DEPARTMENT OF BIOCHEMISTRY & MICROBIOLOGY
(BMD)

SCHOOL OF HEALTH & LIFE SCIENCES (SHLS)

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NORTH SOUTH UNIVERSITY (NSU)

A GUIDE TO

BS BIOCHEMISTRY & BIOTECHNOLOGY (BBT)

DEPARTMENT OF BIOCHEMISTRY & MICROBIOLOGY

COURSE MAP BS IN BIOCHEMISTRY & BIOTECHNOLOGY

YEAR	SEM	COURSE CODE	CREDITS
1ST YEAR	1	ENG102/ ENG103* · BIO103 · CHE101	9
	2	ENG103/ ENG105* (ENG102/ ENG103) · MAT116 · BEN205** · CHE101L · BIO103L	11
	3	CHE201 (CHE101) · BIO201 (BIO103) · BIO201L (BIO103L) · MIS107 · POL101/ POL104/ ECO101/ ECO104/ SOC101/ ANT101/	13
2ND YEAR	4	BUS172 · CHE202 (CHE101) · CHE202L (CHE101L) · HIS103**	10
	5	BIO202 (BIO103) · BBT221 (BIO201) · CHE203 (BIO201, CHE202) · CHE203L (BIO201L, CHE202L) · BBT230 (BIO201, BUS172)	13
	6	BBT312 (CHE203) · BBT312L (CHE203L) · BBT314 (CHE201, CHE203) · BBT314L (CHE203L) · BBT315 (CHE203) · BIO202L (BIO103L)	12
3RD YEAR	7	BBT316 (BBT221, BBT314) · BBT316L (BBT314L) · BBT317 (BBT312) · BBT335 (BBT315)	10
	8	BBT318 (BBT221, BBT312, BBT315) · BBT413 (BBT312, BBT 315) · BBT413L (BBT312L) · BBT423 (BBT335)	10
	9	BBT415 (BBT317) · BBT416 (BBT230, BBT317) · BBT419 (BBT335)	9
4TH YEAR	10	BBT415L (BBT312L, BBT314L) · BBT417 (BBT318) · BBT418 (BBT415) · BBT424 (BBT316,B BT318)	10
	11	BBT421 (BBT316, BBT317) · BBT425 (BBT 318) · BBT427 (BBT415)	06/09
	12	BBT426 (CHE203,B BT335) · BBT422 (BBT335,B BT415,BB T416)	07/04

COLOR EXPLANATION: UNIV. GED (Prerequisite) · SHLS/SCHOOL CORE (Prerequisite) · MAJOR REQUIRED (Prerequisite) · ELECTIVE/ FREE ELECTIVE (Prerequisite)

IMPORTANT INFO

1. You can take ENG103 only if ENG102 is waived for you or you must complete ENG102 first.
2. *ENG103 & ENG105 are mandatory language courses for all NSU UG students.
3. ** BEN205 and HIS103 are mandatory courses for all NSU UG students from batch 163 and onwards.
4. If you are student from Batch 152 - 162 then you can take any course from HUMANITIES Section to complete 3 CREDITS Requirement (HIS101/HIS102/HIS103).
5. If you get waiver in ENG102 and you are a student from Batch 152-162 then you have to do ENG111 to maintain 9 Credits from Language Section..
6. Elective & free Elective courses are BBT418 , BBT419 ,BBT421 , BBT423 , BBT425 ,BBT426 ,BBT427.
7. You must do minimum 3 Elective courses out of the seven courses.
8. Students are encouraged to take 3 Free Elective Courses also from the ELECTIVE & FREE ELECTIVE COURSES SECTION in order to strenghten their knowledge in the of Biochemistry & Biotechnology.

LIST OF PREREQUISITE COURSES
BS in BIOCHEMISTRY & BIOTECHNOLOGY (BATCH 152 & ONWARDS)

LANGUAGES		**12 CREDITS with ENG102 or 9 CREDITS with ENG102 Waived**		
#	**CODE**	**NAME**	**CREDIT/S**	**Pre-requisite course/s**
1	ENG102	Introduction to Composition	3	Not Required
2	ENG103*	Intermediate Composition	3	ENG102
3	ENG105*	Advanced Composition	3	ENG103
4	ENG111**	English Speech/Professional Communication	3	ENG103
5	BEN205***	Bengali Language & Literature	3	Not Required
	HUMANITIES‡			**3 CREDITS**
6	HIS101	Bangladesh History & Culture	3	Not Required
7	HIS103***	Emergence of Bangladesh	3	Not Required
8	PHI101	Introduction to Philosophy	3	Not Required
SOCIAL	**SCIENCES**			**3 CREDITS**
9	POL101/POL104	Political Science/ Governance	3	Not Required
10	ECO101/ECO104	Micro-/Macro-Economics	3	Not Required
11	SOC101/ANT101	Sociology/Anthropology	3	Not Required
C	**OMPUTER & MATH**			**9 CREDITS**
12	MIS107	Information System & Computing	3	Not Required
13	MAT116	Pre-calculus (In SHLS core)	3	Not Required
14	BUS172	Introduction to Statistics (In SHLS core)	3	Not Required
SCIENCE				**4 CREDITS**
15	BIO103	Biology I	3	Not Required
16	BIO103L	Biology I Lab	1	Not Required
17	PHY107L	General Physics I	4	MAT120
*** ENG103**	**& ENG105 are mandatory language courses for all NSU UG students**			
	***** BEN205 and HIS103 are mandatory courses for all NSU UG students from batch 163 and onwards.**			
	**** If you get waiver in ENG102 and you are a student from Batch 152-162 then you have to do ENG111 to maintain 9 Credits from Language Section**			
‡ If you	**are student from Batch 152 - 162 then you can take any course from HUMANITIES Section to complete 3 CREDITS Requirement**			
#	**CODE**	**NAME**	**CREDIT/S**	**Pre-requisite course/s**
18	CHE101	General Chemistry (In Univ. GED)	3	Not Required
19	CHE101L	General Chemistry Lab (In Univ. GED)	1	Not Required
20	BIO201	Introduction to Biochemistry & Bitechnology	3	BIO103
21	BIO201L	Introduction to Biochemistry & Bitechnology Lab	1	BIO103L
22	BIO202	Basic Microbiology	3	BIO103
23	BIO202L	Basic Microbiology Lab	1	BIO103L
24	CHE201	Biophysical Chemistry	3	CHE101
25	CHE202	Bioorganic Chemistry	3	CHE101
26	CHE202L	Bioorganic Chemistry Lab	1	CHE101L
27	CHE203	Chemistry of Biomolecules	3	BIO201, CHE202
28	CHE203L	Chemistry of Biomolecules Lab	1	BIO201L, CHE202L

29	BBT230	Biostatistics	3	BIO201, BUS172
#	**CODE**	**NAME**	**CREDIT/S**	**Pre-requisite course/s**
30	BBT221	Human Physiology	3	BIO201
31	BBT312	Molecular Biology	3	CHE203
32	BBT312L	Molecular Biology Lab	1	CHE203L
33	BBT314	Protein & Enzyme Chemistry	3	CHE201, CHE203
34	BBT314L	Protein & Enzyme Chemistry Lab	1	CHE203L
35	BBT315	Metabolism	3	CHE203
36	BBT316	Immunology	3	BBT221, BBT314
37	BBT316L	Immunology Lab	1	BBT314L
38	BBT317	Molecular Genetics	3	BBT312
39	BBT318	Cell Biology	3	BBT221, BBT312, BBT315
40	BBT335	Integrated Metabolism	3	BBT315
41	BBT413	Plant Biochemistry & Biotechnology	3	BBT312, BBT315
42	BBT413L	Plant Biochemistry & Biotechnology Lab	1	BBT312L
43	BBT415	Molecular Biotechnology	3	BBT317
44	BBT415L	Molecular Biotechnology Lab	1	BBT312L, BBT314L
45	BBT416	Bioinformatics	3	BBT230, BBT317
46	BBT417	Endocrinology	3	BBT318
47	BBT424	Virology & Oncology	3	BBT316, BBT318
48	BBT422	Research Methodology & Project	4	BBT335, BBT415, BBT416
#	**CODE**	**NAME**	**CREDIT/S**	**Pre-requisite course/s**
49	BBT418	Pharmaceutical Biotechnology	3	BBT415
50	BBT419	Clinical Biochemistry & Xenobiotics	3	BBT335
51	BBT421	Applied Immunology & Immunogenetics	3	BBT316, BBT317
52	BBT423	Nutritional Biochemistry	3	BBT335
53	BBT425	Neurochemistry	3	BBT417
54	BBT426	Chemistry of Natural Products	3	BBT335
55	BBT427	Environmental Biotechnology	3	BBT415

*** Students are encouraged to take 3 Free Elective Courses also from the ELECTIVE & FREE ELECTIVE COURSES SECTION (Course Number # 49 -55) in order to strengthen their knowledge in the field of Biochemistry & Biotechnology**

Essential QR code & Links

Departme nt of Biochemistry & Microbiology.
Web Page
http://www.northsouth.edu/academic/shl s /bmd.html

BBT Course Curriculum
http://www.northsouth.edu/newassets / files/BS_BBT_FN_Approved_by_UGC_o n_24102017.pdf

MIC Course Curriculum
http://www.northsouth.edu/assets/files/B i o_Chem/BS_MIC_.pdf

NSU Student Portal
https://rds3.northsouth.edu/
Students can login with their NSU ID and
check their NSU profile

NSU Student' Parents Portal
https://rds3.northsouth.edu/index.php/w el come/parent_login
Parents of the students can login with their mobile number used during admission and check their son/ daughters NSU profile.

BMD Facebook Page
https://www.facebook.com/biochemde ptnsu/
Official Facebook Page of the Department. (Please LIKE the page)

LSC HUB
https://www.facebook.com/groups/nsu.ls c /
A hub only for students of BMD where notifications/ announcements are posted. When joining the group please provide NSU ID otherwise will be rejected.

LIST OF IMPORTANT CONTACT NUMBERS

BMD Chairman	**Dr. Mainul Hossain** Associate Professor & Chair Phone: +880-2-55668200 Ext: 1910 & 1920 Email: mainul.hossain01@northsouth.edu Office: Room#SAC828, South Academic Building, NSU Campus
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A section of our Alumni

Taha
BS in BBT , Batch: 072
Current Position:
Postdoctoral Research Fellow,
Institute for Glycomics, Griffith University,
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Nahreen Mirza
BS in MIC Batch 072
Current Position:
Graduate assistant at Savannah State University,
Georgia, USA.

Farhana Matin
BS in BBT, Batch 073
Current Position:
Final year Ph.D. candidate
Queensland University of Technology (QUT),
Australia

Sirajul Islam Khan Sujon
BS in MIC, Batch 072 , MS in Biotechnology
Assistant Section Manager,
Current Position
Assistant Section Manager,
C.P. Bangladesh Co., Ltd.

Ishmam Nawar
BS in BBT, Batch 083
Current Position
Medical Writer
Nucleus Global, London, UK

Nusrat Annie Jahan
BS in MIC Batch 101
Current Position
PhD candidate
University of Minnesota, USA

Shobnom Mustaree
BS in MIC, Batch 102
Swedish Institute Scholarship recipient
Current Position:
Research officer,Environmental Microbiology
Laboratory, Bangladesh

Nawseen Tarannum
BS in BBT, Batch 103
Current Position
Pursuing the Wellcome Trust
PhD in Molecular and Cell Biology
University of Manchester

North South University

Department of Biochemistry & Microbiology

Curriculum for

Bachelor of Science in Biochemistry & Biotechnology
(120 credits)

UGC APPROVAL DATE: 24-10-2017

Updated Curriculum

Bachelor of Science in Biochemistry & Biotechnology (BS BBT) Department of Biochemistry & Microbiology
School of Health & Life Sciences North South University Bashundhara, Dhaka 1229

Minimum credit requirement: 120

CREDITS About the program:

Biochemistry is the study of the molecular reactions of life, whereas biotechnology focuses on the application of this knowledge. Biochemistry has taken the forefront in defining broadly based opportunities in biotechnology applications that indicate the path for biologically based future of the twenty-first century. The two disciplines go hand in hand and now-a-days there is little distinction between the two. The Bachelor of Science in Biochemistry and Biotechnology program at NSU is a merger of the above two disciplines, first of its kind in Bangladesh. The program integrates the molecular life sciences from the most basic biology-chemistry interface to advanced molecular biology, molecular genetics, bioinformatics and genetic engineering.

The program provides a 4-year (3 semesters/ year) academic program leading to the undergraduate BS degree in Biochemistry and Biotechnology. Majors have the opportunity through extensive coursework, laboratories, seminars and diverse range of general education courses to develop the knowledge and skills necessary to enter the workforce, or to go on with further higher education in biochemistry and biotechnology or related subjects at home and abroad.

Curriculum:

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

Category	**CREDITS**
University Core	28
Science/School of Health & Life Sciences Core	26
BBT Major Core	48
BBT Major Electives	9
Open Electives	9
Total	**120 CREDITS**

BIOCHEMISTRY AND BIOTECHNOLOGY (BBT) (120 CREDITS)

UNIVERSITY CORE			**(28CREDITS)**
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
PHY107L	Physics I		4
SCIENCE/ SCHOOL OF HEALTH & LIFE SCIENCES CORE			**(26 CREDITS)**
MAT116	**Pre-calculus**	**GE**	**3**
BUS172	**Introduction to Statistics**	**GE**	**3**
BBT230	**Biostatistics**		**3**
CHE201	**Biophysical Chemistry**		**3**
With Lab			
BIO201	**Introduction to Biochemistry & Biotechnology**		**4**
BIO202	**Basic Microbiology**		**4**
CHE101	**Chemistry I**	**GE**	**4**

CHE202	**Bio-Organic Chemistry**	**4**
CHE203	Chemistry of Biomolecules	4
MAJOR REQUIRED COURSES		**(48 CREDITS)**
BBT221	Human Physiology	3
BBT315	Metabolism	3
BBT317	Molecular Genetics	3
BBT318	Cell Biology	3
BBT335	Integrated Metabolism	3
BBT416	Bioinformatics	3
BBT417	Endocrinology	3
BBT424	Virology & Oncology	3
*With **Lab***		
BBT312	**Molecular Biology**	**4**
BBT314	**Protein & Enzyme Chemistry**	**4**
BBT316	**Immunology**	**4**
BBT413	**Plant Biochemistry & Biotechnology**	**4**
BBT415	**Molecular Biotechnology**	**4**
BBT422	**Research Methodology & Project**	**4**
ELECTIVE COURSES	aaa	(9 CREDITS)
BBT418	Pharmaceutical Biotechnology	3
BBT419	Clinical Biochemistry & Xenobiotics	3
BBT421	Applied Immunology & Immunogenetics	3
BBT423	Nutritional Biochemistry	3
BBT425	Neurochemistry	3
BBT426	Chemistry of Natural Products	3
BBT427	Environmental Biotechnology	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. 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. Prerequisite: ENG 103. 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 behavior; 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 Webpage's design. Students also learn some basic skills in searching and evaluating online resources. 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, and graphs of trigonometric functions, analytic trigonometry, and additional applications of trigonometry, mathematical induction, the binomial theorem, and sequences. Prerequisite: MAT112 (College Algebra)/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
PHY107L	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, DeBrogglie, 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 onedimensional inelastic collisions. Apparatus: air track. Prerequisite: Physics in HSC/A Level**.** 4 CREDITS

SCIENCE / SCHOOL OF HEALTH & LIFE SCIENCES CORE			(26 CREDITS)
MAT116	Pre-calculus	GE	3
BUS172	Introduction to Statistics	GE	3
BBT230	Biostatistics		3
CHE201	Biophysical Chemistry		3
With Lab			
BIO201	Introduction to Biochemistry & Biotechnology		4
BIO202	Basic Microbiology		4
CHE101	Chemistry I	GE	4
CHE202	Bio-Organic Chemistry		4
CHE203	Chemistry of Biomolecules		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, and graphs of trigonometric functions, analytic trigonometry, and additional applications of trigonometry, mathematical induction, the binomial theorem, and sequences. Prerequisite: 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

BBT230 **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, implement statistical methods using R: programming in R, reading data in R, accessing R packages, writing R functions to analyze data sets. Topics in statistical data analysis will provide working samples. 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 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 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. 4 CREDITS

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 biomolecules 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

BIO202 **Basic Microbiology:** Important historical developments which led to the formulation of the germ theory of disease and those discoveries that lead to the development of the science of biotechnology; historical background of the classification of microorganisms, and the techniques used to categorize them; differences between the old five-kingdom system and the modern three-domain system; structure and function of prokaryotic and eukaryotic cells; Bacterial growth curve- lag phase, exponential phase, stationary phase and death phase; archaeal diversity and life in extreme environment; survey of prokaryotic microorganisms with unusual characteristics; basic structure and characteristics of viruses, infection process with emphasis on animal viruses and bacteriophage; diversity and importance of eukaryotic microorganisms, namely protozoa, fungi and algae; nutritional requirement of microorganisms and classification; cultivation of microorganisms in the laboratory.

Laboratory work: Staining techniques: positive staining, negative staining, differential staining, endospore staining, capsule staining; nutritional requirements: media for the routine cultivation of bacteria, obtaining a pure culture: serial dilution, pour plate, spread plate, streak plate drop plate methods; fermentation of carbohydrates: fermentation of glucose, sucrose, lactose; methyl red test; Voges- Proskauer test; test for O2 utilization: oxidase test; catalase test; nitrate reduction; utilization of amino acids: indole production; citrate utilization test; gelatin hydrolysis; urea hydrolysis; culture methods: pour plate, spread plate and streak plate methods; 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 (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

CHE203 Chemistry of Biomolecules: 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. <u>*Laboratory Work:*</u> 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 **(48 CREDITS)**

BBT221	Human Physiology	3	iii
BBT315	Metabolism	3	iii
BBT317	Molecular Genetics	3	iii
BBT318	Cell Biology	3	iii
BBT335	Integrated Metabolism	3	iii
BBT416	Bioinformatics	3	iii
BBT417	Endocrinology	3	iii
BBT424	Virology & Oncology	3	iii
With Lab			iii
BBT314	Protein & Enzyme Chemistry	4	iii
BBT316	Immunology	4	iii
BBT413	Plant Biochemistry & Biotechnology	4	iii
BBT415	Molecular Biotechnology	4	iii
BBT422	Research Methodology & Project	4	iii

BBT221 **Human Physiology:** Physiology is the study of how living organism functions. The main theme of human physiology is the molecular and cellular interactions needed to
maintain the constant internal environment, i.e. homeostasis. This course commences with the principles of physiology, which is followed by an elaborate discussion of
molecular-cellular physiology with a specific focus on neural and endocrine control
and integration of homeostasis. Individual organ systems, including musculoskeletal, circulatory, respiratory, digestive, urinary, and reproductive systems are also given emphasis for a complete understanding of how the human body functions.
3 CREDITS

BBT315 **Metabolism:** Metabolism is the study of the chemical processes of living things. The course is an in-depth examination of the structure and function of biomolecules: chemical and physical properties of proteins, carbohydrates, and lipids; enzyme kinetics and mechanisms; metabolism of carbohydrates, lipids, and amino acids and the metabolic relationships of organ systems. At the end of the course, students will understand how the chemical and physical properties of biological molecules influence their function. Furthermore, they will be able to use this knowledge to describe how chemical changes alter the function of biological systems. The student will master new vocabulary and demonstrate an understanding of the molecular structure and function of biological molecules. 3 CREDITS

BBT317 **Molecular Genetics:** Molecular genetics is an essential tool for studying biology. This course discusses in details the mechanisms underlying the storage, transmission and expression of heritable information in the genetic and chromosomal level of an organism. The topics that are included in this course are mutation and its repair;

recombination and its role in DNA repair and genetic diversity; Transfer of genetic materials in prokaryotes; the concept of regulation of gene expression; CRISPR/Cas9 and targeted genome editing, the biology of Cas9, mechanism of action of CRISPR/Cas9 *in vivo*: bacterial adaptive immunity, CRISPR/Cas9 system applications: genome engineering; developmental biology with model organism *Drosophila melanogaster*. At the end, this course discusses about the principle and application of recombinant DNA technology. 3 CREDITS

BBT318 **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

BBT335 **Integrated Metabolism:** The goal of this course is to understand the integrated metabolism of the human body in the well-fed state, the transition into fasting, and in an extended starvation state. The course requires understanding the reaction chemistries of individual metabolic pathways and how the activities of these
pathways are integrated and regulated by neurotransmitters and hormones. The
second goal is to apply the knowledge and understanding of integrated metabolism to the ability of the human body to adapt and respond to its environment and
maintain health. The course include: i) connection between primary carbohydrate metabolism and glycogen metabolism; ii) pentose phosphate, ROS, fatty acid
biosynthesis, dietary Lipid metabolism, β- oxidation, and ketone Bodies relation; iii)
Interrelationship between cholesterol metabolism, lipoprotein transport, protein digestion, nitrogen disposal, urea cycle, amino acid catabolism; and iv) Integrated metabolism and diabetes mellitus. 3 CREDITS

BBT416 **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

BBT417 **Endocrinology:** The course covers the endocrine system and its hormonal products, including the characterization of hormone producing cells, synthesis and
modification mechanisms of the hormones, release and transport of the hormones of different chemical nature, various hormone receptors and the mechanisms of
hormone action, the effects of hormones on target cells, and physiological processes, as well as the diseases caused by inappropriate hormone functions. This course will
cover the general principles of endocrinology, followed by brief discussion of the system-based endocrinology. 3 CREDITS

BBT424 **Virology & Oncology:** The virology part emphasizes the common reactions that must be completed by all viruses for successful reproduction within a host cell and survival and spread within a host population. The molecular basis of alternative reproductive cycles, the interactions of viruses with host organisms, and how these lead to disease are presented with examples drawn from a set of representative animal and human viruses, although selected bacterial viruses will be included.
This second part of the course designed to provide insight into the biological chemistry of cancer. Major topics include chemical carcinogenesis, genomic
instability, oncogenes and tumor suppressor genes, cell growth, apoptosis, tumor
progression and metastasis, tumor angiogenesis, hormones, viruses, and drug resistance. 3 CREDITS

BBT312 **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 (designing of cloning and expression vector).

Laboratory Work: The lab course is designed to introduce the students to the technical world of molecular biology. In this course the students will learn basic techniques used in molecular biology including DNA and RNA isolation, purification and detection, restriction analysis, polymerase chain reaction (PCR), expression cloning, Molecular identification using 16s RNA sequencing for bacteria and Internal Transcribed Spacer (ITS) region for fungi., SDS gel electrophoresis and western blotting. 4 CREDITS

BBT314 Protein & Enzyme Chemistry: The objective of this course is to provide understanding on protein structure, properties and their most important functions. Key concepts related to this course are studying properties of amino acids and peptides, reaction and analysis of amino acids, different structural level of organization of proteins with specific examples, how protein interact with other molecules related to their function, and different analytical techniques use in protein chemistry. Studying enzymes and its classification, enzyme kinetics, enzyme's mechanisms of action, enzyme inhibition, regulation, and reaction mechanism of some enzymes and clinical, diagnostic and industrial application of enzymes are also key notions relation to this course. This course will be useful for future studies in biochemistry, microbiology, molecular and cellular biology, and biotechnology, pharmaceutical and medically related fields.

Laboratory Work: The laboratory part of this course is intended to introduce you to some of the most widely used experimental procedures in biochemistry, including protein purification and characterization and enzyme assays and kinetics. You will also gain some familiarity with some of the types of equipment frequently used in biochemistry. 4 CREDITS

BBT316 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 is to study 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 antigenantibody 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; to understand how the immune system causes and prevents disease, the use and performance of immunological tests. 4 CREDITS

BBT413 Plant Biochemistry & Biotechnology: This course provides a deepening of the subject in areas of plant physiology and plant biochemistry and provides a basic knowledge of plant molecular biology and plant biotechnology. The course deals with the life processes of plants: Seed germination, plant growth, anatomy and

differentiation, metabolism, photosynthesis, stress physiology and flowering. The specific characteristics of plants are introduced such as cell wall synthesis, cell extension, the three genomes (chromosomal, mitochondrial and chloroplast), gene regulation, plant growth hormones and natural products. In addition methods of molecular biology used in plant biotechnology such as plant model systems, transformation methods, plant tissue specific expression and use of databases are introduced.

Laboratory Work: The students will gain a thorough understanding of the basic laboratory techniques in plant molecular biology. They will also learn their use to address scientific questions in different fields of plant biology ranging from ecology to biochemistry. These techniques include the tools of DNA technology as well as the basic analysis of proteins. The students will plan and carry out molecular biology experiments. They will learn how to keep a laboratory notebook and to gain the confidence and skills necessary to be able to attempt new laboratory procedures. The course will make students competitive for employment in an introductory laboratory research position. 4 CREDITS

BBT415 Molecular Biotechnology: Molecular Biotechnology is an evolving field of science that integrates applications from molecular biology, biochemistry, immunology, genetics and microbiology to create useful products in areas as diverse as human and animal health, agriculture, food and sustainable energy production, and the textile industry. This course will provide sound knowledge regarding transfer of genetic information between organisms to capitalize on existing biological processes to create new and innovative products. Topics include: recombinant DNA technology; chemical synthesis, amplification & sequencing of DNA: classical sequencing, Next Generation Sequencing (NGS), single molecule real time DNA sequencing (Helicos, first single-molecule DNA sequencer), RNASeq, advantages and disadvantages of different sequencing approaches, application of NGS and its impact on genomics research; manipulation of gene expression in prokaryotes; heterologous protein production in eukaryotes; site directed mutagenesis & protein engineering, development of transgenic animal and use of molecular biotechnology to synthesize commercial products.

Laboratory Work: The principal aim of this course is to introduce the students modern techniques of molecular biology used in clinical diagnosis. The course will emphasize the importance on molecular diagnostic and clinical applications in light of the process of diagnosis and the diagnosti c importance of pathology and genetics. 4 CREDITS

BBT422 Research Methodology & 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. 4 CREDITS

ELECTIVE COURSES (9 CREDITS)

BBT418	Pharmaceutical Biotechnology	3
BBT419	Clinical Biochemistry & Xenobiotics	3
BBT421	Applied Immunology & Immunogenetics	3

BBT423	Nutritional Biochemistry	3
BBT425	Neurochemistry	3
BBT426	Chemistry of Natural Products	3
BBT427	Environmental Biotechnology	3

BBT418 **Pharmaceutical Biotechnology:** The course is designed to equip students with a basic knowledge of concepts directly relevant to working in the bio-pharmaceutical industry. The course topics include five sections: 1) introduction (definition of traditional pharmaceutical, biologic and biotechnological product; advantages of producing biotechnological products by recombinant means); 2) biotechnological drug development (introductory xenobiotics, preclinical studies and clinical trials, developing recombinant therapeutic protein); 3) the biotechnological products manufacturing process (overview of cell banking systems, typical upstream and downstream processes, fermentation, product recovery, stabilization and formulation); 4) biotechnological product regulation; 5) practical aspect of pharmaceutical manufacture (Overview of QA and QC); 6) biosimilar medicines, the differences between biopharmaceuticals, biosimilars, and generic medications, the potential for biosimilar medicines, capturing the benefits of biosimilar medicines; 7) the biochemistry, production and medical uses of selected biotechnology products (Insulin, hormone, monoclonal antibodies, recombinant vaccines, gene therapy, cancer therapy). 3 CREDITS

BBT419 **Clinical Biochemistry & Xenobiotics:** This course will introduce diagnostic enzymology and the role of clinical biochemistry in evaluating diseases related to hepatic, renal, respiratory, and thyroid function and genetic disorder. An overview of the biochemistry of various diseases such as atherosclerosis, hepatitis, diabetes, rheumatoid arthritis, obesity, gout, mal-absorption syndromes, acidosis and alkalosis will be given. This xenobiotics part of the course will provide strong conceptual foundation of enzymology and mechanisms of drug biotransformation pathways. As a foundation for learning we will provide examples of drugs and other xenobiotics that exhibit toxicity related to biotransformation. 3 CREDITS

BBT421 **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

BBT423 **Nutritional Biochemistry:** The course objective is to enable students to understand the relationships between the biochemistry of macronutrients and micronutrients; and their metabolism in specific physiological and disease states. Course will cover the metabolic and physiological functions of nutrients at different levels -molecular, cellular, organ and whole body. Course will also focus on aspects of current research that are relevant to macronutrient-related diseases (e.g. atherosclerosis, obesity, diabetes, cancer, perinatal growth). Students will be encouraged to develop their ability to analyze current articles/reviews/advertising/diet and drug recommendations related to the topics of this course. 3 CREDITS

BBT425 **Neurochemistry: T**he course comprises the biochemistry of the nervous system; neurotransmitter synthesis and metabolic mechanisms at the synapse, release and reuptake/degradation of classical neurotransmitters and peptide transmitters.
Receptors for neurotransmitters and their ligands will be discussed from a chemicalpharmacological point of view including the relevance of these molecules and their interactions for development of tolerance, super-sensitivity and long-term potentiation. 3 CREDITS

BBT426 **Chemistry of Natural Products:** Natural Products Chemistry is an advanced-level course in biochemistry. The goal during the course is to provide a basic knowledge and understanding on the chemical nature of secondary metabolites and the
emerging trend around it to improve their properties in order to increase their
biological or commercial utilization for the well-being of mankind. The course starts by exploring the historical and contemporary role of natural products in health care
and commerce. The classification of natural products according to their biosynthetic
origins, their chemical properties and synthetic pathway of key natural products will
be discussed. A special emphasis will be placed on how chemical structure affects the physiological function of various natural products. These "structure activity relationships" help us learn about the interaction of small molecules in living systems and pharmacology of drugs. 3 CREDITS

BBT427 **Environmental Biotechnology:** This course firstly explores the diversity, function and ecological adaptations of microorganisms within the environment. Subsequently it explores the application of these environmental microorganisms, products and
processes within the environmental biotechnology sector for the benefit of both
human society and the environment. It aims to provide an understanding of the
central importance of microbial life to key ecosystem processes and systems and in turn how
microbiology can be applied to address the key environmental and
biological challenges facing society through the integration of biology and
environmental science with consideration to important legal, regulatory and society issues. Key themes within this course include biogeochemistry and biodegradation,

and waste management and processing and bioenergy. Underpinning the course is the importance of microbial diversity as an immensely rich resource for
biotechnological application and the importance of molecular biology approaches that
have transformed our understanding of environmental microbiology and are, in turn, now being applied for the development and/or enhancement of a range of
environmental biotechnology tools and approaches, including wastewater treatment, bioremediation and bioenergy production. 3 CREDITS

FREE ELECTIVE COURSES (9 CREDITS)

Attachment 1

Books recommended for the courses in the updated curriculum of BS in Biochemistry & Biotechnology.

Course Code, Course Name	Name/s of Recommended Books
ENG102, Introduction to Composition	"Course Reader" provided by the concerned department
ENG103, Intermediate Composition	"Course Reader" provided by the concerned department
ENG105, Advanced Composition	"Course Reader" provided by the concerned department
BEN205, Bengali Language & Literature	"Course Reader" provided by the concerned department
HIS101, Bangladesh History & Culture	"Course Reader" provided by the concerned department
HIS103, Emergence of Bangladesh	"Course Reader" provided by the concerned department
PHI101, Introduction to Philosophy	Lee Archie, John G. Archie, *Reading for Philosophical Inquiry: A Brief Introduction to Philosophical Thinking*, version 0.21, Open Source Reader.
POL101, Political Science	Nigel Jackson, Stephen D Tansey; *Politics: The Basics*; 5th Edition; ISBN-13: 978-0415841429; Routledge; September 28, 2014
POL104, Governance	Alan R. Ball, B. Guy Peters; *Modern Politics and Government*; Seventh Edition; ISBN-13: 978-0333961612; Palgrave Macmillan; March 24, 2005
ECO101, Micro-Economics	Roger A. Arnold; *Microeconomics*; 12th Edition; ISBN-13: 978-1305399433; Cengage Learning; January 27, 2015
ECO104, Macro-Economics	Roger A. Arnold; *Microeconomics*; 12th Edition; ISBN-13: 978-1285738352; Cengage Learning; January 1, 2015
SOC101, Sociology	Richard T. Schaefer; *Sociology: A Brief Introduction*; 10th Edition; ISBN-13: 978-0078026720; McGraw-Hill Humanities/Social Sciences/Languages; September 13, 2012
ANT101, Anthropology	Conrad Kottak; *Cultural Anthropology: Appreciating Cultural Diversity*; 15th Edition; ISBN-13: 978-0078035005; McGraw-Hill Education; October 11, 2012
MIS105, Introduction to Computers	Peter Norton; Peter Norton's Introduction to Computers; 6th Edition; ISBN-13: 978-0071117166; McGraw Hill Higher Education; September 1, 2005
MAT116, Pre-calculus	Michael Sullivan; *Precalculus*; 10th Edition; ISBN-13: 978-0321979070; Pearson; February 27, 2015
BUS172, Introduction to	Prem S. Mann; *Introductory Statistics*; 8th Edition; ISBN-13: 978-

Statistics	0470904107; Wiley; November 19, 2012
PHY107L, Physics I	David Halliday, Robert Resnick, Jearl Walker; *Fundamentals of Physics*; 10th Edition; ISBN-13: 978-1118230718; Wiley; August 5, 2013

Books recommended for the courses of BS in Biochemistry & Biotechnology updated curriculum

BIO103, Biology I	1. 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 2. Kathleen A. Ireland; *Visualizing Human Biology*; 4th Edition; ISBN-13: 978-1118169872; Wiley; September 11, 2012 *3.* 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
BIO201, Introduction to Biochemistry & Biotechnology	1. David L. Nelson, Michael M. Cox; *Lehninger Principles of Biochemistry*; 6th edition; ISBN-13: 978-1429234146; W.H. Freeman; November 21, 2012 2. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Lubert Stryer; *Biochemistry*; 8th Edition;ISBN-13: 978-1464126109; W. H. Freeman; April 8, 2015 *3.* William J. Thieman, Michael A. Palladino; *Introduction to Biotechnology;* 3rd Edition; ISBN-13: 978-0321766113; Pearson; January 23, 2012 4. John L. Tymoczko, Jeremy M. Berg, Lubert Stryer; *Biochemistry: A Short Course;* 3rd Edition; ISBN-13: 978-1464126130; W. H. Freeman; April 24, 2015 5. 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
BIO202, Basic Microbiology	1. Joanne Willey, Linda Sherwood, Christopher J. Woolverton; *Prescott's Microbiology;* 9th Edition; ISBN-13: 978-0073402406; McGraw-Hill Education; January 8, 2013 2. Thomas Brock et. al.; *Brock Biology of Microorganisms*; 14th Edition; ISBN-13: 978-0321897398; Pearson; January 12, 2014 *3.* Gerard J. Tortora, Berdell R. Funke, Christine L. Case; *Microbiology: An Introduction*; 11th Edition; ISBN-13: 978-0321733603; Benjamin Cummings; January 6, 2012 *4.* James G. Cappuccino, Natalie Sherman, *Microbiology: A Laboratory Manual*; 10th Edition; ISBN-13: 978-0321840226; Pearson; January 24, 2013
CHE101, Chemistry I	1. Martin Silberberg, Patricia Amateis; *Chemistry: The Molecular Nature of Matter and Change*; 7th Edition; ISBN-13: 978-0073511177; McGraw-Hill Education; January 6, 2014 2. Raymond Chang, Kenneth A. Goldsby; *Chemistry*, 11th Edition; ISBN-13: 978-0077666958; McGraw-Hill Education; January 17, 2012 3. Darrell Ebbing, Steven D. Gammon, General Chemistry; 10th Edition; ISBN-13: 978-1285051376; Brooks Cole; April 20, 2012

CHE201, Biophysical Chemistry	1. Julio de Paula, Peter Atkins; *Atkins' Physical Chemistry*; 10th ed; ISBN-10: 019969740X, ISBN-13: 978-0199697403; Oxford University Press; January 1, 2014 2. Arun Bahl, B.S. Bahl,G.D. Tuli; *Essentials of Physical Chemistry*; ISBN 10: 8121929784 / ISBN 13: 9788121929783; S. Chand & Company Ltd, 2014 3. James P. Allen; *Biophysical Chemistry*; ISBN: 978-1-4051-2436-2; Wiley-Blackwell; September 2008 4. 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

Books recommended for the courses of BS in Biochemistry & Biotechnology updated curriculum

	5. 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, 2014
CHE202, Bio-Organic Chemistry	1. John E. McMurry; *Organic Chemistry*; 9th edition; ISBN-10: 1305080483, ISBN-13: 9781305080485; Cengage Learning/ January 1, 2016 2. T. W. Graham Solomons, Craig B. Fryhle, Scott A. Snyder; *Organic Chemistry* ; 11th edition; ISBN-13: 978-1118133576; Wiley/January 17, 2013 3. Leroy G. Wade; *Organic Chemistry*; 8th edition; ISBN-13: 978-0321768414; Prentice Hall/ January 6, 2012
CHE203, Chemistry of Biomolecules	1. John E. McMurry; *Organic Chemistry with Biological Applications*; 3rd edition; ISBN-13: 978-1285842912; Cengage Learning/ February 27, 2014 2. S. P. Bhutani; *Chemistry of Biomolecules*; ISBN-13: 978-1439839294; CRC Press/ September 24, 2010 3. John McMurry, Begley Tadhg; *The Organic Chemistry of Biological Pathways*; 1st Edition; ISBN-13: 978-0974707716; Roberts and Company Publishers; February 1, 2005
BBT221, Human Physiology	1. Stuart Fox; *Human Physiology*; 13th edition; ISBN-13: 978-0077836375, ISBN- 10: 0077836375; McGraw-Hill Science/Engineering/Math; March 16, 2015 2. Lauralee Sherwood; *Human Physiology: From Cells to Systems*; 9th edition; ISBN-13: 978-1285866932, ISBN-10: 1285866932; Cengage Learning; January 1, 2015 3. Dee Unglaub Silverthorn; *Human Physiology: An Integrated Approach*; 7th edition; ISBN-13: 978-0321981226, ISBN-10: 0321981227, Pearson; January 9, 2012

BBT230, Biostatistics	1. Wayne W. Daniel, Chad L. Cross; *Biostatistics: A Foundation for Analysis in the Health Sciences*; 10th Edition; ASIN: B00ZE0KGUA; Wiley India; 2013 2. Michael C. Whitlock and Dolph Schluter; *The Analysis of Biological Data*; ISBN-13: 978-1936221486, ISBN-10: 1936221489; Roberts and Company Publishers/2014 3. Jerrold H. Zar; *Biostatistical Analysis*; ISBN: 0131008463, 9780131008465; Prentice Hall/ 2010
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BBT314, Protein & Enzyme Chemistry	1. David L. Nelson, Michael M. Cox; *Lehninger Principles of Biochemistry*; 6th edition; ISBN-13: 978-1429234146; W.H. Freeman; November 21, 2012 2. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Lubert Stryer; *Biochemistry*; 8th Edition;ISBN-13: 978-1464126109; W. H. Freeman; April 8, 2015 3. Thomas M. Devlin; Textbook of Biochemistry with Clinical Correlations; 7th Edition; ISBN-13: 978-0470281734; John Wiley & Sons; January 19, 2010 4. Norbert Sewald, Hans-Dieter Jakubke; *Peptides: Chemistry and Biology*; 2nd Edition; ISBN-13: 978-3527318674; Wiley-VCH; April 13, 2009 5. Bugg, T. D. H.; *Introduction to Enzyme and Coenzyme Chemistry*; 3rd edition; ASIN: B010WFOTLI; Wiley; 2012 6. 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, 2014

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BBT317, Molecular Genetics	1. Leland Hartwell; *Genetics: From Genes to Genomes*; 5th edition; ISBN-13: 978-0073525310; McGraw-Hill Science/Engineering/Math; September 5, 2014 2. D. Peter Snustad, Michael J. Simmons; *Principles of Genetics*; 6th edition; ISBN-13: 978-0470903599; John Wiley and Sons; August 23, 2011 3. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll; *Introduction to Genetic Analysis*; 10th edition; ISBN-13: 978-1429229432; W. H. Freeman; December 24, 2010 4. James D. Watson, Tania A. Baker, Stephen P. Bell; *Molecular Biology of the Gene*; 7th edition; ISBN-13: 978-0321762436; Benjamin Cummings; March 2, 2013 5. Robert Brooker; *Genetics: Analysis and Principles*; 5th edition; ISBN-13: 978-0073525341; McGraw-Hill Science/Engineering/Math; January 10,

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BBT413, Plant Biochemistry & Biotechnology	1. Hans-Walter Heldt, Birgit Piechulla, Plant Biochemistry, Fourth Edition; ISBN-13: 978-0123849861; Academic Press; October 25, 2010 2. C. Neal Stewart Jr.; Plant Biotechnology and Genetics: Principles, Techniques, and Applications; 2nd Edition; ISBN-13: 978-1118820124; Wiley; March 21, 2016 3. Bob Buchanan, Wilhelm Gruissem, Russell Jones; *Biochemistry & Molecular Biology of Plants*; 2nd Revised edition; ISBN-13: 978-0470714218; Wiley-Blackwell; Sep 4, 2015 4. Adrian Slater , Nigel W. Scott , Mark R. Fowler; *Plant Biotechnology: The Genetic Manipulation of Plants*; ISBN: 978-0199282616; 0199282617; Oxford University Press; 2nd edition; 2008 5. H S Chawla; *Introduction to Plant Biotechnology*; ISBN: 978-1578086368;1578086361; CRC Press; 3rd edition; 2009
BBT415, Molecular Biotechnology	1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten; *Molecular Biotechnology: Principles and Applications of Recombinant DNA*; 4th Edition; ISBN-13: 978-1555814984; ASM Press; November 1, 2009 2. Alexander N. Glazer, Hiroshi Nikaido; *Microbial Biotechnology: Fundamentals of Applied Microbiology*; 2nd Edition; ISBN-13: 978-0521842105; Cambridge University Press; October 1, 2007 3. Frank H. Stephenson*; Calculations for Molecular Biology and Biotechnology, A Guide to Mathematics in the Laboratory;* 2nd Edition; ISBN-13: 978-0123756909; Academic Press; July 12, 2010 4. Heather Miller, D. Scott Witherow, Sue Carson; *Molecular Biology Techniques, A Classroom Laboratory Manual*; 3rd Edition; ISBN-13: 978-0123855442; Academic Press; November 21, 2011
BBT416, Bioinformatics	1. Michael Agostino; Practical Bioinformatics; ISBN-0815344562, 978-0815344568; Garland Science/2012 2. Marketa Zvelebil, Jeremy Baum; Understanding Bioinformatics; ISBN: 978-0815340249, 0815340249; Garland Science/2007 3. Pavel Pevzner , Ron Shamir; Bioinformatics for Biologists; ISBN: 1107648874, 978-1107648876; Cambridge University Press/2011

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BBT419, Clinical Biochemistry & Xenobiotics	1. Miriam D. Rosenthal, Robert H. Glew; *Medical Biochemistry: Human Metabolism in Health and Disease*; 1st Edition; ISBN-13: 978-0470122372; Wiley; March 30, 2009 2. Martin Andrew Crook; *Clinical Biochemistry and Metabolic Medicine*, 8th edition; ISBN-13: 978-1444144161; Hodder Education;July 1, 2012 3. Michael W. King; *Integrative Medical Biochemistry: Examination & Board Review*; ISBN: 9780071786126; McGrawHill Education; June 13th 2014 4. Pavel Anzenbacher, Ulrich M. Zanger; *Metabolism of Drugs and Other Xenobiotics*; 1st Edition; ISBN-13: 978-3527329038; Wiley-VCH; May 29, 2012 5. G. Gordon Gibson, Paul Skett; *Introduction to Drug Metabolism*; 3rd Edition; ISBN-13: 978-0748760114; Nelson Thornes Ltd; October 30, 2001
BBT421, Applied Immunology & Immunogenetics	1. Judith A. Owen, Jenni Punt, Sharon A. Stranford; *Kuby Immunology*, 7th Edition; ISBN-13: 978-1464119910; W. H. Freeman; January 25, 2013 2. Kenneth Murphy, Casey Weaver; *Janeway's Immunobiology*; 9th Edition; ISBN-13: 978-0815345053; Garland Science; March 29, 2016 3. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai; *Cellular and Molecular Immunology*; 8th Edition; ISBN-13: 978-0323222754; Saunders; August 28, 2014
BBT422, Research	1. C. R. Kothari; *Research Methodology: Methods and Techniques*; 3rd

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BBT424, Virology & Oncology	1. Alan J. Cann; *Principles of Molecular Virology*; 6th Edition; ISBN-13: 978-0128019467; Academic Press; March 27, 2015 2. John Carter and Venetia Saunders; *Virology : principles and applications*; 2nd edition; ISBN-13: 978-1119991427; Wiley; May 6, 2013 3. Robert A. Weinberg; *The Biology of Cancer*; 2nd Edition; ISBN-13: 978-0815342205; Garland Science; ;May 18, 2013 4. John Mendelsohn MD, Peter M. Howley MD, Mark A. Israel MD, Joe W. Gray PhD, Craig B. Thompson MD; *The Molecular Basis of Cancer,* 4th Edition; ISBN-13: 978-1455740666; Saunders; March 5, 2014
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BBT426, Chemistry of	1. Paul M. Dewick; *Medicinal Natural Products: A Biosynthetic Approach*;

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