the basic principles behind the operation of batch and continuous fermenters; discuss the differences between industrial processes that are purely chemical processes and those that are microbiological, and discuss the different uses of batch and continuous fermentation for different industrial purposes. They will be aware of the different methods of genetic improvement that have been used to modify microorganisms for different fermentations. They will learn examples of the modification of chemical compounds in microbial processes. 3 CREDITS

BBT653 **Enzymology & Enzyme Technology:** The course will provide an overview of the key principles of enzymology and its applications in large-scale industrial production processes. This course will cover the catalytic mechanisms of enzyme reactions, with an emphasis on: cofactors in enzymology, mechanisms of group transfer reactions, enzyme kinetics, and characterization of enzyme classes. Students should be able to compare different methods for production, purification, characterization and immobilization of enzymes. Particular attention will be provided to topics like applications of immobilized enzymes involving enzyme, membrane and other reactors. The course will also focus on topics like enzymes in biosensors, biotransformation, immobilized-enzyme processes and enzyme usages. An outline of applications of enzymes in several fields of medicine, recent advances and a few future prospects of enzyme technology will be discussed. 3 CREDITS

BBT659 **Genes & Disease:** Because of recent advances, powerful diagnostic tests now detect genetic diseases, and there is promise of gene replacement therapy. In this course students cover general genetic principles, DNA tools for genetic analysis, cytogenetics, gene mapping, the molecular basis of genetic diseases, animal models, immunogenetics, genetics of development, genetics of cancer, and treatment of genetic diseases. Molecular methods of analysis are emphasized. 3 CREDITS

BBT671 **Bioinformatics:** Retrieval and analysis of electronic information are essential in today's research environment. This course explores the theory and practice of biological database searching and analysis. In particular, students are introduced to integrated systems where a variety of data sources are connected through worldwide web access. Information retrieval as well as interpretation is discussed and many practical examples in a computer laboratory setting enable students to improve their data mining skills. Methods included in the course are searching the biomedical literature, sequence homology searching and multiple alignments, protein sequence motif analysis, and several genome analytical methods. Classes are held in a computer laboratory. Acquaintance with computers is required. 3 CREDITS

BBT685 **Biostatistics:** This course introduces statistical concepts and analytical methods as applied to data encountered in biotechnology and biomedical sciences. It emphasizes the basic concepts of experimental design, quantitative analysis of data, and statistical inferences. Topics include probability theory and distributions; population parameters and their sample estimates; descriptive statistics for central tendency and dispersion; hypothesis testing and confidence intervals for means, variances, and proportions; the chi-square statistic; categorical data analysis; linear correlation and regression model; analysis of variance; and nonparametric methods. The course provides students with a foundation to critically evaluate information to support research objectives and product claims and a better understanding of statistical design of experimental trials for biological products/devices. *The course also acquaints students with SPSS or"R" or STATA program.* 3 CREDITS

BBT695 **Pharmaceutical Biotechnology:** This course deals with the facts and figures about the biopharmaceuticals, and discussions of how biotechnology is applied in human and animal health care, and in industrial and environmental processes. Pharmaceutical Microbiology course consists of ten topics: (i) pharmaceuticals, biologics and biopharmaceuticals; (ii) antimicrobial compounds; (iii) recombinant and synthetic vaccines; (iv) enzyme therapeutics; (v) recombinant pharmaceuticals; (vi) monoclonal antibodies and recombinant antibodies; and (vii) nucleic acids as therapeutic agents. 3 CREDITS

BBT 792 **Genomics & Proteomics:** Genome sequences continue to be completed on a regular basis, and numerous bioinformatics and proteomic tools rapidly reveal a wealth of information contained in these genomes. This course combines lectures and laboratory exercises to cover state-of-the-art functional genomics tools at the advanced undergraduate and beginning graduate levels. Topics include web-based bioinformatics tools; gene and homology searches; whole genome comparisons, phylogenetics, selection analysis, 'Next Gen' sequence analysis (RNA-seq)/Metagenomics, Genome-Wide Association Studies, pharmacogenomics, genomic medicine and genomics of microbes and microbiomes.

The Proteomics Part of the course covers the analytical methods used to separate and characterize proteins derived through biotechnology. While emphasis is placed on the general principles and applicability of the methods, current protocols are discussed and problem sets representing realistic analytical challenges are assigned. Topics include chromatography (HPLC, SEC, IEC), electrophoresis techniques (2-D gel electrophoresis), spectroscopic methods (UV/Vis, fluorescence, CD), analytical ultracentrifugation, microarrays, mass spectroscopy, amino acid analysis, sequencing, and methods to measure protein-protein interactions, post-translational modification analysis, proteomics databases and analysis. 3 CREDITS

Elective Courses (6 credits): Choose any 2 courses from Core Courses or Elective Courses; Thesis can be substituted with 2 courses

BBT745 **Quality Control Compliance:** This course will initially deal with the principles of quality & compliance, where topics like regulatory authorities and the laws governing biotech industries will be focused on. Later the course will discuss on, i) quality assurance (QA) in practice to understand the role of QA in the functional plants that make materials for clinical trials and commercial operations; ii) Quality Control (QC) in Quality and Compliance, difference between QA and QC, and the role and function of the QC department. Particular attention will be given on how to plan, examine and implement various regulatory elements like audits, inspections, recalls, alerts etc. At the end of the course, students will also know the principles of validation and their associated requirements set by regulatory bodies. 3 CREDITS

BBT742 **Environmental Biotechnology:** The course represents some significant & progressive areas that will lead the students to know about the key aspects of environmental microbiology prior to their roles and applications in environmental biotechnology. Students will acquire knowledge on basic principles on technologies of decontamination of persistent organic pollutants (dangerous contaminants of the environment) mainly by means of the biological approaches using degradation ability of microorganisms, fungi, and plants, i.e., using bioremediation, mycoremediation, and phytoremediation technologies, as well as physico-chemical technologies, nanotechnologies, and other innovative technologies. The course will also put emphasize on biostimulation and bioaugmentation as two basic strategies of bioremediation. *In situ* and *ex situ* remediation technologies. (Bio) venting, (Bio) sparging, (Bio) stripping, (Bio) sorption barriers, Biofilters, Bioreactors. 3 CREDITS

BBT743 **Biosafety & Regulations:** This course will start with an introduction to the background history and principles of biosafety. Later a number of biosafety related topics, e.g., i) primary contaminants for biohazards, ii) biosafety levels of specific microorganisms, iii) recommended biosafety levels for infectious agents and infected animals will be addressed. A targeted emphasize will be given to risk analysis, risk management, decontamination, disinfection and disposal of biological wastes. This course will also discuss on bio-safety standard guidelines and regulations, definitions of GMOs and LMOs, roles of institutional biosafety committee for GMO applications in food and agriculture, and environmental release of GMOs. Students will learn how to use biosafety reference materials to perform basic biological risk assessments and establish appropriate levels of containment. Concepts of novelty, moral issues, intellectual property rights (IPR) like patents, trademarks, copyrights will be focused on. 3 CREDITS

BBT744 **Bioprocess Engineering:** This course deals with the elements of bioprocess industry and its recent rapid expansion. Bioprocess engineering, bioreactors, isolation, preservation, and maintenance of industrial microorganisms, kinetics of microbial growth and death, media formulation for industrial scale fermentation will be discussed. Emphasis will be put on, i) upstream processing systems- operating considerations for bioreactors, designing of fermenter/ bioreactor, analysis and sterilization of media, air & reactors, inoculum development, maintenance of optimum fermentation condition, and ii) downstream processing systems- removal of microbial cells and solid matters, foam separation,

precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment. The course will cover concepts of food processing and immobilization of enzymes. Production of industrially important products such as alcohol, organic acids, amino acids, glutamic acid, antibiotics, vitamins, enzymes, biodegradable plastic, recombinant protein will be addressed. A brief introduction to bioprocess economics and associated financial assessments will be given at the end of the course. 3 CREDITS

BBT751 **QA/QC for the Pharmaceutical and Biotechnology Industries:** There are many new quality initiatives for drugs, biotech products and medical devices that have been recently introduced. These include risk based, science based and systems-based assessments. Students will be presented with a comprehensive overview of the current best practices in quality assurance and quality control. Students will also be exposed to the most recent theories and expectations from the Food and Drug Administration. 3 CREDITS

BBT780 **Biotechnology Entrepreneurship:** This course focuses on entrepreneurship and venture creation as key engines for wealth creation and successful business strategy in the modern, innovation- intensive, high-tech economy. The course deals with key issues such as: (1) assessing attractiveness of opportunities; (2) launching a new venture; (3) nurturing, growing and entrepreneurial venture; (4) obtaining the necessary financial, human and technology resources; (5) managing the transition from a small entrepreneurial firm to a large, sustainable, professionally managed but still entrepreneurial corporation; and (6) being an entrepreneur and promoting entrepreneurship in a large corporation. 3 CREDITS

BBT702 **Thesis:** Students in the biotechnology program have the opportunity to enroll in an independent research course. This elective course is an option after a student has completed at least eight graduate-level courses and has compiled a strong academic record. Prior to proposing a project, interested students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project. The research project must be independent of current work-related responsibilities as determined by the project mentor. The mentor may be a faculty member teaching in the biotechnology program, a supervisor from the student's place of work, or any expert with appropriate credentials. Prerequisites: all foundation courses and four core courses. 6 CREDITS