Subject: Molecular Biology and Plant Biotechnology[1] (MBBT)				
BSc				
Semester	**Course code**	**Course name**	**Credit value**	**Status**
1	BIOL 11522	Genetics	2	Compulsory
2	MBBT 12513	Introduction to Molecular and Cellular Biology	3	Compulsory
	MBBT 12522	Introduction to Molecular and Cellular Biology Laboratory	2	Compulsory
3	MBBT 21513	Plant Biochemistry	3	Compulsory
	MBBT 21523	Principles of Gene Expression	3	Compulsory
4	MBBT 22533	Microbial Biology	3	Compulsory
	MBBT 22543	Molecular Plant Breeding	3	Compulsory
5	MBBT 31513	Principles and Techniques in Plant Biotechnology	3	Compulsory
	MBBT 31522	Principles and Techniques in Plant Biotechnology Laboratory	2	Compulsory
	PRPL 31992	Professional Placement	2	Optional
6	MBBT 32534	Plant Pathology and Tissue Culture	4	Optional
	MBBT 32542	Plant Pathology and Tissue Culture Laboratory	2	Optional

[1]Limited enrolment.

Subject: Molecular Biology and Plant Biotechnology[1] (MBBT)				
BSc Honours				
Semester	**Course code**	**Course name**	**Credit value**	**Status**
5	MBBT 41766	Plant Genetic Engineering	6	Compulsory
6	MBBT 42776	Advanced Microbial Genetics	6	Compulsory
7	MBBT 41784	Molecular Plant Pathology	4	Compulsory
	MBBT 41794	Genetic Manipulation of Microorganisms	4	Compulsory
	MBBT 41805	Developmental Gene Regulation	5	Compulsory
	MBBT 41813	Bioinformatics in Molecular Biology	3	Compulsory
	MBBT 43824	Modern Trends in Molecular Biology/ Biotechnology	4	Compulsory
	MBBT 43832	Term Paper	2	Compulsory
	MBBT 43848	Research Project	8	Compulsory
8	MBBT 42853	Ethics of Biotechnology, biosafety and intellectual property rights	3	Compulsory
	MBBT 42864	Plant Genomics and Proteomics	4	Compulsory

[1]Limited enrolment.

Semester	1		
Course Code	BIOL 11522		
Course Name	**Genetics**		
Credit Value	2		
Core/Optional	Core		
Pre-requisite	G.C.E (A/L) Biology		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	30 hrs	15 hrs	55 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- describe the principles of inheritance,
- explain fundamentals of molecular genetics, and
- apply the knowledge gained in solving basic problems within the context of genetics.

Course Content:

Review of Mendelian genetics and extensions of Mendelian pattern of inheritance, genetic basis of sex determination and sex-linked inheritance. Linkage and gene mapping. Molecular organization of genetic material. Gene and gene function: Introduction to prokaryotic gene expression, transcription and genetic aspects of translation. Introduction to population genetics. Mutations. Human genome and molecular basis of common human genetic diseases. Fundamentals of the genomes of selected model organisms. Applications of molecular biology and genetics.

Teaching/Learning Methods: Lectures, laboratory exercises and assignments

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 20%	**Final Assessment** 80%		
Details: Oral presentation 10%, Lab reports 5%, Assignments/quizzes 5%	**Theory (%)** 80%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B. and Doebley, J. 2012. *An Introduction to Genetic Analysis*. 10th Edition. W H Freeman.
2. Snustad, D.P. and Simmons, M.J. 2011. *Principles of Genetics*. 6th Edition. John Wiley and Sons.
3. Synder, L., Peters, J.E., Henkin, T.M and Champness, W. 2013. *Molecular Genetics of Bacteria*. 4th Edition. American Society for Microbiology.

Semester	2		
Course Code	MBBT 12513		
Course Name	**Introduction to Molecular and Cellular Biology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisite	All BIOL course units		
Co-requisite	MBBT 12522		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	45 hrs	-	105 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain how eukaryotic cells have evolved,
- describe the functional relationships among different cellular compartments, and
- describe the principles and concepts of basic molecular biological techniques.

Course Content:

The cell as a basic unit of biology. The cell theory. The emergence of modern cell biology. Major investigative methods of cell and molecular biology. Cell structure and function: properties and strategies of cells, major structural features, i.e., plasma membrane, nucleus, membrane-bounded organelles, transport through the membranes of the nucleus,

the chloroplast and other plastids and the mitochondria, cytoplasm with its cytoskeleton, the extracellular matrix and the cell wall. The endosymbiont theory. Viruses, viroids and prions. Cellular movement: the motile appendages of eukaryotic cells. Cell cycle, cell cycle regulation and cancer. Bioenergetics.

Genes, genomes and chromosomes: Molecular structure and function of genes, organization of prokaryotic and eukaryotic genomes. DNA replication and repair mechanisms. Genetic aspects of formation of functional mRNA, decoding of mRNA. Basic tools and techniques in molecular biology: Polymerases, polymerase chain reaction (PCR), variants and applications of PCR. Introduction to PCR cloning, DNA libraries and DNA sequencing.

Teaching/Learning Methods: Lectures, computer- assisted learning, study guide and tutorials

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 10%	**Final Assessment** 90%		
Details: Assignment 5%, Quiz 5%	**Theory (%)** 90%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Becker, W.M., Kleinsmith, L.J. and Hardin, J. 2009. *The World of the Cell*. 7th Edition. The BenjaminCummings, New York.
2. Evert, R.F. and Eichhorn, S.E. 2013. *Biology of Plants*. 8th Edition. W.H. Freeman and Company Publishers, New York.
3. Lodish, H. and Berk, A. 2012. *Molecular Cell Biology*. 7th Edition. W.H. Freeman and Company Publishers.

Semester	2		
Course Code	MBBT 12522		
Course Name	**Introduction to Molecular and Cellular Biology Laboratory**		
Credit Value	2		
Core/Optional	Core		
Pre-requisite	-		
Co-requisite	MBBT 12513		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	-	75 hrs	25 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- demonstrate skills in isolation and identification of cell organelles, and
- explain the principles of basic techniques in cellular and molecular biology.

Course Content:

Microscopy: Laboratory exercises and interactive CD-ROMs to study structure and function of eukaryotic cells. Cell types and tissue distribution in plants. Cell fractionation. Diversity and evolutionary relationships of photosynthetic pigments.

Handling equipment and instruments and preparation of reagents used in molecular biological experiments. Isolation of bacterial genomic and plasmid DNA, isolation of genomic and chloroplast DNA from plant cells. RNA isolation. Qualitative tests for nucleic acids, DNA quality and quantity determination, DNA denaturation and melting curves. Primer design, Polymerase chain reaction (PCR), different types of PCR. Agarose Gel electrophoresis, purification of PCR products and sample preparation for Sanger sequencing.

Teaching/Learning Methods: Laboratory exercises and computer-assisted learning

Assessment Strategy: Laboratory reports, quizzes and end of course unit practical examination

Continuous Assessment 10%	**Final Assessment** 90%		
Details: Assignments 5%, Laboratory reports 5%	**Theory (%)** -	**Practical (%)** 90%	**Other (%)** -

References/Reading Materials:

1. *Inside the Cell*. 2005. Teaching CD-ROM, Insight Media, New York.
2. Green, M.R., Sambrook, J. 2014. *Molecular Cloning: A Laboratory Manual*. 4th Edition. Cold Spring Harbor Laboratory Press.
3. Becker, W.M., Kleinsmith, L.J. and Hardin, J. 2009. *The World of the Cell*. 7th Edition. The BenjaminCummings, New York.

Semester	3		
Course Code	MBBT 21513		
Course Name	**Plant Biochemistry**		
Credit Value	3		
Core/Optional	Core		
Pre-requisite	BIOL 11532		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	40 hrs	20 hrs	90 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- understand how to use selected techniques for purification and characterization of proteins and lipids,
- explain the concepts and principles of enzyme kinetics and apply them in the area of study, and
- describe the structure, function and biosynthetic pathways of essential biochemical molecules.

Course Content:

Calibration of volumetric glassware for molecular biology experiments. Enzyme kinetics and enzyme regulation. Ribozymes. ATP synthesis. Biochemical aspects of genetic code, transcription, translation. Vitamins and coenzymes. Protein based techniques: protein purification and characterization. Functions of carbohydrates in plants: cell wall polysaccharides, glycoconjugates: proteoglycans, glycoproteins, and glycolipids. Carbohydrates as informational molecules in plants: the sugar code. Gluconeogenesis. Pentose phosphate pathway. Structural lipids in membranes: lipids in cell membrane, galactolipids and sulfolipids in chloroplasts. Lipid-based techniques: lipid extraction, chromatography. Secondary metabolites and plant defense.

Teaching/Learning Methods: Study guide, lectures, computer-assisted learning, laboratory exercises and tutorials

Assessment Strategy: Laboratory reports, continuous assessment and end of the course unit written and practical examinations

Continuous Assessment 10%	**Final Assessment** 90%		
Details: Laboratory reports 10%	**Theory (%)** 60%	**Practical (%)** 30%	**Other (%)** -

References/Reading Materials:

1. Lehninger, L., Nelson, D.L. and Cox, M.M. 2000. *Principles of Biochemistry*. Worth, California.
2. Moran, L.A. Horton, H.R., Scrimgeour, K.G. and Perry, M.D. 2012. *Principles of Biochemistry*. Pearson Education, Inc., Illinois.
3. Plummer, D.T. 2012. *An Introduction to Practical Biochemistry*. McGraw-Hill, London.

Semester	3
Course Code	MBBT 21523
Course Name	**Principles of Gene Expression**
Credit Value	3
Core/Optional	Core
Pre-requisite	MBBT 12513
Co-requisite	-

Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	-	105 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- compare and contrast eukaryotic and prokaryotic gene expression and regulation, and
- explain the principles of the techniques used in expression analysis.

Course Content:

Regulation of gene expression in prokaryotes: molecular basis of regulation of transcription initiation and termination. Transcription of nuclear genes by RNA polymerases. Arrangement of protein coding genes. Features of promoters. Modification of primary transcript: polyadenylation, 5'-capping and RNA splicing. Complex transcription units. Genetic aspects of translation. Protein post-translational modification (PTM). Anti-sense RNA and their role in the regulation of gene expression. Techniques of gene expression analysis: qPCR, transcriptomics, RNAseq, ESTs, microarray. Epigenetics.

Teaching/Learning Methods: Lectures, research paper discussions and tutorials

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Research paper based oral presentation 30%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Goodbourn, S. 1996. *Eukaryotic Gene Transcription*. Oxford University.
2. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. 2000. *An Introduction to Genetic Analysis*. 7th Edition. W. H. Freeman.
3. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. and Lewin, B. 2014. *Lewin's Genes XI*. Jones & Bartlett.
4. Ma, J. 2006. *Gene Expression and Regulation*. Springer, NY.

Semester	4
Course Code	MBBT 22533
Course Name	**Microbial Biology**
Credit Value	3
Core/Optional	Core
Pre-requisite	BIOL 11512
Co-requisite	-

Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	20 hrs	100 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- compare the nature of genome organization of bacteria, fungi and viruses,
- describe current trends in microbiology, and
- demonstrate essential skills in microbiological techniques.

Course Content:

Comparison of archaebacteria, eubacteria and eukarya. Reproduction strategies of bacteria and fungi, growth and metabolism in microbes. Antibiotics and chemotherapeutics and their use in control in bacteria, fungi and viruses. Drug resistance in microbes. Viral genomes, symmetry and replication. Lytic and lysogenic cycles of bacteriophages. Growth and maintenance of viruses. Use of microbes in food industry, environmental management and agriculture.

Laboratory exercises: Isolation, identification and enumeration of bacteria and fungi. Identification of bacteria using morphological, biochemical and physiological characteristics. Demonstration of lytic process by bacteriophages, Industrial environmental and agricultural applications of microbes.

Teaching/Learning Methods: Lectures, tutorials and laboratory exercises

Assessment Strategy: Continuous assessment, laboratory reports and end of course unit practical and written examinations			
Continuous Assessment 35%	**Final Assessment** 65%		
Details: Laboratory reports 20%, Quizzes 15%	**Theory (%)** 40%	**Practical (%)** 25%	**Other (%)** -

References/Reading Materials:

1. Schlegel, H.G. 2003. *General Microbiology*. 7th Edition, Cambridge University Press. U.K.
2. Jay, J.M. 2005. *Modern Food Microbiology*. 7th Edition, Chapman & Hall, London, U.K.
3. Maier, R.M., Pepper, I.L. and Gerba, C.P. 2009. *Environmental Microbiology*. 2nd Edition, Academic Press, Burlington, MA, U.S.A.
4. Satyanarayana, T., Tohri, B.N. and Prakash, A. 2012. *Microorganisms in Environmental Management*. Springer Science & Business Media.
5. Tikhonovich, I., Lugtenberg, B. and Provorov, N. 2004. *Biology of Plant-Microbe Interactions*. International Society for Molecular Plant-Microbe Interactions. Minnesota, U.S.A.

Semester	4		
Course Code	MBBT 22543		
Course Name	**Molecular Plant Breeding**		
Credit Value	3		
Core/Optional	Core		
Pre-requisite	MBBT 12513		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- identify pollination mechanisms of different crops,
- describe the concepts of genotyping techniques and applications of molecular markers for crop improvement, and
- construct and interpret linkage and QTL maps.

Course Content:

History of plant breeding, crop wild relatives, underutilized food crops and their importance in crop improvement. Pollination syndrome. Floral biology in relation to pollination. Hybrid seed production. Heritability. Introduction to contemporary molecular markers and genotyping techniques. Estimation of genetic diversity, segregation distortion, linkage disequilibrium using molecular data. Gene mapping: Mapping populations, Linkage mapping. Introduction to Marker Assisted Selection (MAS). Quantitative trait loci (QTL) and QTL mapping. Interpret linkage maps and QTLs. Recent advances in plant breeding research.

Laboratory exercises: Pollination syndrome, pollen viability tests, crop wild relatives and underutilized crops, plant breeding exercise. PCR for a selected molecular marker type, scoring gel images, estimation of segregation distortion and genetic diversity. Linkage mapping and QTL mapping exercises and interpret maps.

Teaching/Learning Methods: Lectures, plant-house exercises, computer – assisted learning and research paper discussions

Assessment Strategy: Continuous assessment, laboratory reports and end of course unit written and practical examinations			
Continuous Assessment 35%	**Final Assessment** 65%		
Details: Reports 25%, Debate 10%	**Theory (%)** 45%	**Practical (%)** 20%	**Other (%)** -

References/Reading Materials:

1. Acquaah, G. 2012. *Principles of Plant Genetics and Breeding.* 2nd Edition. Wiley-Blackwell.
2. Most recent literature on genotyping, MAS and QTL mapping provided by the lecturer

Semester	5		
Course Code	MBBT 31513		
Course Name	**Principles and Techniques in Plant Biotechnology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisite	MBBT 12513		
Co-requisite	MBBT 31522		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	45 hrs	-	105 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain the underpinning principles and strategies of genetic engineering,
- explain how biotechnology is used for plant improvement and discuss the ethical implications, and
- critically review relevant research papers.

Course Content:

Introduction to the nature of plant genome. Restriction enzymes. An introduction to recombinant DNA technology. Plasmids and their importance as vectors. Techniques in plant gene manipulation. Transformation of plant cells. Ti plasmid and vectors derived from Ti. *Agrobacterium* mediated transformation system. Transgenic plants. Expression vectors. Techniques used to study transgene expression.

Teaching/Learning Methods: Lectures, tutorials and paper discussions

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 20%	**Final Assessment** 80%		
Details: Abstract writing 10%, Presentation 10%	**Theory (%)** 80%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B. and Doebley, J. 2012. *An Introduction to Genetic Analysis*. 10th Edition. W H Freeman.
2. Jones, P.G and Sutton, J.M. 1997. *Plant Molecular Biology: Essential Techniques*. John Wiley & Sons.
3. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. and Lewin, B. 2014. *Lewin's Genes XI*. Jones & Bartlett.
4. Stewart, C.N. 2008. *Plant Biotechnology and Genetics: Principles, Techniques and Application*. Wiley.

Semester	5		
Course Code	MBBT 31522		
Course Name	**Principles and Techniques in Plant Biotechnology Laboratory**		
Credit Value	2		
Core/Optional	Core		
Pre-requisite	-		
Co-requisite	MBBT 31513		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	-	75 hrs	25 rs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to explain the concepts and principles of the techniques used in plant biotechnology, and demonstrate skills in their applications.

Course Content:

DNA extraction from plant organelles. Restriction digestion of DNA and analysis by electrophoresis. Techniques used in genetic manipulation of plants: Construction of restriction maps. Ligation of DNA fragments into vectors. Transformation of DNA into bacteria, and selection of recombinants: chemical methods of transformation and electroporation. Bacterial gene transfer by conjugation. Analysis of biochemical pathways using mutants with defects in enzyme synthesis. Southern transfer and other blotting techniques. Introduction to Bioinformatics: Gene banks.

Deposition and accession of information in gene banks. Sequence alignments.			
Teaching/Learning Methods: Lectures, laboratory exercises and visits to Research Institutes			
Assessment Strategy: Laboratory reports, continuous assessment and end of course unit practical examination			
Continuous Assessment 30%	**Final Assessment** 70%		
Details: Laboratory reports 10%, Drama 20%	**Theory (%)** -	**Practical (%)** 70%	**Other (%)** -
References/Reading Materials: 1. Green, M. R. and Sambrook, J. 2014. *Molecular Cloning: A Laboratory Manual*. 4th Edition. Cold Spring Harbor Laboratory Press. 2. Jones, P.G and Sutton, J.M. 1997. *Plant Molecular Biology: Essential Techniques*. John Wiley & Sons. 3. Stewart, C.N. 2008. *Plant Biotechnology and Genetics: Principles, Techniques and Application*. Wiley			

Semester	5		
Course Code	PRPL 31992		
Course Name	**Professional Placement**		
Credit Value	2		
Core/Optional	Optional		
Pre-requisites	-		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	-	200 hrs
Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to, ➢ demonstrate knowledge and understanding of a selected science based area of industrial/ agricultural relevance, and / or concepts of entrepreneurship, and ➢ develop skills needed in communication, leadership and team working in a multicultural and industrial environment.			
Course Content: Major aspects to be covered are the basic principles of management, underlying concepts of entrepreneurship, generic skills needed to work in the real world of work and knowledge and understanding of a biological resources-based industry.			
Teaching /Learning Methods: Training under the supervision and guidance in a relevant industry for six weeks.			
Assessment Strategy: Evaluation of the progress report submitted by the trainer and the student's technical report describing the nature of the training and presentations.			
Continuous Assessment 30%	Final Assessment 70%		
Details: Trainer's report 30%	Theory (%) -	Practical (%) -	Other (%) Trainee's report 50%, Oral presentation 10%, Diary 10%
References/Reading Materials: Reading and reference materials recommended/ provided by the relevant industry.			

Semester	6		
Course Code	MBBT 32534		
Course Name	**Plant Pathology and Tissue Culture**		
Credit Value	4		
Core/Optional	Optional		
Pre-requisite	MBBT 22533		
Co-requisite	MBBT 32542		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	60 hrs	-	140 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain underlying concepts of mechanisms of the compatible and incompatible interactions between plants and microorganisms, and
- describe tissue culture systems and their applications.

Course Content:

Plant Pathology: Concepts and symptoms of plant diseases. Pathogens, pathogenesis and disease establishment. Host pathogen interaction: resistance and susceptibility at molecular, cellular and population level. Disease epidemiology. Fungal, bacterial and viral diseases of local crops and their management.

Tissue Culture: Principles and concepts involved in the in-vitro culture of plant cells and tissues. Organization of a tissue culture laboratory with emphasis on asepsis. Types of cultures and their practical applications in rapid clonal propagation, crop breeding and disease elimination. Existing problems and limitations.

Teaching/Learning Methods: Lectures, tutorials and presentations

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Presentations 15%, Report 15%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Agrios, G.N. 2005. *Plant Pathology*. 5th Edition. Academic Press.
2. නෙළුම් දේශප්‍රිය 2009. ශාක පටක රෝපණය සහ එහි උපයෝගිතා. Biographic Educational Publications.
3. නෙළුම් දේශප්‍රිය 2009. ශාක රෝග: මූල ධර්ම සහ පාලනය. Biographic Educational Publications.
4. Razdan M.K. 2003. *Introduction to Plant Tissue Culture*. Science Publishers Inc. USA.
5. Dodds, J.H. and Roberts, L. W. 2004. *Experiments in Plant Tissue Culture*. Cambridge University.
6. Lucas, J.A. 1998. *Plant Pathology and Plant Pathogens*. 3rd Edition. Blackwell.
7. Schumann, G.L. and D'Arcy, C. 2009. *Essential Plant Pathology*. 2nd Edition. APS Press.

Semester	6		
Course Code	MBBT 32542		
Course Name	**Plant Pathology and Tissue Culture Laboratory**		
Credit Value	2		
Core/Optional	Optional		
Pre-requisite	-		
Co-requisite	MBBT 32534		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	-	75 hrs	25 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to demonstrate skills in

- diagnosis and basic methods of management of plant diseases, and
- *in-vitro* culture of plant tissues.

Course Content:
Plant Pathology: Diagnosis and identification of plant pathogens. Confirmation of pathogenicity via Koch's postulates. Basic methods of plant disease management. Studies on diseases of major crops.

Tissue Culture: Techniques used in the *in-vitro* culture of plant tissues and organs.

Teaching/Learning Methods: Laboratory exercises, presentations, assignments and field visits

Assessment Strategy: Continuous assessment, laboratory reports and end of course unit practical examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Laboratory reports 10%, Report 10%, Presentations 10%	**Theory (%)** -	**Practical (%)** 70%	**Other (%)** -

References/Reading Materials:

1. Waller, J.M., Ritchie, B.J. and Holderness, M. 1998. *Plant Clinic Hand Book*. CAB International.
2. Reinert, J. and Yeoman, M.M. 1982. *Plant Cell and Tissue Culture - A Laboratory Manual*. Springer-Verlag.
3. Dodds, J.H. and Roberts, L.W. 2004. *Experiments in Plant Tissue Culture*. Cambridge University.
4. Trigiano, R.N. 2004. *Plant Pathology: Concepts and Laboratory Exercises*. CRC Press.

Semester	5		
Course Code	MBBT 41766		
Course Name	**Plant Genetic Engineering**		
Credit Value	6		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	60 hrs	30 hrs	210 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,
- explain the underpinning principles and strategies of plant genetic engineering,
- explain the limitations of traditional breeding that are overcome by genetic engineering and practical applications of genetic engineering in agriculture, industry, medicine and environmental protection,
- analyze bio-safety implications of genetic engineering, and
- identify a current global problem, formulate hypothesis and propose solutions via plant genetic engineering.

Course Content:
Nuclear and organelle genes of plants. Techniques used for identification of plant genes or gene clusters: modern molecular markers and high-throughput genotyping techniques, cDNA synthesis, screening of genomic libraries. Types of vectors and construction of vectors. *Agrobacterium tumefaciens*-mediated gene transfer into plants: Ti plasmid, T-DNA vectors and strategies used to transfer of foreign genes. Direct gene transfer into plants: tissue electroporation and other physical methods of transformation. Selectable markers and reporter genes. Analysis of transgenic plants and expression signals. Antisense RNA technology and its application in plant genetic engineering. Selected examples for production of genetically engineered plants with improved agricultural and horticultural values.

Teaching/Learning Methods: Lectures, tutorials and research paper discussions

Assessment Strategy: Continuous assessment, assignments and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Research proposal and defense 30%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Setlow, J.K. 2000. *Genetic Engineering: Principles and Methods*. Kluwer Academic.
2. Bob, B., Buchanan, B., Gruissem, W. and Jones, R.L. 2002. *Biochemistry and Molecular Biology of Plants*. John

Wiley. and Sons.
3. Buchanan, B. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Biologists.
4. Joshi, P. 2004. *Genetic Engineering and its applications*. 2nd edition
5. Most recent scientific literature on plant genetic engineering provided by the lecturer

Semester	6		
Course Code	MBBT 42776		
Course Name	**Advanced Microbial Genetics**		
Credit Value	6		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	60 hrs	30 hrs	210 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,
- explain prokaryotic gene structure and gene expression process at molecular level,
- compare and contrast different transcriptional regulatory mechanisms in bacteria, and
- critically review genetic aspects of bacteriophage life cycles, transposition and mutagenesis.

Course Content:
Prokaryotic gene expression: Features of bacterial promoters, molecular details of transcription initiations and termination. Regulation of gene expression: transcriptional regulation in bacteria; repressors and activators, positive and negative regulation, attenuation and feedback inhibition. Regulation of gene expression by riboswitches. Molecular basis of transformation. Molecular aspects of gene transfer by conjugation and genome mapping and strain construction by conjugation. Genetics of bacteriophages: lytic and lysogenic cycles, phage DNA replication. Generalized transduction, specialized transduction. Transposition and non-homologous recombination, DNA repair and mutagenesis.

Teaching/Learning Methods: Lectures, assignments and tutorials

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Research paper based assignments (reports, oral presentations) 30%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Snynder, L., Peters J.E., Henkin, T.M. and Champness, W. 2013. *Molecular Genetics of Bacteria*. 4th Edition. American Society for Microbiology press.
2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. and Lewin, B. 2014. *Lewin's Genes XI*. Jones & Bartlett.
3. Maloy, S. 2004. *Microbial Genetics*. Jones and Bartlett Series in Biology. Jones and Bartlett Publishers.

Semester	7		
Course Code	MBBT 41784		
Course Name	**Molecular Plant Pathology**		
Credit Value	4		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	45 hrs	15 hrs	140 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain principles involved in modern plant disease diagnostics,
- explain intricacies of the compatible and incompatible interactions between plants and pathogenic microorganisms and the means of their control,
- construct gene for gene models for segregating data, and
- critically review recent scientific literature related to molecular plant microbe interactions.

Course Content:
Diagnostic techniques in plant diseases: use of symptoms, biochemical, physiological, ultra-structural, immunological and nucleic acid based methods in disease diagnosis. Infection and pathogenesis: molecular basis of adhesion and penetration by bacterial and fungal pathogens. Pathogenicity determinants. Constitutive and induced defense in plants including the molecular basis of elicitation, signaling and the mechanisms involved. Soil-borne pathogens in the tropics and their control. Disease management using bio-control agents. Insect pests and their control. Plant quarantine for disease management. Construction of G-F-G model and testing model accuracy with segregation data. QTL mapping of resistance genes. Molecular nature of R and Avr genes. Molecular mechanisms of virus movements in plants. Molecular epidemiology.

Teaching/Learning Methods: Lectures, research paper discussions and visits to research institutes

Assessment Strategy: Continuous assessment, assignments and end of course unit written examination

Continuous Assessment 40%	**Final Assessment** 60%		
Details: Critical review of research paper 13.33%, Report 13.33%, Field visit report 13.33%	**Theory (%)** 60%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Vidhysekaran, P. 2008. *Fungal Pathogenesis in Plants and Crops-Molecular Biology and Host Defense Mechanisms*. Marcel Dekker. New York.
2. Dehne, H.W., Adan, G., Diekmann, M., Frahm, J., Mauler-Machnik, A. and Van, H.P. 1997. *Diagnosis and Identification of Plant Pathogens*. Kluwer Academic.
3. Jeger, M.J. 2007. *Biotic Interactions in Plant Pathogen Associations*. Blackwell.
4. Relevant articles in Annual Review of Phytopathology and any other relevant journal.

Semester	7		
Course Code	MBBT 41794		
Course Name	**Genetic Manipulation of Microorganisms**		
Credit Value	4		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	60 hrs	-	140 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student should acquire knowledge in the potential applications of genetic manipulation of microorganisms in biotechnology.

Course Content:
Exclusive expression of foreign genes in bacteria. Deletion mapping of protein functional domains. Regulation of plasmid replication. Transposon mutagenesis and *in-vivo* cloning. Suicide vectors and their use in bacterial genetic manipulations. Gene replacement and reverse genetics. Genetic modification of bacteriophages in the development of vectors. Use of viral genetic elements in recombinant DNA techniques. Gene cloning, manipulation and targeting in yeast.

Teaching/Learning Methods: Lectures, tutorials and assignments

Assessment Strategy: Assignment reports and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Presentations 15%, Assignments 15%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Snyder, L. and Champness, W. 2003. *Molecular Genetics of Bacteria*. American Society for Microbiology.
2. Freifelder, D. 1997. *Microbial Genetics*. Jones and Bartlet.
3. Relevant scientific literature provided by the lecturer

Semester	7		
Course Code	MBBT 41805		
Course Name	**Developmental Gene Regulation**		
Credit Value	5		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	60 hrs	15 hrs	175 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain genetic regulatory mechanisms operating at different developmental stages of eukaryotes, and
- analyze and interpret the experimental data of molecular events in regulatory cascades.

Course Content:

Essentiality of developmental regulation in eukaryotic organisms. Different developmental regulatory mechanisms operating from DNA to functional protein level. Tissue-specific gene regulation as a mechanism of developmental regulation. Selected examples for tissue-specific gene expression in *Drosophila*, *C. elegans* and mammals. Regulatory cascades: Genetic regulation of mammalian sex determination during development. Prokaryotic regulatory cascades. Effect of chromatin structure on gene expression. Genomic imprinting as an epigenetic regulatory mechanism. Role of enhancer elements in tissue specificity. Gene regulation in plant development. Tissue-specific expression in plants. Exploitation of tissue-specific gene regulation in biotechnology.

Teaching/Learning Methods: Lectures, assignments and tutorials

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Assignments 30%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. and Lewin, B. 2014. *Lewin's Genes XI*. Jones & Bartlett.
2. Griffiths, A.J.F., Wessler S.R., Carroll, S.B. and Doebley, J. 2012. *An Introduction to Genetic Analysis*. 10th Edition. W H Freeman.
3. Sambrook, J., Fritsch, E.F. and Maniatis, T. 1989. *Molecular Cloning*. Cold Spring Harbor Laboratory.
4. Lodish, H. and Berk, A. 2012. *Molecular Cell Biology*. 7th Edition. Macmillan Higher Education, International edition.

Semester	7
Course Code	MBBT 41813
Course Name	**Bioinformatics in Molecular Biology**
Credit Value	3
Core/Optional	Core
Pre-requisite	All MBBT compulsory course units and MBBT 32534
Co-requisite	-

Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- manipulate DNA and protein sequences using stand-alone PC programs and programs available on the web,
- analyze protein sequences, identify proteins, and retrieve protein structures from databases, and
- construct phylogenetic tress with molecular data and interpret relationships.

Course Content:
Analysis of DNA sequences to search for open reading frames, promoter regions, transcription, initiation and termination sites etc. Introduction to codon bias. Determination of amino acid sequences and prediction of secondary and three dimensional structures, proteomics. Microarray data analysis, heat maps. Edit DNA sequence, pair wise alignment, multiple sequence alignment algorithms, DNA barcoding, introduction to phylogenetic analysis, phylogenetic tree construction methods, pros and cons of each method, bootstrapping, use computer software for tree construction, interpret data and trees in most recent literature. Use of appropriate databases on bio-informatics in problem analysis.

Teaching/Learning Methods: Interactive lectures using software designed for DNA and protein analysis

Assessment Strategy: Continuous assessment, assignments and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Reports 20%, Presentations 10%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Baxevanis, A.D. and Francis, B.F. 2001. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. John Wiley & Sons.
2. Mount, D.W. and Mount, D. 2004. *Bioinformatics: Sequence and Genome Analysis*. 2nd Edition. Cold Spring Harbor Laboratory.
3. Zvelebil, M., and Baum, J.O. 2007. *Understanding Bioinformatics*. 1st edition. Garland Science, NY.

Semesters	7 and 8		
Course Code	MBBT 43824		
Course Name	**Modern Trends in Molecular Biology/ Biotechnology**		
Credit Value	4		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	40 hrs	05 hrs	155 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to critically review recent advances in Molecular Biology and Biotechnology.

Course Content:
Current topics in diverse avenues of molecular biology and biotechnology and their applications will be discussed.

Teaching/Learning Methods: Lectures and assignments, research paper discussions and computer – assisted learning

Assessment Strategy: Assignments/ presentations and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Reports 20%, Presentations 10%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:
Recent scientific literature provided by the lecturer

Semesters	6 and 7		
Course Code	MBBT 43832		
Course Name	**Term Paper**		
Credit Value	2		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	05 hrs	-	95 hrs
Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to demonstrate the ability for critical, self-directed learning, and skills in oral and written communication.			
Course Content: Two written papers on topics related to sub disciplines of Molecular Biology and Plant Biotechnology.			
Teaching/Learning Methods: Survey of literature related to a prescribed topic and subsequent presentation in written and oral form.			
Assessment Strategy: Written paper and presentations.			
Continuous Assessment 50%	**Final Assessment** 50%		
Details: Written paper 50%	**Theory (%)**	**Practical (%)**	**Other (%)** Oral presentation 50%
References/Reading Materials: Prescribed by the lecturer in-charge of each term paper			

Semesters	7 and 8		
Course Code	MBBT 43848		
Course Name	**Research Project**		
Credit Value	8		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 3253in4		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	-	-	800 hrs
Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to demonstrate competence in, ➢ planning and carrying out a research project scientifically, ➢ presenting the research in the form of a dissertation, and ➢ defending the work carried out and outcomes.			
Course Content: Research related to sub disciplines of Molecular Biology and Plant Biotechnology.			
Teaching/Learning Methods: One year research project is assigned to each student under the supervision of a senior academic staff member at the beginning of level four. Before commencement of the research work, research plan and methodology of the project should be presented at a seminar. A dissertation should be submitted before the end of the academic year. Presentation of the research findings at a seminar will be evaluated by a board of examiners.			
Assessment Strategy: Dissertation and oral presentation.			

Continuous Assessment -	**Final Assessment** 100%		
Details: -	**Theory (%)** -	**Practical (%)** -	**Other (%)** Dissertation 70%, Oral presentation 30%

References/Reading Materials:

1. Day, R.A. 1994. *How to Write and Publish a Scientific Paper*. Orix.
2. Alley, M. 1998. *The Craft of Scientific Writing*. Springer Verlag.
3. Reference material relevant to each research topic provided by the Department of Botany.

Semester	8		
Course Code	MBBT 42853		
Course Name	**Ethics of Biotechnology, Biosafety and Intellectual Property Rights**		
Credit Value	3		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	45 hrs	-	105 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- review and analyse ethical and social issues related to biotechnology,
- understand the importance of different international agreements and protocols for biosafety and their importance to Sri Lanka, and
- evaluate the importance of intellectual property rights to modern biotechnological innovations and its relevance to Sri Lanka.

Course Content:

Modern biotechnology and questions of ethical and social importance: a framework for thinking ethically about modern Biotechnology. Principles of Bioethics and the tools of the Bioethicist. Controversies over genetically modified organisms and genetically modified food. Biotechnology and environment: ethical reasons for concern. Ethical and social aspects of emerging trends in human genetic research. Ethical Issues in scientific research. National and international conventions on biosafety and regulation of biotechnological applications. Sri Lanka's exceptional biodiversity. Ethics of conservation and protection of genetic resources. Intellectual property rights (IPR), patent submissions.

Teaching/Learning Methods: Lectures, presentations and tutorials, quizzes and debates

Assessment Strategy: Continuous assessment and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Reports 10%, Presentation 10%, Debate 10%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Edwards, R.B. and Graber, G.C. 1988. *Bioethics*. Harcourt College.
2. Hanson, M.J. 2001. *Claiming Power Over Life: Religion and Biotechnology Policy*. Georgetown University.
3. Kass, L.R. and Wilson, J.Q. 1998. *The Ethics of Human Cloning*. AEI Press.
4. Veatch, R.M. 2002. *The Basics of Bioethics*. 2nd Edition. Prentice-Hall Press.
5. Gert, B. 2006. *Bioethics: A systematic approach*. 2nd Edition. Oxford University Press.

Semester	8		
Course Code	MBBT 42864		
Course Name	**Plant Genomics and Proteomics**		
Credit Value	4		
Core/Optional	Core		
Pre-requisite	All MBBT compulsory course units and MBBT 32534		
Co-requisite	-		
Hourly Breakdown	**Theory**	**Practical**	**Independent Learning**
	45 hrs	15 hrs	140 hrs

Course Aim/Intended Learning Outcomes: At the completion of this course student will be able to,

- explain methods of DNA sequencing and latest trends in genome sequencing,
- describe major methods for gene expression analysis, functional genomics and tools in proteomics, and
- critically review current literature on plant genomics and proteomics.

Course Content:

Structural genomics: Genome sequencing strategies, BAC by BAC genome sequencing, Whole genome shotgun sequencing, High throughput sequencing. Gene expression analysis: Microarray analysis, Serial Analysis of Gene Expression (SAGE), Massively Parallel Signature Sequencing (MPSS). Reverse genetics: Mutation and detection, Targeting Induced Local Lesions in Genomes (TILLING), RNA interference (RNAi), Virus Induced Gene Silencing (VIGS).

Proteomics: 2-dimensional (2-D) gels, Mass spectrometry (MS) and protein identification, Protein modification, detection and functional analysis.

Teaching/Learning Methods: Lectures, tutorials and research paper discussions

Assessment Strategy: Continuous assessment, assignments and end of course unit written examination

Continuous Assessment 30%	**Final Assessment** 70%		
Details: Research paper based assignments (reports, oral presentations) 30%	**Theory (%)** 70%	**Practical (%)** -	**Other (%)** -

References/Reading Materials:

1. Cullis, C.A. 2004. *Plant Genomics and Proteomics*. John Wiley and Sons, NY.
2. Brown, T.A. 2002. *Genomes*. John Wiley and Sons, NY.
3. Lesk, A.M. 2007. *Introduction to Genomics*. Oxford University Press.
4. Latest review/research articles that will focus on current research topics in the area of plant genomics and proteomics will be available for students to read.