DEPARTMENT OF PLANT SCIENCES
UNIVERSITY OF COLOMBO

COURSE CATALOGUE

BSc (External) in Biotechnology and Microbiology

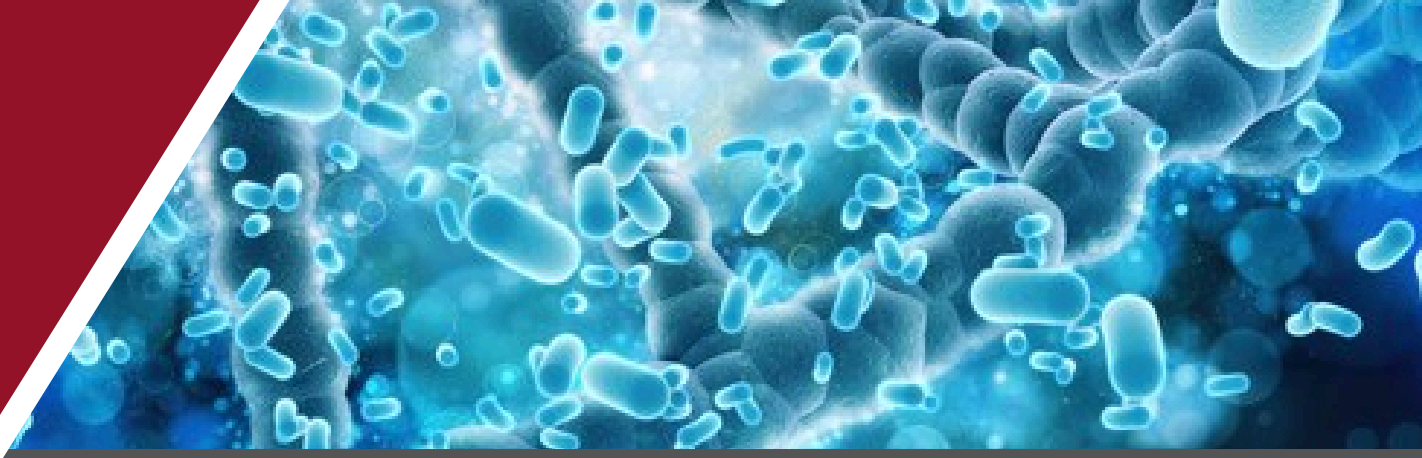
2026

www.science.cmb.ac.lk

CONTENT

OVERVIEW

Biotechnology and Microbiology are exceptionally dynamic and exciting fields of biological sciences. Recent advances in these fields are making our lives better, providing healthier lifestyles and making the world more sustainable. On this interdisciplinary degree program, you can find out how biotechnology and microbes can be used to improve food, healthcare, agriculture, energy, and environment, while laying a solid foundation for a career as a biotechnologist or a microbiologist.



RATIONALE

Biotechnology and Microbiology are rapidly expanding scientific disciplines with cutting-edge technologies that share a number of common interests in industry and academia. Microbiology is an integral part of modern biotechnology as microorganisms are used in almost all biotechnological applications and hence can be considered within the large framework of biotechnology. Furthermore, applications of microbiology and biotechnology dominate the global market mainly in the fields of healthcare, pharmaceuticals, agriculture, environment and food & beverages.

The biotechnology industry merges life sciences with entrepreneurship and hence demands a workforce enriched with knowledge and skills in basic research, product development, regulatory affairs and commercialization. In the industrial sector, the demand for well-trained, skillful and knowledgeable staff is escalating as strict regulatory issues need to be addressed appropriately.

This interdisciplinary three-year BSc (external) degree program which encompasses the latest innovations in the fields of biotechnology and microbiology aims not only to provide you with theoretical and practical knowledge but also with the ability to critically evaluate and explore the advances and applications in these fields. Therefore, our degree program blends a broad range of specialist subjects with course modules that can improve your communication skills, analytical reasoning and computer literacy. All our course modules are conducted in a blended learning mode by experienced academics to provide you with an exceptional learning experience.

PROGRAM LEARNING OUTCOMES (PLOs)

At the end of the 3 years (SLQF Level 5) BSc (External) in Biotechnology and Microbiology degree holders should be able to;

PLO 1: demonstrate broad conceptual understanding in the fields of Biotechnology and Microbiology

PLO 2: demonstrate practical skills in disciplines related to Biotechnology and Microbiology

PLO 3: effectively communicate & disseminate knowledge, information and ideas to specialists and a wider society

PLO 4: develop attitudes and skills required for employment and life-long learning

PLO 5: practice professionalism and uphold ethical standards

PLO 6: function independently as well as interdependently

PLO 7: demonstrate leadership skills

PLO 8: express emotional and intellectual maturity in a global setting

PROGRAM STRUCTURE

BSc (External) degree in Biotechnology and Microbiology is conducted over three years (90 Credits / SLQF Level 5), with two early exit levels.

LEVEL I: Diploma in Biotechnology and Microbiology (30 Credits)

LEVEL II: Higher Diploma in Biotechnology and Microbiology (60 Credits)

LEVEL III: BSc (External) in Biotechnology and Microbiology (90 Credits)

Abbreviated qualification: BSc (External) Biotech & Microb

LEVEL I						
Semester	**Course Code**	**Course Title**	**Credits/Hours**	**Notional Hours**	**Status (Core/Elective)**	
1	BM 1001	Cell Structure and Function	1C (10L 10P)	50	Core	
1	BM 1002	Genes and Heredity	2C (20L 20P)	100	Core	*
1	BM 1003	Variety of Plant and Animal Life	3C (30L 30P)	150	Core	
1	BM 1004	The World of Microorganisms	2C (30L)	100	Core	*
1	BM 1005	Techniques in Microbiology	2C (60P)	100	Core	*
1	BM 1006	Acellular Microorganisms	1C (15L)	50	Core	*
1	BM 1007	Introductory Biochemistry	2C (15L 30P)	100	Core	*
1	BM 1008	Foundation to Biotechnology	1C (15L)	50	Core	*
1	BM 1009	Fundamentals of Molecular Biology	1C (15L)	50	Core	*
2	BM 1010	Environmental Microbiology	3C (30L 30P)	150	Core	*
2	BM 1011	Plant-microbe Interactions	2C (20L 20P)	100	Core	
2	BM 1012	Human-microbe Interactions	2C (20L 20P)	100	Core	
2	BM 1013	Principles of Immunology	1C (15L)	50	Core	
2	BM 1014	Analytical Chemistry for Biotechnology	3C (30L 30P)	150	Core	*
2	BM 1015	Concepts and Methods in Biostatistics	3C (30L 30P)	150	Core	*
2	BM 1016	Scientific Writing I	1C (15L)	50	Core	
Non-GPA modules						
1	BM 1050	English for Academic Purposes	1C (15 L)	50	Compulsory	
1	BM 1051	General IT	1C (30P)	50	Compulsory	

***Compulsory course to be eligible for Diploma in Biotechnology and Microbiology**

LEVEL II						
Semester	**Course Code**	**Course Title**	**Credits/Hours**	**Notional Hours**	**Status (Core/Elective)**	
1	BM 2002	Biochemistry of Life Processes	2C (15L 30P)	100	Core	
1	BM 2003	Cell and Tissue Culture	3C (30L 30P)	150	Core	*
1	BM 2005	Biotechnology and Energy	2C (20L 20P)	100	Core	*
1	BM 2006	Post-Harvest Management	2C (20L 20P)	100	Core	*
1	BM 2009	Molecular Biology Techniques	3C (30L 30P)	150	Core	*
1	BM 2011	Experimental Design	2C (15L 30P)	100	Core	
1	BM 2014	Microbial Culture Maintenance	1C (10L 10P)	50	Core	*
2	BM 2001	Microbial Biochemistry and Physiology	2C (15L 30P)	100	Core	
2	BM 2004	Agricultural Biotechnology	3C (30L 30P)	150	Core	*
2	BM 2007	Plant Disease Management	3C (30L 30P)	150	Core	
2	BM 2008	Basic Bioinformatics	2C (20L 20P)	100	Core	*
2	BM 2010	Immunological Applications in Biotechnology	1C (15L)	50	Core	*
2	BM 2012	Nanotechnology and its Biological Applications	1C (15L)	50	Core	*
2	BM 2013	Microbial Genetics	1C (15L)	50	Core	*
2	BM 2015	Current Topics in Biotechnology and Microbiology	1C (30P)	50	Core	*
2	BM 2016	Scientific Writing II	1C (15L)	50	Core	

***Compulsory course to be eligible for Higher Diploma in Biotechnology and Microbiology**

LEVEL III					
Semester	**Course Code**	**Course Title**	**Credits/Hours**	**Notional Hours**	**Status (Core/Elective)**
1	BM 3001	Food Microbiology	2C (20L 20P)	100	Core
1	BM 3002	Advanced Molecular Biology	3C (45L)	150	Core
1	BM 3003	Applications in Medical Biotechnology	2C (30L)	100	Core
1	BM 3004	Industrial Microbiology	2C (30L)	100	Core
1	BM 3005	GMOs and GMFs	2C (30L)	100	Core
1	BM 3013	Assignment/Case Study	4C (120P)	200	Core
2	BM 3006	Enzyme Technology	2C (30L)	100	Core
2	BM 3007	Entrepreneurship	3C (15L 60P)	150	Core
2	BM 3008	Laboratory Management	3C (45L)	150	Core
2	BM 3009	Pharmaceuticals and Cosmeceuticals	2C (20L 20P)	100	Core
2	BM 3010	Aspects of Bioprospecting	2C (30L)	100	Core
2	BM 3011	Fermentation Technology	2C (30L)	100	Core
2	BM 3012	Protecting Intellectual Property	1C (15L)	50	Core

COURSE SPECIFICATIONS

LEVEL I COURSES:

Semester:	Semester 1
Course Code:	BM 1001
Course Name:	Cell Structure and Function
Credit Value:	1 C (10L 10P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course is designed to introduce basic principles and concepts of cell biology. Cell chemistry and relationship between cell structure and function will be discussed.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- List the fundamental features of prokaryotic and eukaryotic cells
- Describe the structure and functions of various cell organelles
- Describe the structure, composition and role of eukaryotic cell membranes
- Explain specific processes and proteins involved in membrane transport
- Acquire, and apply some fundamental technical, and laboratory skills relevant for Cell Biology

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	10	10	30	50

Course Content: (Main topics, Sub topics)

Introduction to cell biology; Different types of cells: Prokaryotic and Eukaryotic cells; Cell organelles; Structural organization of bio-membrane; Fluid mosaic model of

<table>
<tr><td colspan="4">bio membranes; Cellular functions and processes: Transport of molecules across cell membranes, Cell to cell signaling; Cell cycle.
Practical component: microscopy, spectrophotometry, cell fractionation and isolation of organelles by differential centrifugation</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 40%</td><td colspan="3">Final Assessment: 60%</td></tr>
<tr><td>Details:
Quizzes/mid-term evaluation/ practical assignments 40%</td><td>Theory (%)
40</td><td>Practical (%)
20</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Alberts, B., Hopkin, K., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (4th ed.). (2013). Essential Cell Biology. Garland Science.
Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (6th ed.). (2014). Molecular Biology of the Cell. Garland Science.
Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. (8th ed.). (2016). Molecular Cell Biology. W. H. Freeman.
Wilson, J. & Hunt, T. (6th ed.). (2014). Molecular Biology of the Cell 6E – The Problems Book. Garland Science.</td></tr>
</table>

Semester:	Semester 1
Course Code:	BM 1002
Course Name:	Genes and Heredity
Credit Value:	2C (20L 20P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

The course intends to provide a thorough understanding of the fundamental basis of heredity in living organisms in order to prepare students for more advanced study in Molecular Biology and Biotechnology. The course includes a detailed study of Classical Genetics and a limited understanding of modern genetic studies.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the chromosomal basis of transmission of genetic information
- Analyze situations where Mendel's ratios will not be obtained
- Construct pedigree charts of genetical traits
- Analyze test cross data and construct simple linkage maps
- Discuss the consequences of structural and numerical aberrations in chromosomes and their impact on life

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

Overview of Mendelian Genetics; Chromosomes and heredity – cell cycle, mitosis, meiosis; Deviation from Mendelian patterns of inheritance – spectrum of dominance, multiple alleles, pleiotropy, penetrance & expressivity of genes, gene interactions, polygenic inheritance; Sex determination & sex linkage – pedigree charts & X-linked inheritance patterns, prediction of genetic events and genetic counseling; Aneuploidy of the sex chromosomes – X inactivation and dosage compensation in mammals, sex-limited & sex-influenced inheritance; Linkage & chromosome mapping – incomplete linkage and crossing over, gene mapping with recombination data, mapping studies in diploid & haploid organisms; Chromosome aberrations – numerical & structural aberrations; Gene mutations – types of mutations, transposable elements and mutagenesis; Applications of Genetics in Biotechnology

Practical Component: Analysis of experimental data on the topics covered in theory.

<table>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 30%</td><td colspan="3">Final Assessment: 70%</td></tr>
<tr><td>Details:
Quizzes/assignments/mid-term evaluation 30%</td><td>Theory (%)
35</td><td>Practical (%)
35</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Gardner, E. J., Simmons, M. J., Snustad, P.D. & Santana Calderón, A. (2000). Principles of Genetics. John Wiley.
Griffiths, J. F., Griffiths, A. J., Wessler, S. R., Lewontin, R. C., Gelbart, W. M., Suzuki, D. T. & Miller, J. H. (6th ed.). (2005). An Introduction to Genetic Analysis. Macmillan.
Hartwell, L., Goldberg, M. L., Fischer, J. A., Hood, L. E. & Aquadro, C. F. (2018). Genetics: From Genes to Genomes (p. 960). McGraw-Hill Education.
Klug, W. S. & Cummings, M. R. 9 (2nd ed.). (1986). Concepts of Genetics. Merrill Publishing Company.</td></tr>
</table>

Semester:	Semester 1
Course Code:	BM 1003
Course Name:	Variety of Plant and Animal Life
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

Variety of Plant Life Component (15L 15P):

This component of the course introduces the lineages of plants that evolved through millions of years. General understanding of different groups of plants that we see today, and those that existed in the past will provide a foundation for other

plant-based studies. The practical component will provide in depth knowledge and hands on experience on identification of different groups of plants around us and their tremendous diversity.

Variety of Animal Life Component (15L 15P):
This component of the course provides an introduction to the diversity of animal life on earth. The variety of animal life will be examined through an ecological and evolutionary approach, using the major animal groups living today.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Recognize the morphological, ecological, and reproductive diversity of the plant world and animals (based on body plan, external and internal anatomy, physiology, and behavior)
- Classify and identify different plant groups and animal phyla based on their characteristic features.
- Review the evolutionary affinities and trends among different plant groups.
- Explain major adaptations seen in animals for different modes of life.
- Identify and demonstrate characteristic features and modifications of plant and animal taxa and understand their hierarchical and evolutionary interrelationships.
- Employ knowledge and practical skills in the field to study the diversity of angiosperms and major animal phyla.

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Variety of Plant Life Component:
Cyanobacteria and algae: morphological diversity, basic characteristics, ecology, evolution of eukaryotes and evolutionary trends; Origin of land plants: different groups of bryophytes; Life on land: challenges of a terrestrial environment and adaptation to life on land; Evolution of seedless vascular plants: morphological

diversity of ferns and their ecology; Evolution of seed plants: evolution of seed, morphological diversity of gymnosperms; Diversity of angiosperms: major lineages of angiosperms, morphological variations, major angiosperm plant orders and families.

Practical component: morphological and habitat diversity of cyanobacteria, algae, bryophytes, ferns and gymnosperms; Identification of several dominant angiosperm plant families in Sri Lanka; Plant identification using botanical literature (keys, checklists, field guides) and the use of herbarium for plant identification.

Variety of Animal Life Component:
Basic and unique characteristics and adaptive radiation of animal protoctists, diploblastic and acoelomate triploblastic forms, pseudocoelomates, protostomes and deuterostomes.

Practical Component: Microscopy, biological drawing, field collection, preservation and identification techniques, Study of a variety of animals using representative specimens from major phyla.

Teaching /Learning Activities:
Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 30%	50	20	–

Recommended Reading:

- Hickey, M., King, C. & King, M. (2000). *The Cambridge illustrated glossary of botanical terms*. Cambridge University Press.
- Niklas, K. J. (2016). *Plant evolution: an introduction to the history of life*. The University of Chicago Press.

- Rupert, E. E., Fox, R. S. & Barnes, R. D. (2004). *Invertebrate Zoology: A functional evolutionary approach*. Thomson-Brooks/Cole, Belmont, CA.
- Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. & Reece, J. B. (11th ed.). (2016). *Campbell Biology*. Pearson.
- Young, J. Z. (1962). *The life of vertebrates*. New York, Oxford University Press.

Semester:	Semester 1
Course Code:	BM 1004
Course Name:	The World of Microorganisms
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course provides an understanding of the basic structural and physiological characteristics of microorganisms with an emphasis on the evolution, diversity and economically important functions.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe evolutionary lineages of microorganisms and their role as ancestor of all extant life forms
- Identify different classes of microorganisms and their interactions with each other and other organisms
- Describe various applications of microorganisms in industry
- Relate microbial physiology to habitat selection and industrial applications
- Design microbial culture systems based on their growth characteristics

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Major groups of microorganisms and their evolutionary relationships; Major domains and their characteristics: Bacteria- morphology and structure, metabolism and reproduction, economic importance; Fungi- Diversity and classification, major characters: morphology and structure, ecology & nutrition, types of spores, hyphal modifications, hyphal aggregations, characteristics of major fungal groups, reproduction, economic Importance; Introduction to Mycoplasma and Archaea; structure and ecological significance; Isolating and growing microorganisms; Factors affecting growth, growth kinetics; Culturing techniques; studies on microbial density and diversity: culture dependant and independent methods; Control of microorganisms: physical and chemical methods; Antimicrobial drugs: types, modes of action, development of antibiotic resistance; Microbial interactions: competition, symbiosis, ammensalism, antagonism, etc

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- Heritage, J., Evans, E.G.V. & Killington, R.A. (1996). *Introductory microbiology*. Cambridge University Press.
- Hudson, H. J. (1986). *Fungal biology.* Cambridge University Press.
- Madigan, M. T., Bender, K., Buckley, D. H., Sattley, W.M., & Stahl, D.A. (16th ed.). (2021). *Brock Biology of Microorganisms*. Pearson Publishers.
- Tortora, G. J., Funke, B. R., & Case, C. L. (5th ed.). (1994). *Microbiology: an introduction*. Benjamin Cummings.
- Tortora, G. J., Funke, B. R., & Case, C. L. (12th ed.). (2014). *Microbiology: an Introduction*. Pearson Publishers.

Semester:	Semester 1
Course Code:	BM 1005
Course Name:	Techniques in Microbiology
Credit Value:	2 C (60P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

The course is aimed at providing hands-on experiences of the fundamental microbiological techniques.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate the techniques used in isolation, growth, growth control of microorganisms and sterilization

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	–	60	40	100

Course Content: (Main topics, Subtopics)

Characteristics of bacteria and fungi: Microscopy, staining techniques, biochemical tests; Growing microorganism; Sterilization techniques; Isolation and purification of microorganisms; Determining the factors affecting the growth of microorganisms; Enumeration methods; Techniques used in identification of bacteria and fungi; determining the activity of antimicrobial compounds

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	–	60	–

Recommended Reading:

- Bergey, D. H. & Holt, J. G. (9th ed.). (2000). *Bergey's manual of determinative bacteriology.* Philadelphia: Lippincott Williams & Wilkins.
- Black, J. G. & Black, L. J. (2018). *Microbiology: principles and explorations*. John Wiley & Sons.
- Cappuccino, J. G. & Welsh, C. T. (2017). *Microbiology: A laboratory manual*. Pearson Education.
- Goodfellow, M. & O'Donnell, A.G. (1994). *Chemical methods in prokaryotic systematics*. Wiley.
- Johnson, T. R. & Case, C. L. (2004). *Laboratory experiments in microbiology*. Pearson/Benjamin Cummings.
- Manclark, C. R., Moore, H.B. & Pickett, M. J. (1972). *Laboratory manual for medical bacteriology*. Appleton Century Crofts.
- Schaad, N. W., Jones, J. B. & Chun, W. (3rd ed.). (2001). *Laboratory guide for the identification of plant pathogenic bacteria*. American Phytopathological Society (APS Press).
- Shapton, D. A. & Board, R. G. (1972). *Safety in microbiology*. Academic Press.
- Sirockin, G. & Cullimore, S. (1969). *Practical microbiology*. McGraw-Hill.

Semester:	Semester 1
Course Code:	BM 1006
Course Name:	Acellular Microorganisms
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

The course is aimed at providing basic information on general characteristics, morphological and structural diversity of viruses & virus reproduction. An insight into the other acellular microorganisms will also be provided.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe general characteristics of viruses and sub viral particles
- Distinguish between different viral morphologies
- Describe viral reproduction methodologies and associated pathogenicity

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Viruses: General characteristics; Diversity in morphology and structure: DNA and RNA viruses; Classification; Reproduction and pathogenicity; growing viruses; Sub-viral agents; prions, satellite viruses, virusoids and nanobacteria

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- Bott, R., Madigan, M., Martinko, J., Bender, K., Buckley, D. & Stahl, D. (2014). *Brock Biology of Microorganisms.* Pearson.

Semester:	Semester 1
Course Code:	BM 1007
Course Name:	Introductory Biochemistry
Credit Value:	2 C (15L 30P)

Core/Optional:	Core
Pre-requisites:	BM 1001

Course Aim:

This course aims to explore the basic principles of biochemistry and to develop the student's appreciation and understanding of biological networks. It will focus on the understanding of biochemical processes in the context of chemical principles.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate understanding of the basic principles and concepts in biochemistry
- state the laws of thermodynamics
- Describe biomolecules and their functions
- Define activation energy and explain how enzymes enhance rates of biological reactions

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	30	55	100

Course Content: (Main topics, Subtopics)

Introduction to biochemistry; Cells, water, and buffers; Thermodynamics and bioenergetics; Biomolecules- amino acids, proteins, carbohydrates, lipids, nucleic acids, vitamins and co-factors; Enzyme catalysis – activation energy, regulation of enzyme activity, isozymes and metabolic significance, enzymes in industry

Practical component: extraction, isolation and identification of biomolecules; nature of enzymes and enzymatic reactions

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%

Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/mid-term evaluation/practical assignments 40%	40	20	–

Recommended Reading:

- Berg, J. M., Tymoczko, J. L., Gatto, G. & Stryer, L. (8th ed.). (2015). *Biochemistry*. W. H. Freeman & Company.
- Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. & Reece, J. B. (11th ed.). (2016). *Campbell Biology.* Pearson.

Semester:	Semester 1
Course Code:	BM 1008
Course Name:	Foundation to Biotechnology
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course provides an overview of Biotechnology, its importance and impacts, and fundamental knowledge which is necessary to study advanced and current topics in Biotechnology.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate an understanding of the fundamentals of biotechnology
- State the importance of the use of biotechnology in areas such as agriculture, health and environment protection
- Describe and practice safe use of biotechnology
- Recognize biotechnology as a tool to search and develop answers to current and future challenges

Time allocation (Hourly Breakdown)	**Theory** 15	**Practical** –	**Independent Learning** 35	**Notional** 50
Course Content: (Main topics, Subtopics) Introduction to Biotechnology: early and modern biotechnology; Biotechnology in everyday life; Overview of uses of biotechnology in agriculture, health and environment protection; Appropriate & safe use of biotechnology, bio-terrorism; Use of biotechnology as a tool to face the challenges of the present and the future.				
Teaching /Learning Activities: Blended learning mode				
Assessment Strategy:				
Continuous Assessment: 30%	**Final Assessment:** 70%			
Details: Quizzes/assignments/mid-term evaluation 30%	**Theory (%)** 70	**Practical (%)** –	**Other (%) (specify)** –	
Recommended Reading: ➢ Thieman, W.J., and Palladina, M. A., 2012. Introduction to Biotechnology. (3rd ed). Benjamin Cummings				

Semester:	Semester 1
Course Code:	BM 1009
Course Name:	Fundamentals of Molecular Biology
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course focuses on the fundamental concepts of Molecular Biology to provide a solid background for more advanced courses in Cell and Molecular Biology, and research.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the process of DNA replication and repair mechanisms, transcription, and translation
- Compare and contrast the process of transcription in prokaryotes and eukaryotes
- Describe the structure of an operon and its regulation
- Explain the basis of recombinant DNA technology

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Sub topics)

Structure and function of nucleic acids; Fundamentals of protein structure and folding; DNA replication and repair: Structure and function of DNA polymerases, semi-conservative replication, replication in prokaryotes, types of DNA damage, DNA repair mechanisms; Transcription of protein-coding genes: Structure, function and organization of genes in prokaryotes and eukaryotes; Basic principles of transcription – initiation, elongation and termination, transcription in prokaryotes, transcription and RNA processing in eukaryotes; Translation: Transfer RNA structure and function, properties of the genetic code, amino acid activation, the role of the ribosome, mechanism of protein synthesis–initiation, elongation and termination; Regulation of gene expression in prokaryotes: the Lac operon; Introduction to recombinant DNA technology

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:			
Continuous Assessment: 20%	**Final Assessment:** 80%		
Details: Quizzes/assignments/mid-term evaluation 20%	**Theory (%)** 80	**Practical (%)** –	**Other (%) (specify)** –

Recommended Reading:

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. ,1989. Molecular biology of the cell. New York: Garland Publishing Inc., New York.
- Lewin, B. ,1990. Genes IV.Oxford University Press, USA.
- Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. and Darnell, J. ,2000. Molecular cell biology. W. H. Freeman, New York.

Semester:	Semester 2
Course Code:	BM 1010
Course Name:	Environmental Microbiology
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1004

Course Aim:

The course provides an in-depth knowledge on microorganisms, their distribution, roles played in environment components such as water and air. Climate change and its effect on global carbon store and microbial processes are also discussed.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the role of microorganisms in soil, water, and air
- Describe factors affecting microbial survival in soil and air & adaptations shown by microorganisms for an air-borne life
- Explain the involvement of microorganisms in nutrient cycling process
- Demonstrate the techniques used in assessing water and air quality and soil microbial communities

- Critically analyze the methods of air quality monitoring
- Employ microorganisms in environmental management practices

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Sub topics)

Components of environment; Soil as a habitat for microorganisms: Ecological and nutritional classification; Soil organic matter: organic matter as food for microorganisms, fresh organic matter and r & K strategists, mineralization; Nutrient cycling; C, N, and S cycles, significance of nutrient cycling in agriculture; Bioremediation; biomarkers and biosensors in environmental applications.

Microbiology of water; Wastewater treatment: techniques employed; Potable water treatment; Disinfection of water; Water quality indicators and standards; Microbiology of air; factors affecting the air-borne microorganisms: Adaptations of microorganisms for an air-borne life; methods of air quality monitoring; in-house air quality and sick building syndrome; microorganisms and climate; bacterial sociology.

Practical component: Techniques in soil microbiology; demonstration of steps in Nitrogen and Sulphur cycling in laboratory, Microorganisms of air; sampling and enumeration methods, techniques used in determining microbial quality of water, Field visits to water and wastewater treatment plants

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	40	20	–

Recommended Reading:

- Bott, R., Madigan, M., Martinko, J., Bender, K., Buckley, D. & Stahl, D. (14th ed.). (2014). *Brock Biology of Microorganisms*. Pearson Publishers.
- Lynch, J. M. & Poole, N. J. (1979). *Microbial ecology: a conceptual approach*. Blackwell Science Ltd.
- Madigan, M.T., Bender, K., Buckley, D. H., Sattley, W.M. & Stahl, D.A. (16th ed.). (2021). *Brock Biology of Microorganisms*. Pearson Publishers.
- Mitchell, R. & Gu, J.D. (2nd ed.). (2010). *Environmental microbiology*. John Wiley & Sons.
- Waksman, S. A. (1953). Soil microbiology. *Soil Science, 75*(01).

Semester:	Semester 2
Course Code:	BM 1011
Course Name:	Plant-microbe Interactions
Credit Value:	2 C (20 L 20P)
Core/Optional:	Core
Pre-requisites:	BM 1004; BM 1005

Course Aim:

The course provides an insight into different components of plant microbiome, its importance and ways of manipulating plant microbiome for increased agricultural production

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the plant microbiome and the roles played by microbionts in maintaining plant health
- Distinguish the nature of different microbial associations and describe their functions.
- Discuss the importance of manipulating plant microbiome for better agricultural productivity

Time allocation (Hourly Breakdown)	**Theory** 20	**Practical** 20	**Independent Learning** 60	**Notional** 100

Course Content: (Main topics, Subtopics)

The concept of plant microbiome; Components of plant micorbiome: Rhizosphere, phyllosphere and endosphere microorganisms, microbial residence and functions; Root, stem and leaf nodules: formation and structure in relation to function; Mycorrhizal associations: different types, importance to the plant and the ecosystem stability; Manipulation of plant microbiome for improved agriculture production; Associations between cyanobacteria and higher plants; Effect of climate change on plant microbiome; Metagenomics as a tool in microbiome studies.

Practical component: Observing the components of plant microbiome: Rhizosphere, phyllosphere, root nodules, mycorrhizae, etc. Isolation of microorganisms having plant growth promoting characteristics using different isolation techniques

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details: Quizzes/assignments/mid-term evaluation 40%	**Theory (%)** 30	**Practical (%)** 30	**Other (%) (specify)** –

Recommended Reading:

- Galloway, L.D. (1939). *Applied mycology and bacteriology*. London: Leonard Hill Ltd.
- Madigan, M.T., Bender, K., Buckley, D. H., Sattley, W.M. & Stahl, D.A. (16th ed.). (2021). *Brock Biology of Microorganisms.* Pearson publishers.
- Stevenson, G. (1967). *The biology of fungi, bacteria, and viruses*. Edward Arnold.

Semester:	Semester 2
Course Code:	BM 1012
Course Name:	Human-microbe Interactions
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	BM 1004; BM 1005

Course Aim:

The course provides information on human microbiome hotspots, dominating organisms and the role of microbiome on disease suppression and other health related issues. Industrial applications of microbiome microorganisms will also be discussed.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the human microbiome and the roles played by microbionts in maintaining human health
- Discuss the involvement of microbiome on human health

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

The human microbiome: establishment of a microbiome; hotspots; resident microflora of skin, gastrointestinal canal and urogenital system, importance and causes of dysbiosis; The Human Microbiome project; application of microbiome components in food, medicine, pharmacy and forensics.

Practical component: Observation and enumeration of microbiota from different microbial hotspots; demonstrating dysbiosis with respect to antimicrobial/antiseptic use.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:			
Continuous Assessment: 40%	**Final Assessment:** 60%		
Details: Quizzes/assignments/mid-term evaluation 40%	**Theory (%)** 30	**Practical (%)** 30	**Other (%) (specify)** –
Recommended Reading: ➢ Madigan, M.T., Bender, K., Buckley, D. H., Sattley, W.M. and Stahl, D.A. (16th ed.). (2021). *Brock Biology of Microorganisms.* Pearson publishers. ➢ Singleton, P. (6th ed.). (2004). *Bacteria in biology, biotechnology and medicine*. John Wiley & Sons.			

Semester:	Semester 2
Course Code:	BM 1013
Course Name:	Principles of Immunology
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None
Course Aim: The course provides students with the knowledge on human immune system and its function in defense against disease causing agents/microbes	
Intended Learning Outcomes: At the successful completion of this course, student will be able to: ➢ Describe the key components of human immune system ➢ Compare different immune mechanisms and their respective roles in immunity ➢ Discuss the failures of the immune system	

Time allocation (Hourly Breakdown)	**Theory** 15	**Practical** –	**Independent Learning** 35	**Notional** 50

Course Content: (Main topics, Subtopics)

Components of the human immune system: Cells and organs of the immune system: immune cells, lymphoid organs and tissues, Molecules of the immune system: Cytokines, Chemokines, Complement components, Major histocompatibility complexes, Antigens and immunoglobulins

Immune response: Innate immunity: Components of innate immunity and their defensive mechanisms, Inflammation, Adaptive immunity: Components of adaptive immunity and their defensive mechanisms, Immunization

Immunity to microbes and immune evasion mechanisms
Failures of immune system: Hypersensitivity, Immunodeficiencies

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 50%	Final Assessment: 50%		
Details: Quizzes/assignments/mid-term evaluation 50%	**Theory (%)** 50	**Practical (%)** –	**Other (%) (specify)** –

Recommended Reading:

- Abbas, A.K., Lichtman, A.H. & Pillai, S. (2021). *Cellular and molecular immunology E-book.* Elsevier Health Sciences.
- Owen, J., Punt, J. & Stranford, S. (2013). *Kuby Immunology: International Edition.* W. H. Freeman & Co. Ltd.

Semester:	Semester 2
Course Code:	BM 1014
Course Name:	Analytical Chemistry for Biotechnology
Credit Value:	3 C (30L 30P)

Core/Optional:	Core
Pre-requisites:	None

Course Aim:

The course intends to equip the students with knowledge and skills to work in natural product chemistry field. Students will gain a thorough knowledge on basic separation techniques needed to isolate a compound from a mixture and on various spectroscopic techniques employed in characterization of compounds.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe and use basic separation techniques used in isolation of compounds from mixtures
- Explain the basic principles behind chromatographic techniques and solvent extraction
- Relate the physical and chemical principles with separation techniques
- Explain basic principles of the interaction of light with matter in terms of the molecular structure
- Demonstrate the understanding of molecular spectroscopic techniques (IR, UV-vis, fluorescence, NMR) and mass spectrometry
- Analyze results of measurements using molecular spectroscopy methods and elucidate structural information
- Apply the knowledge to select suitable separation technique/s and characterization technique/s to a given setup

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Separation techniques (12L):

Introduction to Solvent extraction: solvent properties, partition coefficient, distribution ratio extraction efficiency; Introduction to chromatographic separation methods: planar chromatography column chromatography; Introduction to

separation mechanisms in chromatography: adsorption chromatography, partition chromatography, size exclusion chromatography, ion-exchange chromatography, affinity chromatography, normal and reverse phase chromatography; Introduction to chromatographic retention, selectivity, resolution, and column efficiency; Elution methods; Qualitative and quantitative analytical methods using chromatography.

Molecular spectroscopy (18L):
Ultraviolet and visible spectroscopy: electronic transitions, radiative processes, energy diagram; Emission spectroscopy: fluorescence, phosphorescence, internal conversion, Stokes shift, quenching, and quantum yield; Infrared spectroscopy: introduction of theory and applications; NMR spectroscopy: introduction of theory, 1H and 13C NMR, chemical shift, chemically and magnetically equivalent nuclei, spin-spin coupling, structure elucidation and applications of 1D NMR; Mass spectrometry: introduction of theory, ionization methods, molecule fragmentation.

Practical component: Extraction of organic compounds under different solvent conditions (neutral, acidic, and basic solvent media) using liquid-liquid extraction; Separation of coloured and colourless compounds using paper chromatography; Preparation of thin layer chromatography plates and Separation of coloured and colourless compounds; Separation of coloured compounds using gravity column chromatography and use of UV-visible absorption for detection of separated compounds; Demonstration of HPLC, GC, IR, and MS instruments and Interpretation of IR data, MS data, NMR data and structure elucidation

Teaching /Learning Activities:
Blended learning mode

Assessment Strategy:

Continuous Assessment: –	**Final Assessment:** 100%		
Details:	**Theory (%)** 70	**Practical (%)** 30	**Other (%) (specify)** –

Recommended Reading:

- Harris, D.C., 2010. *Quantitative chemical analysis*. Macmillan.

- Skoog, D.A., West, D.M., Holler, F.J. and Crouch, S.R., 2013. *Fundamentals of analytical chemistry*. Cengage learning.
- Silverstein, R., Webster, F., Kiemle, D. and Bryce, D., 2015. Spectrometric identification of organic compounds. Hoboken, NJ: John Wiley & Sons.

Semester:	Semester 2
Course Code:	BM 1015
Course Name:	Concepts and Methods in Biostatistics
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course provides an overview of basic statistical principles used in the study of biology with an emphasis on biotechnology and microbiology. Students are provided with a set of statistical tools that can be used to collect, organize, analyze, interpret and present data. Core concepts are mastered through application and analysis in the laboratory.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe statistical principles
- Apply suitable statistical analyses and interpret findings
- Calculate statistical significance
- Analyze published data from a statistical perspective
- Translate biological problems into statistical assumptions
- Design hypotheses to solve given problems

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Introduction to basic theory and methods in statistics and probability; Different types of variables; Organization of data – frequency distributions; Description of data: graphical forms and numerical forms; Distributions and relationships between data;Interpreting published data and presentation; Probability and probability distributions (discrete random variables and continuous random variables). Sampling distributions. The central limit theorem and sampling distributions for sample means. Theory and practice of estimation and introduction to statistical inferences: Estimation (point and interval estimates) and Hypothesis testing. Inferences involving one population (Inferences about population mean, inferences about population variance and standard deviation). Inferences involving two populations: Independent samples and Dependent samples (Paired samples). Introduction to multivariate analysis.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- Antonisamy, B., Christopher, S. & Samuel, P.P. (2010). *Biostatistics: principles and practice*. Tata McGraw Hill Education.
- Moore, D.S., Notz, W.I. & Fligner, M.A., (2015). *The basic practice of statistics*. Macmillan Higher Education.
- Zar, J.H. (1999). *Biostatistical analysis*. Pearson Education India.

Semester:	Semester 2
Course Code:	BM 1016
Course Name:	Scientific Writing I
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course introduces scientific writing with a focus on laboratory reports and other writing assignments undertaken by students in the course of their studies. Students are provided with a set of skills which would assist them in effectively presenting data or ideas according to the accepted language and style rules of scientific writing.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe and identify scientific writing types
- Demonstrate use of suitable language for scientific writing
- Analyze the language of academic writing
- Prepare laboratory reports according to the accepted criteria
- Formulate a critical essay, critically review journal articles
- Identify and cite reference sources when obtaining information

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Introduction to scientific writing (part 1). Different types of scientific writing. Key principles in effective scientific writing. Analysis of the language of scientific writing. Communicating information by incorporating suitable visual aids (tables, graphs). Sourcing information and effective citation. Writing effective laboratory reports. Composing critical essays.

<table>
<tr><td colspan="4">Knowledge and skill development in the above sections will be achieved through activities during the lectures and assignments.</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 30%</td><td colspan="3">Final Assessment: 70%</td></tr>
<tr><td>Details:
Quizzes/assignments/mid-term evaluation 30%</td><td>Theory (%)
70</td><td>Practical (%)
–</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Online sources will be used as appropriate to the planned activities (eg: scientific writing for microbiology majors – Microsoft Word – WICOct16.DOC (oregonstate.edu), Critical essays – Argument – The Writing Center • University of North Carolina at Chapel Hill (unc.edu)</td></tr>
</table>

Non-GPA Modules:

Semester:	Semester 1
Course Code:	BM 1050
Course Name:	English for Academic Purposes
Credit Value:	1
Core/Optional:	Compulsory
Pre-requisites:	None
Course Aim: This course is designed to provide students with the language skills necessary for success in higher education programs conducted in English medium and to prepare them with language skills needed for employment. The course is designed to impart the following skills, particularly by focusing on grammar and language	

structure. (i) Language skills – (Listening, Speaking, Reading), (ii) Grammar for Listening, Speaking, Reading

Intended Learning Outcomes:

After successful completion of this course, the students will be able to:

- utilize various parts of speech accurately and appropriately in both written and spoken English
- analyze and apply accurate and appropriate tense and voice in various contexts.
- identify and employ appropriate reading strategies suitable for a given purpose
- use active listening strategies and formulate comprehensions of resources such as lectures and meetings

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	-	35	50

Course Content: (Main topics, Sub topics)

Application of grammar: types of nouns: common nouns (countable and uncountable, concrete and abstract), proper nouns, compound nouns, collective nouns; pronouns: types of pronouns, use of pronouns; articles: types of articles, rules for using articles; verbs: classes of verbs (helping verbs or auxiliary verbs, transitive and intransitive verbs, regular and irregular verbs); basic tenses: simple present, past and future, continuous forms, perfect forms; active and passive voice: how to identify the voice in sentences, use of active and passive voice; reported speech; Introduction to reading skills: styles of reading: scanning for specific information, skimming for getting the gist of something; Listening: the difference between listening and hearing, barriers to listening, understanding types of listening, effective listening, listening to a variety of listening audios, academic listening: understanding the purpose of lectures, recognize language in lectures, identifying the strategies used by the speaker to emphasize the important points, recognize spoken sentences (stress, intonation), take down notes effectively.

Teaching /Learning Activities: Online learning mode with self-study sessions			
Assessment Strategy:			
Continuous Assessment: 40%	**Final Assessment**: 60%		
Details: Quizzes/assignments - 40%	**Theory (%)** 60	**Practical (%)** –	**Other (%)(specify)** –
Recommended Reading: ➢ Sasikumar V. (2007). *A Course in Listening and Speaking I.* Cambridge University Press India Pvt Ltd ➢ Michael J. W. (1984). *Study Skills in English*. Cambridge University Press, . Cambridge ➢ Nagasundaram P. (2018). *Grammar for by Communication: A Grammar Guide for Students of English.* Olanco Press			

Semester:	Semester 1
Course Code:	BM 1051
Course Name:	General IT
Credit Value:	1
Core/Optional:	Compulsory
Pre-requisites:	None
Course Aim: This course aims to provide practical training in basic Information Technology (IT) concepts, including the use of common productivity tools with attention to digital literacy.	

Intended Learning Outcomes:

After successful completion of this course, the students will be able to:

- assess the suitability of different computer applications for specific tasks
- make use of common computer applications, such as word processors, spreadsheets, and presentation software to complete a task efficiently
- apply principles of digital literacy by demonstrating responsible internet and email usage

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	–	30	20	50

Course Content: (Main topics, Sub topics)

Introduction to system and application software, operating systems and use of system software tools, word Processing: comparison of word processing applications, the concept of files and compatibility, document formatting, text formatting, proofing tools, effective writing practices; spreadsheets: the concept of spreadsheets, cell referencing, formulas and functions, data summarization and visualization; presentation software: slide design and layout, adding and formatting text, images, and multimedia, transitions, animations, effective presentation practices, exporting presentations to different formats; digital literacy: introduction to internet and email literacy, Email Etiquette and Best Practices, introduction to learning management systems (LMS), Scientific applications of IT

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 50%	**Final Assessment:** 50%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%)(specify)**
Quizzes/assignments/mid-term evaluation 50%	50	–	–

Recommended Reading:

- Rajaraman, V. (2018) *Introduction to information technology*. PHI Learning Pvt. Ltd.
- Lesk, A. (2019). *Introduction to Bioinformatics*. Oxford University Press.
- Zvelebil, M. J., & Baum, J. O. (2007). *Understanding Bioinformatics*. Garland Science.

LEVEL II COURSES:

Semester:	Semester 1
Course Code:	BM 2002
Course Name:	Biochemistry of Life Processes
Credit Value:	2 C (15L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1001, BM 1007

Course Aim:

This course intends to introduce the fundamental processes of central metabolism common to most organisms.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate an understanding of the basic metabolic concepts
- Explain how metabolism is regulated generally
- Describe the common metabolic processes
- Discuss the importance of different metabolic processes for life
- Design and conduct experiments to study the selected life processes
- Demonstrate skills in scientific writing, and in analyzing experimental data

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	30	55	100

Course Content: (Main topics, Subtopics)

Overview of metabolic concepts; Regulation of metabolism; Cellular respiration: Glycolysis, Fermentation, Citric Acid Cycle; Gluconeogenesis; Glyoxylate Cycle; Lipid metabolism; Photosynthesis; Carbohydrate metabolism; Pentose Phosphate Pathway; Mechanisms of plant hormone responses; Assimilation of mineral nutrients in plants

Laboratory component: biochemical assays related to selected metabolic pathways			
Teaching /Learning Activities: Blended learning mode			
Assessment Strategy:			
Continuous Assessment: 40%	**Final Assessment:** 60%		
Details: Quizzes/mid-term evaluation/practical assignments 40%	**Theory (%)** 40	**Practical (%)** 20	**Other (%) (specify)** –
Recommended Reading: ➢ Berg, J. M., Gatto Jr, G. J., Tymoczko, J. L. and Stryer, L. (8th ed.). (2015). *Biochemistry.* W. H. Freeman. ➢ Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. & Reece, J.B. (11th ed.). (2016). *Campbell Biology*. Pearson.			

Semester:	Semester 1
Course Code:	BM 2003
Course Name:	Cell and Tissue Culture
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	None
Course Aim: This course will provide basic knowledge and practical skills in plant tissue culture and cell culture. It has a vocational focus and introduces the student to the role of tissue culture in plant propagation, secondary metabolite production and crop improvement.	

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the nature of plant growth processes in the *in vitro* tissue culture environment
- Determine appropriate culture media for different tissue culture applications
- Demonstrate competence in techniques used in tissue culture
- Apply concepts of tissue culture to select, manage and improve plants
- Discuss the major applications of plant cell cultures

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Introduction to plant tissue culture and terminologies; Historical aspects of plant tissue; Culture media and its components: Plant hormones and their effects; Sources of contamination and aseptic techniques; Stages of micropropagation; Plant regeneration and propagation techniques for plant improvement and conservation: shoot-tip culture, meristem culture, nodal culture, callus culture, somatic embryogenesis, organ culture, seed culture, anther and microspore culture, embryo rescue and wide-hybridization, protoplast culture, tissue culture as a method for germplasm conservation; Plant tissue culture and genetic transformation; Commercial plant tissue culture: Concept of commercialization, designing of a commercial tissue culture laboratory, laboratory management; Cell suspension cultures: secondary metabolite production, establishment of cell suspension cultures, bioreactors and biotransformation.

Practical component: Practical sessions will provide knowledge and skills on basic techniques of plant tissue culture and cell suspension cultures

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:			
Continuous Assessment: 10%	**Final Assessment:** 90%		
Details: Quizzes/assignments/mid-term evaluation 10%	**Theory (%)** 50	**Practical (%)** 40	**Other (%) (specify)** –

Recommended Reading:

- Doods, J.H. & Roberts, L.W. (2nd ed.). (1985). *Experiments in plant tissue cultures*. Cambridge University Press, Cambridge, UK.
- Razdan, M. K. (2003). *Introduction to plant tissue culture*. Science Publishers Inc. Enfield, New Hampshire, USA.
- Smith, R. H. (3rd ed.). (2013). *Plant tissue culture techniques and experiments*. Academic Press, New York, USA.
- Thorpe, T. A. (1981). *Plant tissue culture methods and application in agriculture*. Academic Press, New York, USA

Semester:	Semester 1
Course Code:	BM 2005
Course Name:	Biotechnology and Energy
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

The course aims to provide students with knowledge on biotechnological approaches to minimize the use of non-renewable energy sources, reducing the human impact on global warming and climate change.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the importance of the reduced use of non-renewable energy sources

- Explain the impacts of petrochemical use on climate change and global warming
- Describe the scientific basis underpinning the biotechnology approaches in reducing energy consumption in industrial setting
- Design biotechnological procedures in a laboratory and/or observe in industrial setting

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

Global warming and the significance of fossil fuels; Evolution of biofuels; Biological fuel generation in photosynthesis, the ultimate energy source; Biofuels from biomass, Bioethanol, Biodiesel, Methane and Hydrogen as biofuel, reducing the use of and reliance on petrochemicals to cut greenhouse gas emissions; Biotechnological approaches in improving manufacturing process efficiency to save energy and operating costs by application of biocatalysts; future of biotechnology for energy conservation.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 30%	70	–	–

Recommended Reading:

- Hill, J., Nelson, E., Tilman, D., Polasky, S., Tiffany D (2006). Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. Proc Natl Acad Sci U S A 103:11206–11210.

- Sexton S, Zilberman D, Rajagopal D, Hochman G (2009). The role of biotechnology in a sustainable biofuel future. Ag Bio Forum 12(1):130–140
- Munshi M (2011) Next generation biofuel: technology options for India, Department of Biotechnology. Government of India, New Delhi
- Reviews and journal articles relevant to the subject

Semester:	Semester 1
Course Code:	BM 2006
Course Name:	Post-Harvest Management
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	BM 1004, BM 1005

Course Aim:

The course will provide an understanding of the factors that contribute to wastage of horticultural produce after harvest, and knowledge and skills needed to minimize post-harvest losses through the use of biotechnology and post-harvest technology.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Recognize the level of post-harvest losses and the importance in use of appropriate technologies to mitigate
- Assess different factors related to quality deterioration and wastage of horticultural produce after harvest
- Examine different methods available to minimize post-harvest losses and uphold quality standards
- Design and implement appropriate strategies to minimize post-harvest losses and maintain post-harvest quality of horticultural commodities

Time allocation (Hourly Breakdown)	**Theory** 20	**Practical** 20	**Independent Learning** 60	**Notional** 100

Course Content: (Main topics, Subtopics)

Overview of postharvest handling; Biological aspects: Respiration, transpiration and water loss, ethylene, morphological, anatomical and physiological basis of postharvest technology, physiological disorders; Post harvest diseases: Types and sources of infection, factors affecting disease development; Harvesting of produce: Maturity indices, pre-harvest modifiers of quality; Preparation/treatment of produce: Trimming, cleaning and water elimination, curing, waxing and grading, ripening, de-greening and color adding, precooling strategies, Packing house preparation: Purpose and function; Packaging and transport of produce: Functions and types of packaging, transport conditions; Refrigerated storage: objectives, structural requirements; Supplements to refrigeration: Irradiation, chemical and biological treatments, controlled and modified atmosphere; Alternatives to refrigeration: Ambient storage, evaporative cooling, storage in water, air-cooled and clamp storage, solar cooling; Commercial practices: quarantine treatments, distribution and marketing, food safety and quality standards; Emerging concepts and practices.

Practical component: Practical sessions will cover the physiological basis of post-harvest quality, post-harvest diseases and techniques to mitigate post-harvest losses.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 25%	**Final Assessment:** 75%		
Details: Quizzes/assignments/mid-term evaluation 25%	**Theory (%)** 40	**Practical (%)** 35	**Other (%) (specify)** –

Recommended Reading:

- Siddiqui, M.W. (Eds.). (2015). *Postharvest biology and technology of horticultural crops: principles and practices for quality maintenance*. CRC Press.
- Singh, B. & Singh, S. (Eds.). (2018). *Advances in postharvest technologies of vegetable crops*. CRC Press.
- Wills, R.B. & Golding, J. (Eds.). (2016). *Advances in postharvest fruit and vegetable technology*. CRC press.

Semester:	Semester 1
Course Code:	BM 2009
Course Name:	Molecular Biology Techniques
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1002

Course Aim:

The course aims to provide knowledge on basic and current advances in molecular biological techniques, and hands on experience in commonly used techniques.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the scientific basis underpinning the fundamental molecular biology techniques
- Work safely and independently in a molecular biology laboratory
- Utilize equipment and reagents, appropriately to achieve objectives
- Maintain detailed lab reports with experimental objectives, procedures, and discussion of results
- Identify and execute strategies to overcome experimental failures
- Judge which molecular biology technique(s) best suits to answer a given biological question and then, design and execute experiments to solve the problem

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Methods in molecular biology: techniques for isolation, visualization, and quantification of nucleic acids and proteins, gel electrophoresis, staining techniques, blotting techniques, nucleic acid hybridization, detection of nucleic acids through probing techniques, detection of proteins using antibodies; Recombinant DNA techniques: restriction endonucleases and restriction mapping, DNA modifying enzymes, cloning vectors, cloning and methods for screening recombinant transformants; Analysis and uses of cloned genes: DNA sequencing, Polymerase Chain Reaction (PCR); Construction and screening of cDNA, genomic and expression libraries; Genetic engineering and its applications: gene transfer methods to animals and plants, recombinant protein production, development of genetically modified organisms.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 5%	**Final Assessment:** 95%		
Details: Maintenance of lab book 5%	**Theory (%)** 50	**Practical (%)** 45	**Other (%) (specify)** –

Recommended Reading:

- Wilson, K. and Walker, J. (Eds.). 2000. *Principles and techniques of practical biochemistry*. United Kingdom: University Press, Cambridge.
- Watson, J. D., Gilman, M., Witkowski, J., and Zoller, M. 1992. *Recombinant DNA*. New York: W. H. Freeman.

- Turner, P., McLennan, A., Bates, A. and White, M. 2005. *Instant Notes in Molecular Biology.* New York: Taylor and Francis Group.

Semester:	Semester 1
Course Code:	BM 2011
Course Name:	Experimental Design
Credit Value:	2 C (15 L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1015

Course Aim:

This course provides the theoretical knowledge and practical skills for designing biological experiments and performing data analysis using selected statistical tools.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the basic concepts on experimental designs, statistical inference, and hypothesis testing
- Identify suitable experimental designs for research-based experiments
- Explain the underlying principles of different data analysis methods
- Identify suitable experimental data analysis methods, analyze data, and make correct statistical inferences
- Employ statistical software in data analysis

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	30	55	100

Course Content: (Main topics, Subtopics)

Experimental designs: Importance of selecting a design at planning, basic concepts of designing scientific experiments, details of selected experimental designs,

validity of an experiment; Analysis of Variance (ANOVA): importance and concept of comparing several population means, assumptions and theory behind ANOVA, hypothesis testing in one-way and two-way ANOVA, post-hoc tests (LSD, HSD, DMRT); Correlation and Regression analysis: importance and concept of analysis, assumptions and hypothesis testing; Non-parametric statistics: importance and different non-parametric methods (sign test, Mann-Whitney U test, rank correlation); Data analysis using Statistical software packages.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: –	**Final Assessment:** 100%		
Details:	**Theory (%)** 50	**Practical (%)** 50	**Other (%) (specify)** –

Recommended Reading:

- Dytham, C. (2011). *Choosing and using statistics: a biologist's guide*. Chichester, West Sussex, UK: Wiley-Blackwell.

Semester:	Semester 1
Course Code:	BM 2014
Course Name:	Microbial Culture Maintenance
Credit Value:	1 C (10L 10 P)
Core/Optional:	Core
Pre-requisites:	BM 1005

Course Aim:

This course provides theoretical and practical aspects of maintaining pure cultures, record keeping and compliance to quality standards.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the importance of culture maintenance
- Demonstrate the ability to maintain a pure culture collection
- Compile documentary records of activities pertaining to culture maintenance

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	10	10	30	50

Course Content: (Main topics, Subtopics)

Standard organisms and their uses: referencing, quality indicators; Maintaining pure cultures; Documentary requirements: standard operating procedures, activity schedules, data sheets; Techniques used in preserving standard cultures: short term and long-term storage techniques.

Practical component: A variety of methods used in culture preservation will be practiced. Also, hands on experience in record maintenance will be provided.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details: Quizzes/assignments/mid-term evaluation 40%	**Theory (%)** 30	**Practical (%)** 30	**Other (%) (specify)** –

Recommended Reading:

- Isaac, S. & Jennings, D. (1995). *Microbial Culture.* Taylor and Francis.
- Varma, A. & Sharma A.K. (2017). *Modern Tools and Techniques to Understand Microbes*. Springer.

Semester:	Semester 2
Course Code:	BM 2001
Course Name:	Microbial Biochemistry and Physiology
Credit Value:	2 C (15L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1001, BM 1007, BM 2002

Course Aim:

This course intends to provide students with fundamental understanding of the unique organization and metabolism of microbial cells and to further understand the diverse nature of microbial life. It also provides the theoretical background and understanding that is necessary to conduct relevant research, to engage in related industry and to find solutions for relevant environmental issues.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate understanding of the different types of metabolic strategies that differentiate species of microorganisms
- Describe various metabolic pathways in microorganisms and compare /contrast those with other organisms
- Discuss bacterial respiratory mechanisms and analyze the significance of their applications
- Evaluate the importance of analysis of microbial growth kinetic data
- Conduct biochemical assays to distinguish microbial species based on their metabolic properties

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	30	55	100

Course Content: (Main topics, Subtopics)

Types of metabolic strategies in microbes – autotrophy/heterotrophy/ mixotrophy/ lithotrophy, etc. Bacterial respiration in detail: Glucose catabolizing pathways - Glycolysis & Krebs Cycle, Oxidative Pentose Phosphate Pathway (Hexose

monophosphate shunt), Entner-Doudoroff (ED) pathway; Anoxic pathways: Fermentation - alcohol and lactic acid (Homo-fermenters/hetero-fermenters) pathways and their biotechnological applications; Anaerobic respiration: Nitrogen respiration, Sulphate reduction and impacts on soil environment and agriculture; Metal respiring bacteria and their applications. Electron transport and ATP synthesis: Electro motive force/proton extrusion theory; Microbial electron transport and energy conservation: Bioelectrochemical systems (BESs)/ Microbial Fuel Cells (MFCs). Microbial growth: phases and kinetics. Microbial signal transduction and homeostasis. Extremophiles and extremozymes.

Laboratory component: biochemical assays to identify differences in metabolism types shown by various species of bacteria.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/mid-term evaluation/ practical assignments 40%	40	20	–

Recommended Reading:

- Berg, J. M., Gatto Jr, G. J., Tymoczko, J. L. & Stryer, L. (8th ed.). (2015). *Biochemistry*. W. H. Freeman.
- Cohen, G. N. (2nd ed.). 2011. *Microbial Biochemistry.* Springer.
- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M. & Stahl, D. A. (15th ed.). (2017). *Brock Biology of Microorganisms*. Pearson Publishers.
- Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. & Reece, J. B. (2016). *Campbell Biology*. Pearson.
- White, D., Drummond, J., & Fuqua, C. (4th ed.). (2011). *The Physiology and Biochemistry of Prokaryotes*. Oxford University Press.

Semester:	Semester 2
Course Code:	BM 2004
Course Name:	Agricultural Biotechnology
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	BM 2003

Course Aim:

The course focuses on basic principles, selected applications of biotechnology and other modern technologies for improving agricultural crops. This course offers students a theoretical understanding of technologies and practical examples as to how technologies are used in agricultural systems.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Define concepts and principles of agricultural biotechnology
- Discuss major practical biotechnologies aimed at solving food production problems.
- Discuss the benefits and challenges faced in agriculture biotechnological applications

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Introduction and definitions; Application of modern plant biotechnologies in agriculture: transgenic crops, common genetically modified (GM) crops, engineering plant nutritional quality and protein, engineering plants to overcome biotic and abiotic stress, plant pathogen detection and disease diagnosis, plant molecular pharming, directed mutagenesis and protein engineering, RNA interference; Transgenic animals: transgenic livestock, transgenic poultry, transgenic fish; Use of modern applications for commercial agriculture: Weather prediction, Yield prediction and modelling; Phytohormones in biotechnology and

<table>
<tr><td colspan="4">agriculture: controlled use of plant growth regulators in commercial cultivation and their effects; Smart fertilizer application; Irrigation.

Practical component: Practical sessions will cover the basic techniques applied in transgenic plant development</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td colspan="2">Continuous Assessment: 10%</td><td colspan="2">Final Assessment: 90%</td></tr>
<tr><td>Details:
Quizzes/assignments/mid-term evaluation 10%</td><td>Theory (%)
50</td><td>Practical (%)
40</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Chawla, H. S. (3rd ed.). (2009). Introduction to plant biotechnology. Science Publishers, Enfield, NH, USA.
Glick, B. R., Pasternak, J. J. & Patten, C. L. (4th ed.). (2010). Molecular biotechnology: principles and applications of recombinant DNA technology. ASM Press, Washington, DC.
Taiz, L. & Zeiger, E. (2015). Plant physiology. Sunderland, MA, USA: Sinauer Associates, Inc.</td></tr>
</table>

Semester:	Semester 2
Course Code:	BM 2007
Course Name:	Plant Disease Management
Credit Value:	3 C (30L 30P)
Core/Optional:	Core
Pre-requisites:	BM 1004, BM 1005, BM 1006

Course Aim:

The course intends to cover fundamental aspects and emerging concepts and practices of plant pathology while providing students with skills necessary to diagnose and manage common pests and diseases of important crops.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate an understanding on basic concepts of plant pathology, plant diseases, their causes, effects, and controls
- Assess environmental, biological, genetic, and cultural factors influencing plant disease development
- Examine the molecular mechanisms underlying plant-pathogen interactions and pathogen virulence
- Evaluate the importance of biotechnology in plant disease diagnosis and management
- Design and apply suitable techniques for accurate plant disease diagnosis and integrative approaches for disease management.

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	30	90	150

Course Content: (Main topics, Subtopics)

Introduction: concept of disease, parasitism and pathogenicity, symptoms and signs of diseases; Causative agents of plant diseases: fungi, bacteria, mollicutes, viruses and viroids, nematodes; Environment stress and plant disorders; disease diagnosis: Kochs' postulates; Disease cycle and pathogenesis; Disease triangle: impact of environment, host and pathogen, disease pyramid; Plant disease epidemiology: elements, development and patterns of epidemics, comparison, forecasting and simulation of epidemics; Defense mechanisms of plants: pre-existing and induced defenses: Genetics of plant diseases: genes and diseases, molecular plant-microbe interactions, plant disease resistance; Plant disease management: exclusion and eradication of pathogens, resistance of plants, direct protection via physical and chemical means, biological control, disease

management in organic farming and protected structures/greenhouses, integrated pest/disease management; Molecular techniques in plant pathology; Emerging concepts; Disease of important field, plantation and vegetable crops in Sri Lanka.

Practical component: Practical sessions will provide knowledge and skills on basic techniques of plant pathology, plant disease diagnosis, pathogen isolation and identification and molecular basis of pathogen-host relationships.

Teaching /Learning Activities:
Blended learning mode

Assessment Strategy:

Continuous Assessment: 25%	**Final Assessment:** 75%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 25%	40	35	–

Recommended Reading:

- Agrios, G. (2005). *Plant pathology*. Amsterdam: Elsevier Academic Press.
- Agrios, G. N. (1997). *Plant pathology*. San Diego: Academic Press.
- Ahmad, S. (2017). *Biotechnology and plant pathology*. Publisher: Centrum Press.
- Pérez-Clemente, R. & Vive, V. (2016). *Biotechnology and plant pathology: Current Trends*. New York: Magnum Publishing.
- Sheetal, S. (2014). *Plant pathology and biotechnology*. Lakshi Publishers.

Semester:	Semester 2
Course Code:	BM 2008
Course Name:	Basic Bioinformatics
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course intends to introduce the basic concepts of Bioinformatics and existing bioinformatic resources to access the wealth of biological data.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Appreciate and discuss the role of Bioinformatics in hypothesis-driven research in life sciences
- Search and retrieve data from a variety of currently available biological databases
- Generate sequence alignments for DNA/protein sequences of interest
- Construct phylogenetic trees based on biological sequence data
- Predict protein structure and function using bioinformatics tools
- Interpret outputs from different Bioinformatics tools

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

Introduction: definitions, goal and scope, applications, limitations, new themes in the field of Bioinformatics; Biological databases: types of databases, information retrieval from biological databases, pitfalls of biological databases; Sequence alignment: pairwise sequence alignment, database similarity searching, multiple sequence alignment; Commonly used tools in Bioinformatics analyses; Structural bioinformatics: protein structure databases, protein structure visualization, protein structure and function prediction, applications (i.e. drug discovery)

Teaching /Learning Activities: Blended learning mode			
Assessment Strategy:			
Continuous Assessment: –	**Final Assessment:** 100%		
Details:	**Theory (%)** 50	**Practical (%)** 50	**Other (%) (specify)** –

Recommended Reading:

- Attwood, T.K. and Parry-Smith, D.J. (1999) Introduction to Bioinformatics. Prentice Hall.
- Claverie, J. and Notredame, C. (2003). Bioinformatics for Dummies. Wiley Publishing, Inc. USA.
- Gibbas C. and Jambeck P. (2001) Developing Bioinformatics Computer Skills: An Introduction to Software Tools for Biological Applications. O'Reilly Media, Inc.
- Krane, D.E. and Raymer, M.L. (2003) Fundamental Concepts of Bioinformatics. Benjamin Cummings.
- Krawetz, S. A. and Womble, D.D. (2003). Introduction to Bioinformatics: A Theoretical and Practical Approach. Totowa, N. J., Humana Press.
- Mount, D. W. (2006) Bioinformatics: Sequence and Genome Analysis. Cambridge University Press.
- Westhead, D.R., Parish, J.H., Twyman, R.M. (2003) Instant Notes: Bioinformatics. BIOS Scientific Publishers, UK.

Semester:	Semester 2
Course Code:	BM 2010
Course Name:	Immunological Applications in Biotechnology
Credit Value:	1 C (15L)
Core/Optional:	Core

Pre-requisites:	BM 1013

Course Aim:

The course aims to provide students with the knowledge on immunological techniques, their applications and biotechnology-based advancement

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Describe the principles of immunological techniques and their applications
- Compare immunological techniques used for disease diagnosis
- Discuss the contribution of biotechnology for advances in immunological applications

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Immunological techniques: principles and applications;

Antigen – antibody interactions and factors affecting those interactions

Principles of immunological techniques: Enzyme linked immunosorbent assay, Immunofluorescence assay, Agglutination assays, Immunochromatography assays, Flow cytometry.

Immunological applications; Diagnosis, therapeutics, and vaccination /immunization

Biotechnology for advances in immunological applications; Monoclonal and polyclonal antibodies: properties, production and applications, Antibody engineering and cloning, Conventional and novel vaccine strategies

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 50%	**Final Assessment:** 50%

Details: Quizzes/assignments/mid-term evaluation 50%	**Theory (%)** 50	**Practical (%)** –	**Other (%) (specify)** –

Recommended Reading:

- Owen, J., Punt, J. and Stranford, S., 2013. Kuby Immunology: International Edition. New York: W. H.
- Abbas, A.K., Lichtman, A.H. and Pillai, S., 2021. Cellular and molecular immunology E-book. Elsevier Health Sciences.

Semester:	Semester 2
Course Code:	BM 2012
Course Name:	Nanotechnology and its Biological Applications
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course provides an introduction and overview of nanotechnology, and potential application of nanomaterials and devices in biotechnology.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Discuss the wide range of applications and overview of nanotechnology and its interdisciplinary aspect.
- Explain the principles governing the effect of size on material properties at the nanoscale and perform quantitative analysis.
- Demonstrate knowledge in nanomaterials such as Carbon Nanotubes (CNT), Fullerenes, Quantum Dots, Iron Oxide Nanoparticles, Polymer-based Nanostructures (Dendrimers), Gold Nanostructures and Protein-based Nanostructures applied in nanobiotechnology.
- Apply the knowledge on characterization techniques available for nanomaterials.

- Correlate the impact of nanotechnology and nanoscience in a global, economic, environmental, and societal context.
- Explain and discuss scientific papers in the bionanotechnology/nanomedicine field.

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

The basics of nanotechnology: History, development, and underlying science of nanomaterials. The important nanomaterials: CNT, Fullerenes, quantum dots, iron oxide, gold nanoparticles, dendrimers and other protein-based nanomaterials applied in bio nanotechnology. Various synthetic methods available to synthesize these nanomaterials: Outline of formation of crystals, nano-sized crystals and controlled growth of crystals, capping agents and their role, brief description of popular methods and detailed description of four important methods (co-precipitation, organometallic pathway, electrochemical pathways, and micelles pathway). Characterization techniques of nanomaterials and their characterization methods (visualization of nanoscale): Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscope (STM), X-ray diffraction (XRD), Thermogravimetric analysis (TGA) and other relevant methods. Application of the nanomaterials: In biotechnology, medicine, agriculture etc. Nanostructures for daily applications: nano-size ingredients in cosmetics.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%		
Details: Quizzes/assignments/mid-term evaluation 30%	**Theory (%)** 70	**Practical (%)** –	**Other (%) (specify)** –

Recommended Reading:

- Lowe, C.R., 2004. Nanobiotechnology: Concepts, Applications and Perspectives. Edited by CM Niemeyer and CA Mirkin.
- Mirkin, C.A. and Niemeyer, C.M. eds., 2007. *Nanobiotechnology II: more concepts and applications*. John Wiley & Sons.
- Vo-Dinh, T. ed., 2017. *Nanotechnology in biology and medicine: methods, devices, and applications*. CRC Press.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J., 2000. *Molecular Cell Biology. 4th edition*. WH Freeman.
- Brydson, R.M. and Hammond, C., 2005. Generic methodologies for nanotechnology: classification and fabrication. *Nanoscale science and technology*, pp.1-55.
- Brydson, R.M. and Hammond, C., 2005. Generic methodologies for nanotechnology: characterization. *Nanoscale Science and Technology*, pp.56-129.
- Leggett, G.J. and Jones, R.A., 2005. Bionanotechnology. *Nanoscale Science and Technology*, pp.419-445.
- Bucke, C., 2005. Bionanotechnology—lessons from nature. By David S Godsell. Wiley-Liss, Hoboken, NJ, 2004. 352 pp, ISBN 0 471 41719 X. *Journal of Chemical Technology & Biotechnology*, *80*(8), pp.964-965.
- Goodsell, D. S., .2004. *Bionanotechnology: Lessons from Nature*. Nashville, TN: John Wiley & Sons

Semester:	Semester 2
Course Code:	BM 2013
Course Name:	Microbial Genetics
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course will provide basic understanding on genetic processes of bacteria, fungi and viruses while emphasizing their practical applications in biotechnology.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate an understanding of microbial genes, genomes, gene expression and genetic processes
- Review applications of microbial genetics in biotechnology
- Assess techniques and tools derived or inspired by microbial genetics process
- Apply suitable technique and tools associated with microbial genetics in basic research

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Structure and organization of prokaryotic DNA; Replication of DNA; Gene regulation and expression: positive and negative regulation, inducers and repressors, operon concept; Extra-chromosomal genetic elements: plasmids and transposons; Genetic recombination in bacteria: conjugation, transformation and transduction; Drug resistance in bacteria; Fungal genetics: features, heterothallism, homothallism, mating types, vegetative incompatibility, polyploidy and aneuploidy, yeast plasmids; Viral genetics : characteristics of viral genome, lytic and lysogenic cycle of bacteriophages; Tools, protocols and databases.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%

Details: Quizzes/assignments/mid-term evaluation 30%	**Theory (%)** 70	**Practical (%)** –	**Other (%) (specify)** –

Recommended Reading:

- Chaudhari, K. (2013). *Microbial Genetics*. The Energy and Resources Institute (TERI).
- Trun, N. & Trempy, J. (2009). *Fundamental bacterial genetics*. John Wiley & Sons.

Semester:	Semester 2
Course Code:	BM 2015
Course Name:	Current Topics in Biotechnology and Microbiology
Credit Value:	1 C (30P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course intends to introduce the current topics in biotechnology and microbiology, providing an understanding through discussion.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate an understanding of the current topics in biotechnology and microbiology
- State the importance of the current uses of biotechnology and microbiology
- Recognize biotechnology as a tool to provide answers for current and future challenges

Time allocation (Hourly Breakdown)	**Theory** –	**Practical** 30	**Independent Learning** 20	**Notional** 50

Course Content: (Main topics, Subtopics) Current applications of biotechnology and microbiology in solving global problems affecting man and environment.			
Teaching /Learning Activities: Blended learning mode			
Assessment Strategy:			
Continuous Assessment: 100%	**Final Assessment:** –		
Details: Quizzes/assignments/mid-term evaluation 100%	**Theory (%)** –	**Practical (%)** –	**Other (%) (specify)** –
Recommended Reading: ➢ Reviews and journal articles relevant to the subject.			

Semester:	Semester 2
Course Code:	BM 2016
Course Name:	Scientific Writing II
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	BM 1016
Course Aim: This course aims to provide the students with the necessary skills to communicate their research among diverse audiences as well as provide guidance on aspects such as funding applications and ethics in scientific writing.	
Intended Learning Outcomes: At the successful completion of this course, student will be able to: ➢ Prepare the outline of a literature review ➢ Describe the key sections of a dissertation	

- Present their research findings using appropriate means
- Apply ethical practices in their scientific writing
- Evaluate and apply for prospective funding sources
- Evaluate how science is communicated through the media

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Introduction to scientific writing (part 2). Key sections of a dissertation. Writing a literature review (summarizing and synthesizing). Introduction to presenting research findings (abstracts, journal articles). Applying for funding (evaluating funding sources, guidance on writing grant proposals), Ethics in scientific writing (originality, accuracy, avoiding predatory journals and plagiarism). Science communication to a general audience (blogs, newspaper articles and other written media).

The lectures will be conducted in a student-centered manner which will include knowledge and skill development in the above sections through activities.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 100%	**Final Assessment:** –		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 100%	–	–	–

Recommended Reading:

- Online sources will be used as appropriate to the planned activities.

LEVEL III COURSES:

Semester:	Semester 1
Course Code:	BM 3001
Course Name:	Food Microbiology
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	BM 1004, BM 1005

Course Aim:

This course discusses application of microorganisms in food, food industry and food safety.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Discuss the use of microorganisms as food and food supplements
- Identify and describe the factors affecting food spoilage
- Identify food-borne pathogens and the diseases they cause
- Apply food preservation techniques
- Critically analyze the conformity of a food production facility to food quality standards

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

Introduction to food and food spoilage, factors affecting food spoilage; Food preservation techniques; Food-borne pathogenic microorganisms and food intoxications; Fermented foods; Food supplements and probiotics: characteristics of probiotics, common probiotic microorganisms; Food quality standards: HACCP, Codex Alimentarius; Assessing compliance of a food production facility to food quality standards.

Practical component: Fermented food production**,** Detection of food-borne pathogens: *Escherichia coli*, *Salmonella* sp., determining commercial sterility of canned foods, conducting an HACCP analysis using hypothetical cases, factory visits.			
Teaching /Learning Activities: Blended learning mode			
Assessment Strategy:			
Continuous Assessment: 40%	**Final Assessment:** 60%		
Details: Quizzes/assignments/mid-term evaluation 40%	**Theory (%)** 30	**Practical (%)** 30	**Other (%) (specify)** –
Recommended Reading: ➢ Bott, R., Madigan, M., Martinko, J., Bender, K., Buckley, D. & Stahl, D. (2014*). Brock Biology of Microorganisms.* Pearson Publishers. ➢ Harrigan, W.F. & McCance, M.E. (1976). *Laboratory methods in food and dairy microbiology*. Academic Press Inc. (London) Ltd. ➢ Jay, J. M., Loessner, M. J. & Golden, D. A. (2008). *Modern food microbiology*. Springer Science & Business Media.			

Semester:	Semester 1
Course Code:	BM 3002
Course Name:	Advanced Molecular Biology
Credit Value:	3 C (45L)
Core/Optional:	Core
Pre-requisites:	BM 2009
Course Aim: This course provides in-depth coverage of key concepts of Molecular Biology and technologies for functional genome studies.	

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain genome complexity
- Compare and contrast different types of genetic marker systems
- Discuss 'Omics' technologies
- Critically appraise scientific literature relating to the course content

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	45	–	105	150

Course Content: (Main topics, Subtopics)

Organization of the genome: complexity of bacterial and eukaryotic genomes, gene and genome duplication, mobile genetic elements; Genetic markers: concepts of classical and molecular markers and their applications; Introduction to 'Omics' sciences: genomics, transcriptomics, proteomics, metabolomics, epigenomics etc.,

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 30%	70	–	–

Recommended Reading:

- Buchanan B. B., Gruissem W., Jones R. L. 2015. *Biochemistry and molecular biology of plants*. Wiley Blackwell, New York.
- Grierson D. 1991. Developmental regulation of plant gene expression. Springer Science Business Media, New York.
- Grierson, D and Covey, S. N. 1988 *Plant Molecular Biology (Tertiary Level Biology*). Springer Science Business Media, New York.

- Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. *Molecular cell biology*. W. H. Freeman, New York.
- Primrose, S. B. and Twyman, R. M. (2006) Principles of Gene Manipulation and Genomics. Blackwell Publishing, USA.

Semester:	Semester 1
Course Code:	BM 3003
Course Name:	Applications in Medical Biotechnology
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	BM 2009, BM 3002

Course Aim:

The main focus of this course is to acquaint students with advances in the use of molecular biotechnology in medicine – medical diagnosis, therapeutics and biomedical research. Achieving the learning experience is aimed through case studies, independent study and presentations.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Discuss the role of biotechnology in medicine
- Explain the scientific basis of key molecular biotechnological applications
- Critically analyze the pros and cons of molecular biotechnological applications

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Introduction to medical biotechnology: techniques and products; Applications of biotechnology in medicine: molecular diagnosis, genetic counseling, human gene therapy, production of vaccines, pharmacogenomics, and other related

<table>
<tr><td colspan="4">applications; Controversial issues in medical genetics; Fundamentals of drug designing; Current research in medical biotechnology – a case study</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 50%</td><td colspan="3">Final Assessment: 50%</td></tr>
<tr><td>Details:
Quizzes/assignments/presentations/debates 50%</td><td>Theory (%)
50</td><td>Practical (%)
–</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
➢ Reviews and journal articles relevant to the subject</td></tr>
</table>

Semester:	Semester 1
Course Code:	BM 3004
Course Name:	Industrial Microbiology
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	None
Course Aim: This course provides the knowledge on the use of microorganisms in the manufacture of food or industrial products in large scale. Selection of industrial microorganisms and factors affecting product formation and recovery will also be discussed.	
Intended Learning Outcomes: At the successful completion of this course, student will be able to: ➢ Explain how microorganisms are applied in manufacturing various industrially important products	

- Describe fermentation and its applications in large scale production
- Relate quality controlling to the manufacturing process
- Demonstrate skills in isolating, culturing, and maintaining industrially important microorganisms
- Design a laboratory scale fermentor

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Primary and secondary metabolites as Industrial Products; techniques used for overproduction of metabolites of industrial microorganisms; Industrial microorganisms: Screening for productive strains; Strain Improvement: Selection from naturally occurring variants, genetic manipulation; Preservation of the Gene Pool in industrial organisms: Culture collections, microbial preservation methods; maintaining sterility in industrial production; Microbial processes and microorganisms having industrial importance: biofertilizers and biological control agents, vitamin, amino acid, single cell protein, organic acid antibiotic, alkaloids, steroids/sterols, enzyme and vaccine production, alcoholic fermentation, biomining, Quality control and quality assurance.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- Duddington, C.L. (1961). *Micro-organisms as allies*: *The industrial use of fungi and bacteria.* Faber, London.

- National Academy of Sciences, (2001). *Microbial processes: promising technologies for developing countries*. The Minerva Group, Inc.
- Prescott, S.C. & Dunn, C.G. (1940). *Industrial microbiology.* McGraw-Hill Company, Inc New York, London.
- Vanek, Z., Hostalek, Z. & Cudlín, J. (1973). *Genetics of industrial microorganisms. In International Symposium on the Genetics of Industrial Microorganisms 1970: Prague).* New York, Elsevier Pub. Co.

Semester:	Semester 1
Course Code:	BM 3005
Course Name:	GMOs and GMFs
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course intends to provide the history and the present status of GMOs, GMFs and biosafety aspects.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Define the terms GMO, GEO, LMO
- Describe the scientific basis of genetic engineering of organisms
- Discuss the advantages of genetic engineering compared to conventional breeding
- Evaluate the benefits and potential risks of GMOs and their release to the environment
- Explain the biosafety regulations, testing of GMOs and approval process of GMOs and GMFs
- Discuss issues pertaining to consumer choice and labelling

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Definitions, History of genetic modifications of plants and animals, advantages of genetic engineering over conventional breeding, applications and products of molecular biotechnology. Production of genetically modified organisms (GMOs) and genetically modified Foods (GMFs). Biosafety regulations, social, moral and ethical considerations of GMOs and GMFs, benefits and possible risks associated with GMOs and GMFs, Case studies Biosafety conventions and regulations, Cartagena protocol and guidelines for Sri Lanka. Public perception of GMOs and GMFs, Labelling and consumer choice, issues associated with labelling, testing and release of GMOs to environment.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 30%	**Final Assessment:** 70%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/presentations/mid-term evaluation 30%	70	–	–

Recommended Reading:

- Relevant official websites, reviews, and journal articles relevant to the subject

Semester:	Semester 1
Course Code:	BM 3013
Course Name:	Assignment/Case Study
Credit Value:	4 C (120P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course module provides an opportunity for students to apply the knowledge and skills they have gained so far to conduct a case study or assignment to broaden their knowledge, and improve research, analytical and scientific communication skills.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Formulate research problems/hypotheses and design appropriate research methodologies to test/solve research problems/hypotheses
- Collect, analyze and comprehend data to attain logical conclusions
- Present findings and synthesize a project/assignment report
- Argue and defend the findings/conclusions
- Demonstrate an improvement in individual work habits and interpersonal skills

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	–	120	80	200

Course Content: (Main topics, Subtopics)

Each student will be required to carry out a directed study (guided mini case study or an assignment) on a specific topic given, under the supervision of an academic staff member and submit a project or assignment report

Teaching /Learning Activities: Blended learning mode			
Assessment Strategy:			
Continuous Assessment: 100%	**Final Assessment:** –		
Details: Assignment report/seminar presentation/viva-voce examination 100%	**Theory (%)** –	**Practical (%)** –	**Other (%) (specify)** –
Recommended Reading: ➢ Recent scholarly articles relevant to the research topic ➢ Locharoenrat, K. (2017). Research Methodologies for beginners (Available online from Science Library)			

Semester:	Semester 2
Course Code:	BM 3006
Course Name:	Enzyme Technology
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	BM 1007, BM 2002
Course Aim: This course aims to provide students with an understanding of enzymes, as they are produced and applied in biotechnological and chemical engineering industries.	
Intended Learning Outcomes: At the successful completion of this course, student will be able to: ➢ Apply Michaelis-Menten-based enzyme kinetics in the determination of reaction rates	

- Explain enzyme purification and characterization strategies
- Describe important technological applications of industrial enzymes
- Discuss the applications of solubilized or immobilized enzymes and assess the advantages and disadvantages of the two techniques
- Describe the methods of protein engineering as a tool in designing novel enzymes or improving the capabilities of existing enzymes

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Enzyme classification and nomenclature; Enzyme catalytic mechanisms; Enzyme regulation; Enzyme kinetics; Techniques of enzyme isolation, purification and characterization; Enzyme immobilization; Industrial enzymes; Enzyme structure-activity relationship and drug discovery; Protein engineering.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 50%	**Final Assessment:** 50%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/ mid-term evaluation/ assignments 50%	50	–	–

Recommended Reading:

- Aehle, W. (3rd ed.). (2007). *Enzymes in Industry: Production and Applications.* Wiley-VCH.
- Fersht, A. (2018). *Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding*. Freeman, W.H. and Company.
- Messing, R. (2012). *Immobilized Enzymes for Industrial Reactors.* Academic Press.

- Nelson, D. L., Cox, M. M. (2012). *Lehninger Principles of Biochemistry*. Worth Publishers Inc.
- Scope, R. K. (1993). *Protein Purification: Principles and Practice.* Springer.

Semester:	Semester 2
Course Code:	BM 3007
Course Name:	Entrepreneurship
Credit Value:	3 C (15L 60P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

To provide students a sound knowledge on the role of the entrepreneur, entrepreneurial process and develop confidence to explore entrepreneurial opportunities.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Demonstrate the understanding of the importance of entrepreneurship in national economy
- Discuss the ways in which entrepreneurs perceive opportunity, manage risk, organize resources, and add value
- Apply both theoretical and practical perspectives in entrepreneurial activities

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	60	75	150

Course Content: (Main topics, Subtopics)

Entrepreneurship in practice: Small and medium-sized enterprises in national development; Novel ideas and innovations at individual, group and organizational levels, business strategies and models; Business idea into practice: entrepreneurial skills, market analysis, basics in operations, finance, marketing and human resource

<table>
<tr><td colspan="4">management, developing a business plan; Strategy for business growth; Business ethics and social responsibilities; Case studies on success and failures.</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 60%</td><td colspan="3">Final Assessment: 40%</td></tr>
<tr><td>Details:
Quizzes/assignments/mid-term evaluation 60%</td><td>Theory (%)
40</td><td>Practical (%)
–</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Byrd Megginso. 1993. Small Business Management: An Entrepreneur's Guidebook. McGraw-Hill, Irwin
Carter, S & Jones Evans, D (eds) 2012, Enterprise and Small Business: Principles, Practice and Policy. Financial Times, 3rd edn.
Hisrich, R.D., Peters, M.P. and Shepherd, D.A., 2013. Entrepreneurship. 9th international ed.
Kuratko, D. 2013. Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wiley.</td></tr>
</table>

Semester:	Semester 2
Course Code:	BM 3008
Course Name:	Laboratory Management
Credit Value:	3 C (45L)
Core/Optional:	Core
Pre-requisites:	None
Course Aim: This course provides the knowledge and skills on maintaining a microbiology laboratory to conform to the technical requirements set by ISO 17025 international standard.	

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Critically analyze the technical requirements of ISO 17025
- Define laboratory management requirements
- Evaluate the compliance of a laboratory to ISO 17025
- Simulate laboratory audits on technical aspects

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	45	–	105	150

Course Content: (Main topics, Subtopics)

General considerations; Biological risks, hazard categories and laboratory safety requirements; Requirements for quality control and quality assurance in microbiology as per ISO 17025: Laboratory personnel, equipment, test methods, housekeeping, media and glassware, performing intermediate checks: minimization of errors and calculation of uncertainty; Laboratory accreditation: Internal and external audits; GLP and GILSP practices; documentary requirements

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- ISO/IEC 17025: 2017 General requirements for the competence of testing and calibration laboratories
- World Health Organization. Laboratory Biosafety Manual. – 3rd Edition

Semester:	Semester 2
Course Code:	BM 3009
Course Name:	Pharmaceuticals and Cosmeceuticals
Credit Value:	2 C (20L 20P)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course provides basic knowledge on chemical nature of pharmaceuticals and cosmetics and their applications. Students will be equipped with quality assurance and quality control of pharmaceutical and cosmetics products.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain the chemical nature of cosmetics and pharmaceuticals.
- Describe various applications of cosmetics and pharmaceuticals.
- Develop a simple cosmetic / pharmaceutical product
- Perform basic quality checks as per national/international standards

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	20	20	60	100

Course Content: (Main topics, Subtopics)

Pharmaceuticals: Basic laws governing pharmaceuticals- National Medicines Regulatory Authority Act 2015 and Regulations there to. WHO Good Manufacturing Practices (GMP); Chemistry of pharmaceuticals- Selected inorganic [aluminum hydroxide, iron dextran, calcium phosphates], organic small molecules [paracetamol, amoxicillin, artemisinin], macromolecules [monoclonal antibodies, zinc insulin, rDNA insulin analogues]. The manufacture of herbal medicines-hydro-alcoholics, oils, powders; Biological drug discovery, development, and clinical trials. [heparins]; Dosage form design- powders, granules, tablets, capsules, extended-release tablets, ointments, creams; Parenteral preparations- clean room

technology, humidity control, Water for injection, glass container types; Quality assurance, quality control and official compendia. The British Pharmacopoeia- Studies in General Notices, active ingredient, and dosage form monographs. Physical, chemical, biological and microbiological analysis; Principles of stability studies.

Practical component: Analysis of aluminum hydroxide tablets BP;

Analysis of amoxicillin oral suspension BP; Determination of dextrose in Glucose-saline infusion.

Cosmeceuticals (10 h lectures):

Nomenclature of cosmetics using the International Nomenclature of Cosmetics; Biochemistry of skin and ageing; Skin lightening mechanisms: Melanin, melanin biosynthetic pathway, tyrosinase; Cosmetic Ingredients: Preservatives in cosmetics - types and their mode of action, pH range etc.; Fragrance and fragrance chemistry: Rules of the International Fragrance Association, fragrance triangle; Colours used in Cosmetics – CI numbers; Basic of cosmetics formulation with examples; Microbiology in cosmetics including challenge testing; Stability Testing of Cosmetics – ICH guidelines; Cosmetics Registration/Regulatory aspects; International certification of Natural and Nature Identical cosmetics i.e.. Ecocert, Natrue BDIH etc.

Practical component:

Preparation of a cream; Practical on fragrance identification; Microbiological testing of Cosmetic/ pharmaceutical products

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 20%	**Final Assessment:** 80%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 20%	60	20	–

Recommended Reading:

- Sharma, G., Gadiya, J. and Dhanawat, M., 2016. A Textbook of Cosmetic Formulations. *Department of Pharmacy, Mewar University, Rajasthan-312*, *901*.
- De Polo, K.F., 1998. *A Short Textbook of Cosmetology*: *A Short Guide to the Development, Manufacture and Sale of Modern Skin Care and Skin Protection Cosmetics with an Aside on the History and Prehistory of Cosmetics*. Verlag fur chemischeIndustie, H. Ziolkowsky.
- Schueller, R. and Romanowski, P., 2009. *Beginning cosmetic chemistry*: *Practical knowledge for the cosmetic industry*. 3rd ed. Allured Books.
- Barel, A.O., Paye, M. and Maibach, H.I. eds., 2010. *Handbook of cosmetic science and technology*. 3rd ed. Informa Medical.
- World Health Organization, 2007. *Quality assurance of pharmaceuticals*: *A compendium of guidelines and related materials. Good manufacturing practices and inspection* (Vol. 2). World Health OrganizationQAPPR (who.int)
- National Medicines Regulatory Authority Act No. 5 of 2015]/NMRA Act.Google search- nmra act no 15, pdf version. [Only introduction to CHAPTERS and Parts. Limit details to CHAPTER II, Parts II, III, CHAPTER III, Parts I to IV (IV is important), CHAPTER V on borderline products directly applicable to this program. Interpretation of terms pg 89.]Online[https://nmra.gov.lk/index.php?option=com_content&view=article&id=80&Itemid=11&lang=en]
- National Medicines (Regulation and licensing of medicine) Regulations 2019 . Google search- Medicines Regulations- nmra, pdf version.
- Aulton, M. E. and Collett, D. M. (1988) *Pharmaceutics: The science of dosage form design*. 7th ed. London, England: Churchill Livingstone.
- Lachman, L., Lieberman, H.A. and Kanig, J.L., 1986. *The theory and practice of industrial pharmacy*. Lea &Febiger.
- Allen, L. and Ansel, H.C., 2013. *Ansel's pharmaceutical dosage forms and drug delivery systems*. Lippincott Williams & Wilkins.
- Shargel, L. and Yu, A. B. C. 2016. *Applied Biopharmaceutics & Pharmacokinetics, Seventh Edition*. 7th ed. New York, NY: McGraw-Hill Professional

Semester:	Semester 2
Course Code:	BM 3010
Course Name:	Aspects of Bioprospecting
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course intends to emphasize the benefits of commercialization of biodiversity via conservation-based bioprospecting. The course will provide an understanding of the abundant genetic and biochemical resources and strategies of bioprospecting with the intention of inspiring students to adopt bioprospecting related careers.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Appreciate the invaluable genetic and biochemical resources biodiversity possess
- Recognize the benefits of commercialization of biodiversity via conservation-based bio prospecting.
- Examine aspects of commercialization, methods of exploring and screening biodiversity, product development, conservation, bio-piracy, and legal implications in bio prospecting.
- Assess different strategies available for bio prospecting for biological resources.
- Design a comprehensive business plan to develop a product of biological origin.

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Introduction: Biodiversity prospecting; Genetic and biochemical resources: Biochemical resources from plants, animals and microbes; Prospecting for new compounds from plants: Ethnobotanical approach and screening, collecting and harvesting medicinal plants and storage, isolation of pure compounds, bio-assay guided isolation, high throughput screening of extracts; Natural products from microbes: Fungi and bacteria as a source of natural products, sampling and treatment of material, isolation and enrichment, screening strategies, actinomycetes as a source of bioactive compounds, habitat variation in actinomycetes, isolation techniques, procedures for selective isolation; Natural products as drugs; Conventions on biodiversity and bioprospecting: bioprospecting and biodiversity conservation; Bioprospecting agreements, bilateral and multilateral contracts, bio-piracy, legal implications, current status and application in Sri Lanka.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

- Paterson, R. & Lima, N. (Eds.). (2016). *Bioprospecting: success, potential and Constraints (Vol. 16).* Springer.
- Samuelsson, G. (4th ed.). (2002). *Drugs of natural origin: a textbook of pharmacognosy*. Sweden: Apotekarsocieteten.
- Singh, J., Sharma, D., Kumar, G. & Sharma, N.R. (Eds.). (2018). *Microbial bioprospecting for sustainable development.* Springer Singapore.

Semester:	Semester 2
Course Code:	BM 3011
Course Name:	Fermentation Technology
Credit Value:	2 C (30L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course intends to provide a sound knowledge on techniques used in fermentation and downstream processing. Further, application of different techniques under industrial settings will be discussed.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Give an account on status of fermentation technology
- Relate fermentation technologies to industrial applications
- Describe downstream processing
- Apply both theoretical and practical perspectives in designing a fermentation technology

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	30	–	70	100

Course Content: (Main topics, Subtopics)

Overview of global microbial fermentation technology: market size and growth, major challenges, product sectors, market key players in fermentation technology (global and local), forces driving the biotech entrepreneur's decisions; Fermentation techniques and its applications: submerged and solid state fermentation; Downstream processing technologies for the recovery and purification of fermentation products; Bio-refinery concept and fermentation technology for efficient resource utilization; Application of fermentation technology in various industries, biomanufacturing of biotechnology products and technology

<table>
<tr><td colspan="4">sectors; Resource organization; Quality assurance; Recent advances and future prospect of fermentation technology</td></tr>
<tr><td colspan="4">Teaching /Learning Activities:
Blended learning mode</td></tr>
<tr><td colspan="4">Assessment Strategy:</td></tr>
<tr><td>Continuous Assessment: 40%</td><td colspan="3">Final Assessment: 60%</td></tr>
<tr><td>Details:
Quizzes/assignments/mid-term evaluation 40%</td><td>Theory (%)
60</td><td>Practical (%)
–</td><td>Other (%) (specify)
–</td></tr>
<tr><td colspan="4">Recommended Reading:
Stanbury, P.F., Whitaker, A. and Hall, S.J., 2016. Principles of fermentation technology. (3rd ed.), Elsevier.
Kuila, A. and Sharma, V. eds., 2018. Principles and applications of fermentation technology. John Wiley & Sons.
Weber, J., 2017. Fermentation. Science and Technology New York: Larsen and Keller Education.
Peppier, H.J. and Perlman, D., 1979. Microbial Technology: Fermentation Technology. Retrieved from.
Lelieveld, H.L., Gabric, D. and Holah, J. eds., 2016. Handbook of hygiene control in the food industry. Woodhead Publishing.
Todaro, C.M. and Vogel, H.C. eds., 2014. Fermentation and biochemical engineering handbook. William Andrew.
Yang, S.T. ed., 2011. Bioprocessing for value-added products from renewable resources: new technologies and applications. Elsevier.
Liu, S., 2020. Bioprocess engineering: kinetics, sustainability, and reactor design. Elsevier.</td></tr>
</table>

Semester:	Semester 2
Course Code:	BM 3012
Course Name:	Protecting Intellectual Property
Credit Value:	1 C (15L)
Core/Optional:	Core
Pre-requisites:	None

Course Aim:

This course will introduce the basic norms of intellectual property – law, practice, application, management, and enforcement and to prepare students to meet the needs of the knowledge-based environment.

Intended Learning Outcomes:

At the successful completion of this course, student will be able to:

- Explain basic elements of IP, underlying policies, and international IP instruments and the role of IP in innovation
- Describe types of IP (copyright, patent, trademarks, and industrial designs etc) and protection of IP types locally and internationally
- Explore online databases for searching patent information
- Apply knowledge to draft a patent application

Time allocation (Hourly Breakdown)	**Theory**	**Practical**	**Independent Learning**	**Notional**
	15	–	35	50

Course Content: (Main topics, Subtopics)

Introduction to Intellectual Property (IP): Basic norms of IP and International Dimension; Copyright: Subject matter/ rationale/ definition, protected works, rights, idea and expression, works not protected by copyright, protected rights, limitations to rights including fair use, duration, acquisition and ownership, assignment and license, infringement, enforcement and remedies, protection in other countries for Copyright, Industrial designs, Trademarks and Patents; Trademarks: Definition of a mark, registration procedure, acquisition and ownership, assignment and license, infringement, enforcement and remedies; Industrial designs: Definition and

registration procedure; Patents: Definition of invention, patentable inventions, exceptions to patentability, assignment and licensing, enforcement, Patent Cooperation Treaty, preparation and drafting of patent applications and specifications, patent information searching using online patent databases; Unfair Competition and Confidentiality: Unfair competition and protection of inventions and other IP rights, undisclosed information/ trade secrets; and Role of Intellectual Property in Innovation: Promotion of inventions and creativity, transfer of technology, information, investment, R&D, industry promotion, commercialization, employment creation, public revenue, consumer protection.

Teaching /Learning Activities:

Blended learning mode

Assessment Strategy:

Continuous Assessment: 40%	**Final Assessment:** 60%		
Details:	**Theory (%)**	**Practical (%)**	**Other (%) (specify)**
Quizzes/assignments/mid-term evaluation 40%	60	–	–

Recommended Reading:

Textbooks

- Cornish, W. (9th ed.). (2019). *Intellectual Property.* Sweet & Maxwell, London, UK.
- Karunaratna, D. M. (2006). *An introduction to the law of copyright and related rights in Sri Lanka.* Sarvodaya Vishva Lekha, Rathmalana, Sri Lanka.
- Karunaratna, D. M. (2nd ed.). (2007). *A Guide to law of Trademarks and Service Marks in Sri Lanka*. Sarvodaya Vishva Lekha, Rathmalana, Sri Lanka.
- Socio-economic benefit of IP protection in developing countries – WIPO Publication – No 454(E)
- What is Intellectual Property - WIPO Publication – No 450(E)
- Successful Technology Licensing - WIPO Publication – No 903(E)
- Creative expressions - WIPO Publication – No 918(E)

- Inventing the Future -WIPO Publication – No 917(E)
- Making a Mark - WIPO Publication – No 900(E)
- Looking Good - WIPO Publication – No 498(E)

Statues and Regulations

- The Intellectual Property Act No. 36 of 2003
- High Court of the Provinces (Special Provisions) Act No. 10 of 1996 (as amended)
- Intellectual Property regulations published in Gazette Nos. 1415/18 of Oct. 19,205 and 1445/10 of May 17, 2006

International Conventions

- The Agreement of Trade Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1994)
- All the WIPO administered Treaties and conventions including the Paris Convention for the Protection of Industrial Property (1883), the Berne Convention for the protection of Literary and Artistic Works (1886), the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations (1961), the Trademark Law Treaty (1994 & 2006), the WIPO Internet Treaties (1996), The Patent Law Treaty (2000) and the Patent Cooperation Treaty (1970), The UPOV Convention on new Plant Varieties (1991)

Web sources

- www.wipo.int
- www.nipo.gov.lk
- www.uspto.gov

GRADUATE PROFILE

		Subject/Theoretical Knowledge	Practical Knowledge and Application	Communication	Teamwork and Leadership	Creativity and Problem Solving	Managerial and Entrepreneurship	Information Usage and Management	Networking and Social Skills	Adaptability and Flexibility	Attitudes, Values and Professionalism	Vision for Life	Updating Self / Lifelong Learning
		PLO 1	PLO 2	PLO 3	PLO 3, 7	PLO 3, 7	PLO 4, 7	PLO 3	PLO 3, 6	PLO 4, 6, 7	PLO 4, 5, 6, 7	PLO 4, 5, 6, 7, 8	PLO 4, 5, 6, 7, 8
BM 1050	English English for Academic Purposes	H	H	H	M	M	L	L	M	L	L	L	M
BM 1051	General IT	M	H	M	L	M	M	H	H	L	L	L	M
BM 1001	Cell Structure and Function	H	H	M	M	L	L	L	L	L	L	L	L
BM 1002	Genes and Heredity	H	H	M	L	H	L	L	L	M	M	M	H
BM 1003	Variety of Plant and Animal Life	H	H	L	M	M	L	M	L	M	M	H	H
BM 1004	The World of Microorganisms	H	H	M	H	M	L	L	H	L	M	L	L
BM 1005	Techniques in Microbiology	M	H	H	H	H	L	L	H	L	M	L	L
BM 1006	Acellular Microorganisms	H	L	L	L	L	L	L	L	L	L	L	L
BM 1007	Introductory Biochemistry	H	H	M	M	M	L	M	L	L	L	L	L
BM 1008	Foundation to Biotechnology	H	M	M	M	M	L	L	M	H	L	M	M
BM 1009	Fundamentals of Molecular Biology	H	M	L	L	M	L	L	L	L	L	L	L
BM 1010	Environmental Microbiology	H	H	M	H	M	L	L	H	M	M	L	L
BM 1011	Plant-microbe Interactions	H	H	M	H	H	L	L	M	M	M	L	L
BM 1012	Human-microbe Interactions	H	H	H	H	H	L	L	M	M	M	L	L
BM 1013	Principles of Immunology	H	M	M	M	M	L	L	L	L	L	M	M
BM 1014	Analytical Chemistry for Biotechnology	H	M	L	L	M	L	L	L	L	L	L	L
BM 1015	Concepts and Methods in Biostatistics	H	H	M	M	H	L	M	L	M	H	M	H
BM 1016	Scientific Writing I	M	H	H	L	M	L	M	L	M	M	H	H

		Subject/Theoretical Knowledge	Practical Knowledge and Application	Communication	Teamwork and Leadership	Creativity and Problem Solving	Managerial and Entrepreneurship	Information Usage and Management	Networking and Social Skills	Adaptability and Flexibility	Attitudes, Values and Professionalism	Vision for Life	Updating Self / Lifelong Learning
BM 2001	Microbial Biochemistry and Physiology	H	H	M	M	L	L	M	L	L	L	L	L
BM 2002	Biochemistry of Life Processes	H	H	M	M	M	L	M	L	L	L	L	M
BM 2003	Cell and Tissue Culture	H	H	M	M	H	H	M	M	H	M	H	H
BM 2004	Agricultural Biotechnology	H	H	M	M	H	M	M	M	H	H	H	H
BM 2005	Biotechnology and Energy	H	H	M	M	M	L	L	L	L	L	M	M
BM 2006	Post-Harvest Management	H	H	L	M	H	L	M	L	M	M	M	M
BM 2007	Plant Disease Management	H	H	L	M	H	L	M	L	M	M	M	M
BM 2008	Basic Bioinformatics	H	H	L	L	H	L	H	L	L	L	M	M
BM 2009	Molecular Biology Techniques	H	H	H	H	H	L	L	M	M	M	L	M
BM 2010	Immunological Applications in Biotechnology	H	H	M	M	M	L	L	L	L	L	M	M
BM 2011	Experimental Design	H	H	L	L	H	L	H	M	M	L	L	H
BM 2012	Nanotechnology and its Biological Applications	H	H	M	M	M	L	L	L	L	L	H	H
BM 2013	Microbial Genetics	H	L	L	L	L	L	L	M	M	L	L	L
BM 2014	Microbial Culture Maintenance	H	H	M	M	L	M	M	M	L	L	L	L
BM 2015	Current Topics in Biotechnology and Microbiology	H	H	H	H	H	M	L	M	M	M	H	H
BM 2016	Scientific Writing II	H	H	H	L	L	L	H	M	L	M	M	M

		Subject/Theoretical Knowledge	Practical Knowledge and Application	Communication	Teamwork and Leadership	Creativity and Problem Solving	Managerial and Entrepreneurship	Information Usage and Management	Networking and Social Skills	Adaptability and Flexibility	Attitudes, Values and Professionalism	Vision for Life	Updating Self / Lifelong Learning
BM 3001	Food Microbiology	H	H	H	H	M	H	M	M	M	L	L	L
BM 3002	Advanced Molecular Biology	H	M	M	M	M	L	L	L	L	L	L	L
BM 3003	Applications in Medical Biotechnology	H	H	H	H	H	H	L	M	M	M	H	H
BM 3004	Industrial Microbiology	H	M	M	M	M	M	M	L	L	L	L	L
BM 3005	GMOs and GMFs	H	H	H	H	H	M	L	M	M	M	H	H
BM 3006	Enzyme Technology	H	M	H	L	L	L	H	L	L	M	L	M
BM 3007	Entrepreneurship	H	M	H	H	H	H	L	H	H	H	H	H
BM 3008	Laboratory Management	H	H	H	H	H	H	H	M	M	M	L	M
BM 3009	Pharmaceuticals and Cosmeceuticals	H	H	M	M	M	H	L	M	M	M	H	H
BM 3010	Aspects of Bioprospecting	H	H	M	M	H	H	M	M	M	M	M	M
BM 3011	Fermentation Technology	H	M	M	M	M	M	L	M	M	M	H	H
BM 3012	Protecting Intellectual Property	H	H	L	L	M	M	H	M	M	M	M	M
BM 3013	Assignment/Case Study	M	M	H	L	M	L	M	M	M	M	L	M

H	High	M	Moderate	L	Low

PLO 1: demonstrate broad conceptual understanding in the fields of study
PLO 2: demonstrate practical skills in disciplines related to Biotechnology and Microbiology
PLO 3: effectively communicate & disseminate knowledge, information and ideas to specialists and a wider society
PLO 4: develop attitudes and skills required for employment and life-long learning
PLO 5: practice professionalism and uphold ethical standards
PLO 6: function independently as well as interdependently
PLO 7: demonstrate leadership skills
PLO 8: express emotional and intellectual maturity in a global setting

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