Course structure - Plant Biology (PLBL)

BSc (Subject - Plant Biology)				
Semester	**Course code**	**Course name**	**Credit value**	**Status**
1	BIOL 11522	Genetics	2	Compulsory
	PLBL 11532	Organic Gardening[1]	2	Auxiliary
2	PLBL 12513	Cellular and Plant Developmental Biology	3	Compulsory
	PLBL 12521	Cellular and Plant Developmental Biology Laboratory	1	Compulsory
	PLBL 12533	Microbial Biology	3	Compulsory
3	PLBL 21513	Plant Physiology	3	Compulsory
	PLBL 21521	Plant Physiology Laboratory	1	Compulsory
	PLBL 21531	Biostatistics	1	Compulsory
	PLBL 21541	Fundamentals of Molecular Biology	1	Compulsory
4	PLBL 22554	Plant Evolution, Diversity and Taxonomy	4	Compulsory
	PLBL 22561	Plant Evolution, Diversity and Taxonomy Laboratory	1	Compulsory
	PLBL 22573	Floristic Resources and Management[2]	3	Compulsory
	PLBL 22583	Plant Diversity[2]	3	Compulsory
5	PLBL 31514	Ecology and Environmental Resources Management	4	Compulsory
	PLBL 31521	Ecology and Environmental Resources Management Laboratory	1	Compulsory
	PRPL 31992	Professional Placement	2	Optional
6	PLBL 32533	Plant Pathology and Post-Harvest Technology[3]	3	Optional
	PLBL 32542	Recombinant DNA Technology and Tissue Culture[3]	2	Optional
	PLBL 32552	Horticulture[3]	2	Optional

[1]Offered during alternate academic years for non-Biology students.
[2]Offered for BSc Degree in Environmental Conservation and Management.
[3]Compulsory for BSc Hons (Plant Biology).

BSc Hons (Plant Biology)				
Semester	**Course code**	**Course name**	**Credit value**	**Status**
5	PLBL 41763	Plant Physiology and Biochemistry	3	Compulsory
	PLBL 41773	Plant Breeding	3	Compulsory
6	PLBL 42783	Molecular and Microbial Genetics	3	Compulsory
	PLBL 42793	Bioethics	3	Compulsory
7	PLBL 41804	Plant Systematics and Bioinformatics	4	Compulsory
	PLBL 41814	Bioprospecting	4	Compulsory
	PLBL 41823	Food and Industrial Microbiology	3	Compulsory
	PLBL 41833	Forest Management and Soil Nutrient Dynamics	3	Compulsory
	PLBL 41844	Fungi in Ecosystem Processes	4	Compulsory
8	PLBL 42853	Ecology of Sustainability	3	Compulsory
	PLBL 42863	Bioremediation	3	Compulsory
	PLBL 43872	Field Botany	2	Compulsory
	PLBL 43882	Term Paper and Presentation	2	Compulsory
	PLBL 43898	Research Project - Dissertation	8	Compulsory

Course structure - Molecular Biology & Plant Biotechnology (MBBT)

BSc Hons (Molecular Biology and Plant Biotechnology)*				
Semester	**Course code**	**Course name**	**Credit value**	**Status**
1	BIOL 11522	Genetics	2	Compulsory
2	PLBL 12513	Cellular and Plant Developmental Biology	3	Compulsory
	PLBL 12521	Cellular and Plant Developmental Biology Laboratory	1	Compulsory
	PLBL 12533	Microbial Biology	3	Compulsory
3	PLBL 21513	Plant Physiology	3	Compulsory
	PLBL 21521	Plant Physiology Laboratory	1	Compulsory
	PLBL 21531	Biostatistics	1	Compulsory
	PLBL 21541	Fundamentals of Molecular Biology	1	Compulsory
4	PLBL 22554	Plant Evolution, Diversity and Taxonomy	4	Compulsory
	PLBL 22561	Plant Evolution, Diversity and Taxonomy Laboratory	1	Compulsory
5	MBBT 31514	Principles and Techniques in Plant Biotechnology	4	Compulsory
	MBBT 31522	Principles and Techniques in Plant Biotechnology Laboratory	2	Compulsory
	PRPL 31992	Professional Placement	2	Optional
	MBBT 41763	Cell Biology and Biochemistry	3	Compulsory
	MBBT 41773	Molecular Plant Breeding	3	Compulsory
6	MBBT 32533	Plant Pathology	3	Compulsory
	MBBT 32541	Tissue Culture	1	Compulsory
	MBBT 32552	Principles and Practices of Horticulture	2	Compulsory
	MBBT 42784	Microbial Genetics	4	Compulsory
	MBBT 42793	Bioethics and Intellectual Property Rights	3	Compulsory
7	MBBT 41804	Bioinformatics	4	Compulsory
	MBBT 41813	Agricultural, Environmental and Industrial Biotechnology	3	Compulsory
	MBBT 41824	Developmental Gene Regulation	4	Compulsory
	MBBT 41834	Genetic Manipulation of Microorganisms	4	Compulsory
	MBBT 41844	Omics Technologies	4	Compulsory
8	MBBT 42853	Molecular Ecology	3	Compulsory
	MBBT 42863	Immunology and Cancer Biology	3	Compulsory
	MBBT 43872	Term Paper and Presentation	2	Compulsory
	MBBT 43888	Research Project - Dissertation	8	Compulsory

*PLBL course units offered in levels 1 and 2 are considered as course units in the subject of specialization to be eligible for the award of BSc Honours in Molecular Biology & Plant Biotechnology degree and for the award of classes.

Course unit contents - Plant Biology (PLBL)

Semester	1		
Course Code	BIOL 11522		
Course Name	**Genetics**		
Credit Value	2		
Core/Optional	Core		
Pre-requisites	GCE A/L Biology		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	55 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe the principles of inheritance, (i i) explain fundamentals of molecular genetics and (iii) 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. Molecular basis of allelic variations. Linkage and gene mapping. Quantitative genetics of complex traits with agricultural and biomedical relevance. Sources of genetic variations and applications of population genetics. Molecular organization of genetic material. DNA replication and repair. Introduction to prokaryotic genome, genes, gene expression and gene expression regulation: lactose operon. Human genome project, genetic and molecular basis of selected genetic disorders, genetic testing and introduction to gene therapy. Fundamentals of the genomes of selected model organisms. Applications of molecular biology and ge netics.

Laboratory: Microscopy, Cell division: Mitosis and Meiosis, Demonstration of Hardy-Weinberg equilibrium and natural selection, Human heredity

Teaching/Learning Methods: Lectures, laboratory sessions and tutorials

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

Continuous Assessment 25%	Final Assessment 75%		
Details: Quizzes 10%, Oral presentation 10%, Laboratory reports 05%	Theory (%) 75%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B. and Doebley, J. 2015. *An Introduction to Genetic Analysis*. 11th Edition. W.H. Freeman.
2. Snustad, D.P. and Simmons, M.J. 2011. *Principles of Genetics*. 6th Edition. John Wiley and Sons.
3. Snyder, L., Peters, J.E., Henkin, T.M. and Champness, W. 2013. *Molecular Genetics of Bacteria*. 4th Edition. American Society for Microbiology.

Semester	1		
Course Code	PLBL 11532[1]		
Course Name	**Organic Gardening**		
Credit Value	2		
Core/Optional	Auxiliary		
Pre-requisites	-		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	20 hrs	30 hrs	50 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain the biological principles, practic es and ecological approaches of organic gardening, (ii) describe organic gardening methods in sustainable crop production with minimum environmental hazards, (iii) explain agroforestry and its applications in organic gardening and (iv) identify plants used as cover crops, green manure, bio fertilizer and their characteristics.

Course content:
Organic gardening: Soil as a medium for plant growth and requirements of plants, Meeting crop nutrition needs with organic material, Decomposition of soil organic matter and ex-situ and in-situ compost production using organic waste, use of locally available organic material in gardening: cover crops, organic mulch, bio-fertilizer and farm manures. Biological principles, and approaches used in production of compost and bio ferti lizer. Desired agronomic and cultural practices, intercropping, crop rotation and mixed cropping systems. Organic methods of weeds, pest and disease control and integrated pest and disease management, Advantages of organic gardening. Economic sustainability of organic farming.

Teaching /Learning Methods: Lectures, laboratory sessions and assignments

Assessment Strategy: Continuous assessment and end of course unit written and practical examination			
Continuous Assessment 35%	Final Assessment 65%		
Details: Assignment reports 10%, Oral presentation 15%, Laboratory reports 10 %	Theory (%) 40%	Practical (%) 25%	Other (%) -
References/Reading Materials: 1. Baker, A.V., 2010. *Science and Technology of Organic Farming*. CRC Press, Taylor and Francis Group. 2. Hamilton, G., 2011. *Organic Gardening*, DK Publishing, USA. 3. Hansen, A.L., 2010. *The Organic Farming Manual: A Comprehensive Guide to Starting and Running a Certified Organic Farm*. Storey Publishing, LLC.			

[1]Offered during alternate academic years for non-Biology students.

Semester	2		
Course Code	PLBL 12513		
Course Name	**Cellular and Plant Developmental Biology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	All BIOL course units		
Co-requisites	PLBL 12521		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	-	105 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, understand how plant organs develop as the plant grows and differentiate from an embryo to the flowering stage.			
Course Content: Dynamics of plant cell structure and functions, development of the plant: embryogenesis, morphogenesis and differentiation of the plant body. Primary and secondary growth.			
Teaching /Learning Methods: Lectures, tutorials, assignments and computer-assisted learning			
Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 20%	Final Assessment 80%		
Details: Oral presentations and assignments 10%, Quizzes 10%	Theory (%) 80%	Practical (%) -	Other (%) -
References/Reading Materials: 1. Dickison, W.C., 2000. *Integrative Plant Anatomy*. Academic Press. 2. Esau, K., 1977. *Anatomy of Seed Plants*. 2nd Edition. John Wiley & Sons. 3. Evert, R.F. and Eichhorn, S.E., 2013. *Biology of Plants*. 8th Edition. W. H. Freeman. 4. Gifford, E.M. and Foster, A.S., 1989. *Morphology and Evolution of Vascular Plants*. 3rd Edition. W. H. Freeman.			

Semester	2		
Course Code	PLBL 12521		
Course Name	**Cellular and Plant Developmental Biology Laboratory**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	All BIOL course units		
Co-requisites	PLBL 12513		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	45 hrs	05 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, develop and improve observational skills and the ability to use illustrations to recognize the form and structural differentiation, and the growth patterns of plants.			
Course Content: Cellular organization. Cells and tissue distribution. Primary and secondary tissues of plants. Morphological features and modifications of root and shoot systems.			
Teaching /Learning Methods: Laboratory sessions, field exercises and laboratory manual			
Assessment Strategy: Continuous assessment and end of course unit practical examination			
Continuous Assessment 40%	Final Assessment 60%		

Details: Laboratory tests 20%, Laboratory reports 20%	Theory (%) -	Practical (%) 60%	Other (%) -

References/Reading Materials:

1. Ragland, A., 2014. *Plant Anatomy & Microtechniques*. Saras Publication.
2. Raven, P., Johnson, G.B., Mason, K.A., Losos J.B. and Singer, S.S., 2013. *Biology*. McGraw-Hill.
3. Senanayake, S.P., Kannangara, S. and Ratnayake, R.M.C.S., 2019. *Morphology, Anatomy and Taxonomy of Angiosperms*. Laboratory Manual.

Semester	2		
Course Code	PLBL 12533		
Course Name	**Microbial Biology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	BIOL 11512		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	30 hrs	90 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) compare the biology and reproduction of bacteria, fungi and viruses, (ii) isolate and identify microorganisms using relevant laboratory techniques, (iii) describe applications of microorganisms in food and agriculture and (iv) develop skills in small group learning and information usage.

Course Content:

Introduction to six kingdom classification. Comparison of archaebacteria, eubacteria and eukarya. Biology and habitats of atypical bacteria. Morphology, cell structure, ecology and importance of cyanobacteria. Unique characteristics and morphology of fungi belonging to divisions of Zygomycota, Ascomycota and Basidiomycota. Reproduction strategies of bacteria and fungi. Growth and metabolism of microbes. Environmental factors affecting microbial growth. Antibiotics and their mechanisms of action. Viral genomes, symmetry and replication. Lytic and lysogenic cycles of bacteriophages, growth and maintenance of viruses. Use of microbes in food industry and agriculture.

Laboratory: Isolation, purification and enumeration of bacteria and fungi. Characterization of fungi belonging to Zygomycota, Ascomycota and Basidiomycota based on their unique features. Identification and characterization of cyanobacteria using morphological features. Identification and characterization of bacteria using morphological, biochemical and physiological characteristics. Antibiotic sensitivity tests. Demonstration of lytic process by bacteriophages . Food and agricultural applications of microbes.

Teaching/ Learning Methods: Lectures, tutorials, laboratory sessions and computer assisted learning

Assessment Strategy: Continuous assessment and end of course unit practical and written examinations

Continuous Assessment 35%	Final Assessment 65%		
Details: Quizzes 10%, Assignments 10%, Computer assisted learning 5%, Laboratory reports 10%	Theory (%) 40%	Practical (%) 25%	Other (%) -

References/Reading Materials:

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

Semester	3		
Course Code	PLBL 21513		
Course Name	**Plant Physiology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	PLBL 12513		
Co-requisites	PLBL 21521		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	-	105 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, explain how terrestrial vascular plants acquire

and use the energy and material resources needed to complete their life cycle, highlighting relationships between structure and function.

Course content:
Water relations: water potential concept, cell and plant water relations, soil-plant-atmosphere continuum. Stomatal physiology. Photosynthesis: photochemistry and electron transport, photophosphorylation, carbon reduction cycle, C_3, C_4 and CAM pathways, photorespiration, prokaryotic photosynthesis, phloem transport, photosynthetic responses to light, carbon dioxide and temperature. Mineral nutrition: essential nutrients, mineral stresses, plant disorders, characteristics and mechanisms of solute absorption and transport, assimilation of mineral nutrients. Growth and development: phytohormones and growth inhibitors, hormone as a signal transducer, photoperiodism, photomorphogenesis, vernalization, plant movements, seed and bud dormancy, seed germination.

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

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

Continuous Assessment 35%	Final Assessment 65%		
Details: Quizzes 20%, Group assignments 15%	Theory (%) 65%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Hopkins, W.G. and Huener, N.P.A., 2008. *Introduction to Plant Physiology.* 4th edition. John Wiley & Sons.
2. Jayasekera, L.R., 2019. *Plant Physiology* Study Guide, University of Kelaniya.
3. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A., 2015. *Plant Physiology and Development*. 6th Edition, Sinauer Associates, Sunderland, CT.

Semester	3		
Course Code	PLBL 21521		
Course Name	**Plant Physiology Laboratory**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	PLBL 12521		
Co-requisites	PLBL 21513		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	45 hrs	05 hrs

Course Aim/Intended Learning Outcomes:
On successful completion of this course unit, the student should be able to, (i) describe the scientific method and how it would be applied to a novel problem, (ii) demonstrate essential understanding and basic skills needed in studying plant functions and (iii) demonstrate skills in writing a scientific report.

Course Content:
Preparation of aqueous solutions and buffers. Using the scientific method in laboratory experiments. Description of data using statistics. Determination of water potential and solute potential. Studies on membrane permeability. Measurement of transpiration. Stomatal movement. Separation of photosynthetic pigments. The Hill reaction. Acid accumulation of CAM plants. Shoot morphology and leaf anatomy in relation to photosynthetic efficiency: determination of leaf area, leaf dry weight and specific leaf area (SLA), measurement of stomatal conductance and irradiance levels at different heights. Demonstration of photosystem II activity. Differentiation between C_3 and C_4 plants by detection of starch. Mineral deficiency symptoms in plants. Hormonal action. Seed viability and germination tests.

Teaching/Learning Methods: Laboratory exercises supplemented with computer-assisted learning

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

Continuous Assessment 35%	Final Assessment 65%		
Details: Pre-lab quizzes 10%, Assignments 10%, Laboratory reports 15%	Theory (%) -	Practical (%) 65%	Other (%) -

References/Reading Materials:

1. Jayasekera, L.R., 2019. *Plant Physiology* Laboratory Manual. University of Kelaniya.
2. Lambers, H., Chapin III, F. S. and Pons, T. L., 2008. *Plant Physiological Ecology*. 2nd edition. Springer, New York.

Semester	3		
Course Code	PLBL 21531		
Course Name	**Biostatistics**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	-		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	10 hrs	15 hrs	25 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) formulate and test hypotheses, (ii) analyze and interpret data, (iii) recognize appropriate statistical test to be applied in a given research setting, (iv) apply statistical software for data analysis and (v) develop experimental design for research purposes.

Course Content:
Introduction to statistics and scientific method. Collecting data: Direct observation, surveys, sampling methods, experimental designs (Completely Randomized Design, Randomized Block Design, and Latin Square Design). Summarize, analyze and interpretation of data: Descriptive statistics (Frequency distribution, Graphical summary, Measures of central tendency and variation), Inferential statistics (Source of error, Hypothesis testing, t-test, Analysis of variance, Chi-square test, Correlation and regression). Use of software packages for data analysis (MINITAB).

Teaching /Learning Methods: Lectures, computer based laboratory sessions and tutorials

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

Continuous Assessment 40%	Final Assessment 60%		
Details: Assignments 40%	Theory (%) 20%	Practical (%) 40%	Other (%) -

References/Reading Materials:

1. Ott, R.L. and Longnecker, M.T., 2010. *An Introduction to Statistical Methods and Data Analysis*, 6th Edition. Brooks/Cole.
2. Quinn, G.P. and Keough, M.J., 2002. *Experimental Design and Data Analysis for Biologists*. Cambridge University Press.
3. Whitlock, M.C. and Schluter, D., 2014. *The Analysis of Biological Data*. 2nd Edition. W.H. Freeman.

Semester	3		
Course Code	PLBL 21541		
Course Name	**Fundamentals of Molecular Biology**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	BIOL 11522		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	15 hrs	10 hrs	25 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain the organization of the plant genome, (ii) compare and contrast prokaryotic and eukaryotic gene expression processes and (iii) explain the principles of basic molecular biological techniques.

Course content:
Plant genome. Structure and organization of eukaryotic chromosomes. Eukaryotic gene and gene expression: promoters, RNA polymerases, transcription, modification of primary transcript, complex transcription units, translation. Fundamentals of epigenetics. Techniques used for gene expression analysis. DNA and RNA sequencing.

Laboratory: Extraction of genomic DNA from plants. Determination of DNA quantity and quality. DNA denaturation and melting curves. Gel electrophoresis of DNA. Primer designing, Polymerase Chain Reaction (PCR) and its variants.

Teaching/Learning Methods: Lectures and assignments

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Assignments 20%, Laboratory reports 10%	Theory (%) 45%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P., 2014. *Molecular Biology of the Cell*. 6th Edition. Garland Science.
2. Brown, T.A., 2002. *Genomes*. John Wiley and Sons.

3. Brown, T.A., 2016. *Gene Cloning and DNA Analysis*. 7th Edition. Wiley-Blackwell.
4. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. and Lewin, B., 2014. *Lewin's Genes XI*. Jones & Bartlett.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P. 2012. *Molecular Cell Biology*. 7th Edition. W. H. Freeman.

Semester	4		
Course Code	PLBL 22554		
Course Name	**Plant Evolution, Diversity and Taxonomy**		
Credit Value	4		
Core/Optional	Core		
Pre-requisites	PLBL 12513		
Co-requisites	PLBL 22561		
Hourly Breakdown	Theory	Practical	Independent Learning
	60 hrs	-	140 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain evolutionary implications of different groups of algae, (ii) describe asexual and sexual reproduction of algae from evolutionary perspectives, (iii) understand how plants have evolved and differentiated into diverse group of plants and (iv) discuss novel trends in angiosperm taxonomy.

Course Content:
Biological classification and evolutionary relationships of eukaryotes. Diversity and evolutionary trends in algae and plant groups; non-vascular plants (bryophytes), vascular plants, spore bearing plants (pteridophytes), and seed plants (gymnosperms and angiosperms). Reproductive adaptations resulted in successful colonization in terrestrial habitats by seed plants. Basic concepts in plant taxonomy, systems of plant classification, current developments in plant classification, numerical taxonomy, APG system. Plant nomenclature.

Teaching /Learning Methods: Lectures, assignments, computer assisted learning and tutorials

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Group assignments 20%, Oral presentations 10%	Theory (%) 70%	Practical (%) -	Other (%) -

References/Reading Materials:
1. Evert, R.F. and Eichhorn, S.E., 2013. *Biology of Plants*. 8th Edition. W.H. Freeman.
2. Raven, P., Johnson, G.B., Mason, K.A., Losos J.B. and Singer, S.S., 2017. *Biology*. 11th Edition. McGraw-Hill.
3. Sahoo, D. and Seckbach, J., 2015. *The Algae World*. Springer, Netherlands.
4. Simpson, M., 2010. *Plant Systematics*. 2nd Edition. Elsevier Press.
5. Stuessy, T.F., 2009. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. 2nd Edition. Columbia University Press.
6. Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V. and Reece, J.B., 2016. *Campbell Biology*. 11th Edition. Pearson.
7. Walters, D.R., Keil, D.J. and Murrell, Z.E., 2006. *Vascular Plant Taxonomy*. 5th Edition. Kendal/ Hunt Publishing Company.

Semester	4		
Course Code	PLBL 22561		
Course Name	**Plant Evolution, Diversity and Taxonomy Laboratory**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	PLBL 12521		
Co-requisites	PLBL 22554		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	45 hrs	05 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) demonstrate skills in, interpreting evolutionary trends in algae, bryophytes, pteridophytes, gymnosperms and angiosperms using their characteristic features, (ii) develop skills in identification, characterization and interpretation of relationships in angiosperm families, (iii) carryout field exercises for collection of algae and/ or plant species, identification using diagnostic keys, prepare herbarium specimens and assess their diversity using software.

Course Content:
Identification and illustration of morphological features of reproductive and vegetative structures of algae, bryophytes, seedless vascular plants and seed plants. Diversity assessments of algae and/ or plants using Minitab software package.

Cronquist's system of classification, diagnostic features of tropical plant families, use and construction of diagnostic keys and multi-access keys, cluster analysis. Herbarium techniques.			
Teaching /Learning Methods: Laboratory sessions, field exercises and computer assisted learning			
Assessment Strategy: Continuous assessment and end of course unit practical examination			
Continuous Assessment 40%	Final Assessment 60%		
Details: Assignments 20%, Field visit report 10%, Laboratory reports 10%	Theory (%) -	Practical (%) 60%	Other (%) -

References/Reading Materials:

1. Evert, R.F. and Eichhorn, S.E., 2013. *Biology of Plants*. 8th Edition. W.H. Freeman.
2. Gray, L., 2011. *Flowering Plants: A Pictorial Guide to the World's Flora*. Chartwell Books.
3. Lee, R.E., 2018. *Phycology*. 5th Edition. Cambridge University Press.
4. Senanayake, S. P., 2019. *Kingdom Plantae*. Laboratory Manual.
5. Takhtajan, A., 2009. *Flowering Plants*. 2nd Edition. Springer, Netherlands.

Semester	4		
Course Code	PLBL 22573[2]		
Course Name	**Floristic Resources and Management**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	ENCM 11512 & ENCM 11522		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) explain richness and conservation of flora and crop wild relatives of Sri Lanka, (ii) discuss the significance and management of invasive flora, (iii) describe cropping systems and cultural practices used in sustainable organic agriculture and (iv) explain biological principles involved in organic agriculture.

Course Content:

Flora of Sri Lanka: floristic composition: endemic, exotic and indigenous flora and their uses. Relationships between floristic composition and climate. Conservational status and conservation methods of flora. Crop wild relatives and their potential uses. Exotic flora and invasive plants and their adverse impacts, management and potential uses.

Biological principles, and approaches used in production of bio fuels, bio fertilizer, green manure and agroforestry. Uses of botanicals, bio fuels, bio fertilizer, green manure, cover crops and organic solid waste in organic agriculture. Desired agronomic and cultural practices used for sustainable organic crop management.

Teaching/Learning Methods: Lectures, laboratory sessions, field exercises and assignments			
Assessment Strategy: Continuous assessment and end of course unit written and practical examination			
Continuous Assessment 35%	Final Assessment 65%		
Details: Field assignment reports 15%, Herbarium specimen preparation 10%, Reports 10%	Theory (%) 40 %	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Ashton, M., Gunatilleke, S., Zoyza, N., Dassanayake, M. D., Gunatilleke, N. and Wijesundera, S., 1997. *A Field Guide to the Common Trees and Shrubs of Sri Lanka*. Wildlife Heritage Trust.
2. Ferando, M., Wijesundara, S. and Ferando, S., 2003. *Orchids of Sri Lanka: a conservationist's companion*. IUNC, Sri Lanka.
3. Sharma, A.K., 2004. *A Handbook of Organic Farming*. Agrobios, India.
4. Vlas, J., 2008. *Illustrated filed guide to the flowers of Sri Lanka*. Mark booksellers, Kandy.
5. Wild, A., 1993. *Soils and the environment*. Cambridge University Press.

[2]Offered for ENCM programme.

Semester	4		
Course Code	PLBL 22583		
Course Name	**Plant Diversity[2]**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	ENCM 11512 & ENCM 11522		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	25 hrs	95 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain how plants have evolved and phylogenetic relationships among diverse groups of plants and (ii) demonstrate skills in identifying and distinguishing morphologically different groups of algae, bryophytes, pteridophytes, gymnosperms and angiosperms using their characteristic features.

Course Content:
Classification, origin and evolutionary relationships of algae and plants, green alga as common ancestor of plants. Identification and illustration of morphological features of reproductive and vegetative structures of algae, bryophytes, seedless vascular plants and seed plants. Plants as pioneers of the terrestrial environment. Diversity assessments of algae using Minitab software package.

Teaching/Learning Methods: Lectures, laboratory and field exercises, assignments, computer assisted learning and tutorials

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

Continuous Assessment 40%	Final Assessment 60%		
Details: Group assignments 20%, Oral presentations 10%, Field visit report 10%	Theory (%) 50%	Practical (%) 10%	Other (%) -

References/Reading Materials:

1. Evert, R.F. and Eichhorn, S.E., 2013. *Biology of Plants*. 8th Edition. W.H. Freeman.
2. Lee, R.E., 2018. *Phycology*. 5th Edition. Cambridge University Press.
3. Raven, P., Johnson, G.B., Mason, K.A., Losos J.B. and Singer, S.S., 2017. *Biology*. 11th Edition. McGraw-Hill.
4. Sahoo, D. and Seckbach, J., 2015. *The Algae World*. Springer, Netherlands.
5. Senanayake, S. P., 2019. *Kingdom Plantae*. Laboratory Manual.
6. Simpson, M., 2010. *Plant Systematics*. 2nd Edition. Elsevier Press.
7. Stuessy, T.F., 2009. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*. 2nd Edition. Columbia University Press.
8. Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V. and Reece, J.B., 2016. *Campbell Biology*. 11th Edition. Pearson.
9. Walters, D.R., Keil, D.J. and Murrell, Z.E., 2006. *Vascular Plant Taxonomy*. 5th Edition. Kendal/ Hunt Publishing Company.

[2]Offered for ENCM programme.

Semester	5		
Course Code	PLBL 31514		
Course Name	**Ecology and Environmental Resources Management**		
Credit Value	4		
Core/Optional	Core		
Pre-requisites	PLBL 22554		
Co-requisites	PLBL 31521		
Hourly Breakdown	Theory	Practical	Independent Learning
	60 hrs	-	140 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, demonstrate critical analytical skills of ecological interactions, impact of human activities on them and modern technology available to manage environmental resources.

Course Content:
Biosphere: biomes and ecosystems. Ecosystem components: soil formation, properties and biological processes in soil, soils of Sri Lanka. Soil conservation. Plant population ecology, growth characteristics and regulation. Plant community ecology, concept of niche, community composition, patterns in space and time, primary and secondary production, decomposition, energy flow, flux of matter. Tropical rain forest and wetland ecology. Global biogeochemical cycles. Quantitative methods of vegetation analyses: structure assessments and sampling procedures. Vegetation types in Sri Lanka.

Development and environmental degradation, climate change and implications. Principles of environmental management, current practices: protected areas for species/ biodiversity conservation, biomanipulation, ecosystem restoration,

Environmental Impact Assessments and Environmental Protection Licensing. Geographical Information Systems (GIS) as a tool for environmental management.			
Teaching /Learning Methods: Lectures, computer-assisted learning, lecture guides, audio-visual presentations 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. Anderson, J. M., 1981. *Ecology for Environmental Science*. Edward Arnold.
2. Central Environmental Authority. 1995. Man and Environment, CEA, Colombo.
3. Cotgreave, P. and Forseth, I., 2002. *Introductory Ecology*. Blackwell Science Ltd., UK
4. Ewusie, J.Y., 1980. *Elements of Tropical Ecology*. Heinemann Educational Books.
5. Krebs, Charles J., 1999. *Ecological Methodology*. Addison-Welsy Publishers, USA.
6. Lo, C.P. and Yeung, L.K.W., 2002. *Concepts and Techniques of GIS*. Prentice Hall, New Delhi.
7. Morgan, R.P.C., 2005. *Soil Erosion and Conservation*. 3rd Edition. Blackwell Science Ltd., UK
8. Morris, P. (Ed.) 2001. *Methods of Environmental Impact Assessment*. 2nd Edition. Spon Press, London.
9. Newman, E.I., 2006. *Applied Ecology and Environmental Management*. Blackwell Science Ltd., UK
10. Osborne, P.L., 2000. *Tropical Ecosystems and Ecological Concepts*. Press Syndicate of the University of Cambridge, UK.
11. Schuurman, N. 2006. *GIS: A Short Introduction*. Blackwell Publishing.

Semester	5		
Course Code	PLBL 31521		
Course Name	**Ecology and Environmental Resources Management Laboratory**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	PLBL 22561		
Co-requisites	PLBL 31514		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	45 hrs	05 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) demonstrate skills on gathering, analysis, interpretation and presentation of ecological data and information, required for environmental assessment, (ii) describe ecological data using statistics and (iii) demonstrate skills on using GIS as a tool in environmental management.

Course Content:

Determination of pH, water status, porosity, organic matter content, cation exchange capacity, PO_4^{3-} and NO_3^- concentration of soil. Identification of species of aquatic, xerophytic, sea shore, salt marsh and mangrove and forest ecosystems of Sri Lanka and their ecological adaptations. Measurement of water quality. Use of quadrat and plotless sampling methods to determine the vegetation structure of grasslands and forests, use of biodiversity and habitat evaluation systems for environmental resources management. Use of GIS in identification of environmental impacts of development activities.

Teaching /Learning Methods: Laboratory and field exercises, presentations, group exercises on GIS application			
Assessment Strategy: Continuous assessment and end of course unit practical examination			
Continuous Assessment 30%	Final Assessment 70%		
Details: Assignments 10%, Laboratory reports 05%, Field visit report 15%	Theory (%) -	Practical (%) 70%	Other (%) -

References/Reading Materials:

1. Amarasinghe, M., 2001. *Laboratory Manual on 'Vegetation Sampling Methods'*. Department of Botany, University of Kelaniya.
2. Brower, J.E., Zar, J.H. and Ende, C.N., 1990. *Field and Laboratory Methods for General Ecology*, 4th Edition. NCB McGraw-Hill.
3. Henderson, P.A., 2004. *Practical Methods in Ecology*. Blackwell Science Ltd., UK.
4. Lo, C.P. and Yeung, L.K.W., 2002. *Concepts and Techniques of GIS*. Prentice Hall, New Delhi.

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:
Upon successful completion of this course unit, the student should be able to, (i) demonstrate knowledge and understanding of a selected science based area of industrial/ agricultural relevance, and / or concepts of entrepreneurship and (ii) 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	Final Assessment		
-	100%		
Details: -	Theory (%) -	Practical (%) -	Other (%) Trainer's report 30%, Trainee's report 50%, Diary 10%, Oral presentation 10%

References/Reading Materials:
Reading and reference materials recommended/ provided by the relevant industry.

Semester	6		
Course Code	PLBL 32533[3]		
Course Name	**Plant Pathology and Post-Harvest Technology**		
Credit Value	3		
Core/Optional	Optional		
Pre-requisites	PLBL 21513		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	30 hrs	90 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe the basic concepts of mechanisms of plant-pathogen interactions, (ii) explain the mode of infection of post- harvest diseases and (iii) diagnose a plant disease and explain management strategies to control diseases in local crops.

Course Content:
Plant Pathology: Disease triangle. Compatible and incompatible plant-pathogen interactions**.** Disease cycle**:** pathogen inoculation, penetration, pathogenicity determinants, survival and dissemination. Host defense mechanisms. Diseases in economically important local crops. Disease epidemiology. Plant disease management and potential for disease management using bio-control agents. *Post-Harvest Technology*: Post-harvest diseases in Sri Lanka, and mode of infection. Post-harvest treatments to reduce and prevent post-harvest diseases.

Laboratory: Disease symptoms and diseases in crops in Sri Lanka, Koch's postulates, Estimation of Disease incidence, Effect of Fungicides, Biological control of plant pathogens, Post-harvest diseases of fruits and vegetables and their management.

Teaching /Learning Methods: Lectures, laboratory exercises, field visits, oral presentations, computer assisted learning and problem based learning

Assessment Strategy: Continuous assessment and end of course unit written and practical examinations

Continuous Assessment	Final Assessment		
35%	65%		
Details**:** Laboratory reports 05%, Field visit report 10%, Oral presentations 10%, Group project 10%	Theory **(%)** 40%	Practical **(%)** 25%	Other **(%)** -

References/Reading Materials:

1. Abeywickrama, K., 2006. *Pictorial guide to rapid and accurate identification of post-harvest diseases in fruits*. Godage International Publishers.
2. Acquaah, G., 2009. *Horticulture: Principles and Practices*. PHI Learning (Pvt. Ltd), New Delhi.
3. Agrios, G.N., 2005. *Plant Pathology*. 5th Edition. Academic Press.
4. Sambamurty, A.V.S.S., 2009. *A Textbook of Plant Pathology*. I. K. International Publishing House Pvt. Ltd.
5. Schumann, G.L. and D'Arcy, C.J., 2009. *Essential Plant Pathology*. 2nd Edition. APS Press.

[3]Compulsory for BSc Honours (Plant Biology).

Semester	6		
Course Code	PLBL 32542[3]		
Course Name	**Recombinant DNA Technology and Tissue Culture**		
Credit Value	2		
Core/Optional	Optional		
Pre-requisites	PLBL 21541		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	20 hrs	25 hrs	55 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) explain the principles of the techniques used in recombinant DNA technology and their applications in crop improvement and (ii) demonstrate skills in *in vitro* culture of plant tissues.

Course content:

Recombinant DNA Technology: DNA manipulative enzymes. DNA cloning and cloning vectors. DNA libraries and library screening. Ti plasmid, vectors derived from Ti plasmid and *Agrobacterium* mediated gene transfer into plant cells. Other methods used to transfer genes into plant cells. Analysis of transgenic plants. Transgenic plants with improved agricultural and horticultural values. Safety aspects of genetically modified crops. Marker genes. Introduction to antisense RNA technology and its application in plant genetic engineering. *Recombinant DNA Technology Laboratory*: Extraction of genomic and plasmid DNA from bacteria. Restriction digestion and restriction mapping. DNA ligation, Transformation of DNA into bacteria and selection of transformants. DNA sequence analysis and introduction to bioinformatics.

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

Teaching/Learning Methods: Lectures, laboratory sessions and tutorials

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Assignments 20%, Laboratory reports 10%	Theory (%) 45%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Brown, T.A., 2016. *Gene Cloning and DNA Analysis*. 7th Edition. Wiley-Blackwell.
2. Dodds, J.H. and Roberts, L.W., 2004. *Experiments in Plant Tissue Culture*. Cambridge University.
3. Green, M.R. and Sambrook, J., 2012. *Molecular Cloning: A Laboratory Manual* 4th Edition. Cold Spring Harbor Laboratory Press.
4. Griffiths, A.J.F., Wessler S.R., Carroll, S.B. and Doebley, J., 2010. *An Introduction to Genetic Analysis*. 10th Edition. WH Freeman.

[3]Compulsory for BSc Honours (Plant Biology).

Semester	6		
Course Code	PLBL 32552[3]		
Course Name	**Horticulture**		
Credit Value	2		
Core/Optional	Optional		
Pre-requisites	PLBL 21513		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	20 hrs	30 hrs	50 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe the concepts of horticul tural principles and practices, (ii) apply skills in growing and managing horticultural crops, (iii) demonstrate skills required in modern horticultural and landscaping practices and (iv) inculcate team working skills.

Course Content:
Introduction to horticulture: Divisions of horticulture, importance and future scope. Propagation of horticultural plants: Principles and practices of sexual and asexual (vegetative) propagation methods, Micro cutting technique for rapid rooting and mass propagation, Horticultural crop production and factors affecting horticultural production. Maintenance of vegetable plot. Growing plants indoors, Protected cultivation of crops, Hydroponic cultivation methods. Cultivation of mushrooms. Seeds in horticulture, Soil nutrient monitoring and fertilizer applications, Composting. Diagnosing and treating plant diseases. *In situ* identification of insects and insect disorders in horticultural crops. Irrigation methods for horticultural crops. Breeding of horticultural plants. Applications of biotechnology in horticulture. Landscape designing and maintenance. National horticultural products: Survey of the local trade and production of horticultural foods, herbs, spices, floricultural crops, and landscape plants, Important export and import crops, Legal and environmental issues.

Teaching /Learning Methods: Lectures, laboratory sessions, field exercises, tutorials, interactive discussions, field visits, individual assignments and review of research articles

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

Continuous Assessment 35%	Final Assessment 65%		
Details: Assignment reports and oral presentation 15%, Field visit report 10%, Laboratory reports 10%	Theory (%) 40%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Adams, C.R., Bamford, K.M. and Early, M.P., 2008. *Principles of Horticulture*, 5th Edition, Elsevier.
2. Peter, K.V., 2013. *Biotechnology in Horticulture: Methods and Applications*. New India Publishing Agency.
3. Singh, D. K. and Peter, K. V., 2013. *Protected Cultivation of Horticultural Crops*. New India Publishing Agency.
4. Waterman, T., 2009. *The Fundamentals of Landscape Architecture*. AVA Publishing.

[3]Compulsory for BSc Honours (Plant Biology).

Semester	5		
Course Code	PLBL 41763		
Course Name	**Plant Physiology and Biochemistry**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain physiological changes that take place in extreme environments, (ii) discuss the genetic basis of abiotic stress response, (iii) describe the effect of light on plant development and (iv) explain plant metabolic regulation.

Course Content:
Plant Stress Physiology: Stress concepts. Perception of stress, signal transduction and stress responses. Stress responsive genes. Water stress, salt stress, solar radiation stress, temperature stress and nutrient acquisition from toxic or extreme soils. Stress resistance of photosynthetic machinery. Assessing stress responses in plants and crop improvement for stress resistance. *Photomorphogenesis*: Photoreceptors, red and blue light responses of plants.

Plant Biochemistry: Metabolism: metabolic fuel and regulation. Lipid metabolism and regulation: β oxidation, fatty acid synthesis. Pathways and regulation of gluconeogenesis, pentose phosphate pathway, cyanide -resistant respiration. Secondary metabolites and plant defense. Enzymology: enzyme kinetics, isozymes, isoforms of enzymes, allosteric enzymes and regulation of enzyme activity.

Teaching/Learning Methods: Lectures, tutorials and practical assignment

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

Continuous Assessment 40%	Final Assessment 60%		
Details: Practical assignments 40%	Theory (%) 60%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Lambers, H., Chapin, F.S. and Pons, T.L., 2008. *Plant Physiological Ecology*. 2nd edition. Springer Publishers, New York.
2. Moran, L.A. Horton, H. R., Scrimgeour, K.G. and Perry, M.D., 2012. *Principles of Biochemistry*. Pearson Education, Inc., Illinois.
3. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A., 2015. *Plant Physiology and Development*. 6th Edition, Sinauer Associates, Sunderland, CT.

Semester	5		
Course Code	PLBL 41773		
Course Name	**Plant Breeding**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe floral biology, natural and controlled pollination and phenology in relation to pollination, (ii) explain methods of plant breeding and use of molecular tools in crop improvement and (iii) interpret recent research findings in plant breeding.

Course Content:
Objective and requirements of crop improvement. Genetic aspects of plant breeding, male sterility, self-incompatibility and heritability of traits in plants. Inbreeding depression. Pollination syndromes of plants in relation to pollination. Natural pollination control mechanisms. Floral biology in relation to pollination. Mating systems of plants. Main plant breeding methods for cross pollinating and self-pollinating crop plants. Application of molecular techniques in plant breeding.

Teaching /Learning Methods: Lectures, tutorials, field exercises, report writing on selected topics, practical assignments and computer assisted learning

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

Continuous Assessment	Final Assessment		
35%	65%		
Details: Field assignment reports 10%, Online presentations 10%, Reports 10%, Research paper based assignments 5%	Theory (%)	Practical (%)	Other (%)
	65%	-	-

References/Reading Materials:

1. Acquaah, G., 2007. *Principles of Plant Genetics and Breeding*. Blackwell Publishing.
2. Bernardo, R., 2014. *Breeding for quantitative traits in plants.* Stemma Press, Woodbury, Minnesota.
3. Bernardo, R., 2014. *Essentials of Plant Breeding.* Stemma Press, Woodbury, Minnesota.
4. Related review and research articles

Semester	6		
Course Code	PLBL 42783		
Course Name	**Molecular and Microbial Genetics**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) compare and contrast different transcriptional regulatory mechanisms in bacteria, (ii) critically review genetic aspects of bacteriophage life cycles, transposition and mutagenesis and (iii) describe the use of microbial genetic components in construction of cloning vectors and their applications.

Course Content:
Eukaryotic gene expression regulation: purposes and general principles. Bacterial gene expression regulation: transcriptional regulation, alternative sigma factors, negative and positive regulation, induction and repression, lactose operon, tryptophan operon. Molecular basis of transformation and conjugation. Use of conjugation for strain construction and genome mapping. Life cycles of bacteriophages. Genetic regulation in bacteriophage Lambda. General and specialized transduction. DNA damage and repair mechanisms in bacteria. Transposable elements. Use of microbial genetic components in construction of cloning vectors and their applications in recombinant DNA technology: bacteriophages, cosmids, bacterial artificial chromosomes, yeast artificial chromosomes, Ti plasmid.

Teaching /Learning Methods: Lectures and assignments

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

Continuous Assessment	Final Assessment		
30%	70%		
Details: Assignments reports 15%, Oral presentations 15%	Theory (%)	Practical (%)	Other (%)
	70%	-	-

References/Reading Materials:

1. Green, M. R. and Sambrook, J., 2012. *Molecular Cloning: A Laboratory Manual* 4th Edition. Cold Spring Harbor Laboratory Press.
2. Griffiths, A. J. F., Wessler S. R., Carroll, S. B. and Doebley, J., 2010. *An Introduction to Genetic Analysis*. 10th 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. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M. P., 2012. *Molecular Cell Biology*. 7th Edition. W. H. Freeman.
5. Snyder, L., Peters, J. E., Henkin, T. M., and Champness, W., 2013. *Molecular Genetics of Bacteria*. 4th Edition, ASM press, USA.

Semester	6		
Course Code	PLBL 42793		
Course Name	**Bioethics**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) discuss theories and methods in ethics and research ethics (ii) identify, define and analyze ethical issues in the context of novel and potentially problematic areas; and (iii) review and analyze conceptual-logical system, which helps them to address ethical questions and to resolve ethical dilemmas in an efficient way.

Course Content:
Introduction to ethics: Overview of theories and methods in ethics. History of research ethics: Background, landmark cases in research ethics. Environment and ethics: ethical reasons for concern, consequentialism, virtue ethics, kantianism. Deep ecology, Ecofeminism. Biosafety. Sri Lankan biodiversity. Ethical issues in biological research: Criteria and principles, authorship, plagiarism, peer review, informed consent in research, scientific misconduct and fraud, conflict of interest, cases and procedures for establishing misconduct, preventions and sanctions, responsibility for research and the results, limits of responsibility, risks and the precautionary principle, ethical vetting of research. Research ethics committees.

Teaching /Learning Methods: Interactive lectures, essays and reviews, case studies, presentations and debates

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Movie review 05%, Case study 05%, Presentations 10%, Critical review 5%, Debate 5%	Theory (%) 70%	Practical (%) -	Other (%) -

References/Reading Materials:
1. Bouregy, S., Grigorenko, E. L., Latham, S. R. and Tan, M., 2017. *Genetics, Ethics and Education*. Cambridge University Press.
2. Budinger, T. F. and Budinger, M. D., 2006. *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*. 1st Edition. Wiley.
3. Emanuel, E., Crouch, R., Arras, J., Moreno, J. and Grady, C., 2003. *Ethical and Regulatory Aspects of Clinical Research: Readings and Commentary.* Johns Hopkins University Press.
4. European Commission Directorate-General for Research. 2010. *European Textbook on Ethics in Research*. Luxembourg.
5. Gert, B., 2006. *Bioethics: A systematic approach*. 2nd Edition. Oxford University Press.
6. Jamieson, D., 2008. *Ethics and the Environment*. 1st Edition, Cambridge University Press.
7. Veatch, R. M., 2012. *The Basics of Bioethics.* 3rd Edition. Prentice-Hall Press.
8. Wiles, R., 2012. *What are Qualitative Research Ethics?* 1st Edition. Bloomsbury Academic press.
9. Other reading materials and audios/videos provided by the lecturer

Semester	7		
Course Code	PLBL 41804		
Course Name	**Plant Systematics and Bioinformatics**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	30 hrs	125 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) recognize different taxonomic sources, (ii) analyze taxonomic information, and (iii) apply knowledge of bioinformatics in the field of plant systematics; perform sequence analysis using bioinformatic tools, describe principles and algorithms of pairwise and multiple alignments, sequence database searching, construct phylogenetic trees with molecular data sets and interpret evolutionary relationships.

Course Content:
Classification of Angiosperms, Angiosperm Phylogeny Group (APG). Numerical taxonomy: cluster analysis, phenetics and cladistics, definitions and concepts, character selection, symplesiomorphies and synapormorphies, parsimony method. Sources of taxonomic information: structural, chemical, chromosomal, geographical and ecological information. Evolution, variation and biosystematics. Plant nomenclature: type specimens, author citations, rule of priority. Presentation of data: monographs, Floras and revisions.

Introduction to bioinformatics: Biological databases, application domains, web based software, command-line software, programming for bioinformatics. Sequence analysis: DNA, RNA and protein sequence analysis. Sequence alignment: Pairwise sequence alignment, database similarity searching, multiple sequence alignment algorithms, Hidden Markov Models Alignment. Molecular phylogenetics: Phylogenetics basics, phylogenetic tree construction methods and programs, interpretation. Protein structure basics and structure prediction; Genomics: assembly and annotation; Analysis of qPCR data, next generation sequences, metagenomics and microarray data.

Teaching /Learning Methods: Lectures, tutorials, presentations, practical assignments, and group projects

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Assignments 10%, Presentations 10%, Group project 10%	Theory (%) 70%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Forman, L. and Bridson, D., 2010. *The Herbarium Handbook*. 3rd Edition. Royal Botanic Gardens, Kew.
2. Judd, W. S., Campbell, C. S., Kellog, E. A., Stevens, P. F. and Donoghue, M. J., 2007. *Plant Systematics: A Phylogenetic Approach*. 3rd Edition. Sinauer Associates, Inc.
3. Lemey, P., Salemi, M. and Vandamme, A., 2009. *The Phylogenetic Handbook: A Practical Approach to Phylogenetic Analysis and Hypothesis Testing*. 2nd Edition. Cambridge University Press.
4. Manly, B. F. J., 2004. *Multivariate Statistical Methods: A Primer*. 3rd Edition. Chapman and Hall/CRC London.
5. Mount, D. W., 2004. *Bioinformatics: Sequence and genome analysis*. 2nd Edition. Cold Spring Harbor Laboratory Press.
6. Podani, J., 2000. *Introduction to the Exploration of Multivariate Biological Data*. Backhuys Publishers.
7. Ramsden, J., 2015. *Bioinformatics: An Introduction*. 3rd Edition. Springer-Verlag London.
8. Simpson, M., 2010. *Plant Systematics*. 2nd Edition. Elsevier Press.
9. Xiong, J., 2006. *Essential Bioinformatics*. 1st Edition. Cambridge University Press.
10. Zvelebil, M. and Baum, J. O., 2007. *Understanding Bioinformatics*. 1st Edition. Garland Science NY.

Semester	7		
Course Code	PLBL 41814		
Course Name	**Bioprospecting**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	125 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, describe botanical aspects of economically important plants and the potential of plant-based industries.

Course Content:
Botany of economically important plants, domestication of crops, bio geography of selected crop plants. Crop quality improvement. Plant-based industries: Pharmaceuticals, food and beverages, cosmetics, insecticides and pesticides.

Teaching /Learning Methods: Lectures, tutorials, practical assignments, group projects, presentations and visits to research institutes

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

Continuous Assessment 40%	Final Assessment 60%		
Details: Assignment 20%, Project reports 10%, Presentations 10%	Theory (%) 60%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Kaufman, P. B., Cseke, L. J., Warber, S., Duke, J. A. and Brielmann, H. L., 1999. *Natural Products from Plants.* CRC Press, London.
2. Simpson, B. B. and Ogorzaly, M. C., 2000. *Economic Botany*. McGraw-Hill.

Semester	7		
Course Code	PLBL 41823		
Course Name	**Food and Industrial Microbiology**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	30 hrs	75 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) distinguish between the food-borne intoxications and food infections, (ii) describe principles of food preservation and aseptic procedures adopted in industrial food production, (iii) describe manufacturing and treatment processes in industry where microorganisms are involved and (iv) develop skills in problem-based learning, communication and information usage.

Course Content:
Microbial spoilage of food, food-borne intoxications. Food-borne illnesses. Principles and processes of food preservation. Industrial Microbiology: Dairy microbiology and production processes. Fruit processing Industry. Fermented non-alcoholic foods. Probiotics their mechanism action, benefits and production process. Principles of microbial food fermentation and manufacturing process of alcoholic beverages. Chemical applications of microbiology: Phyto-chemistry and medicinal uses, synthesis of plant-based pharmaceuticals and antibiotics, amino acids and solvent formation using microorganisms. Water treatment, sewage treatment and disposal. Principles and procedures of cleaning and sanitation in industry, identification and control of hazards using Hazard Analysis Critical Control Point (HACCP).

Teaching /Learning Methods: Lectures, tutorials, seminars, practical assignments, industry visits, problem based Learning

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

Continuous Assessment	Final Assessment		
30%	70 %		
Details: Assignment reports 10%, Field visit 10%, Presentations 10%	Theory (%)	Practical (%)	Other (%)
	70%	-	-

References/Reading Materials:

1. Bokulich N. A. and Bamforth, C. W., 2017. *Brewing Microbiology: Current research, Omics and Microbial Ecology*. Caister Academic Press, UK.
2. Fuller, R., 2012. *Probiotics 2: Applications and Practical Aspects*. Springer Science & Business Media, UK.
3. Jay, J. M., Loessner, J. M. and Golden, D. A., 2006. *Modern Food Microbiology*. 7th Edition. Springer Science+Business media Inc.
4. Sánchez, S. and Demain, A. L. (Eds.), 2015. *Antibiotics: Current Innovations and Future Trends*. Caister Academic Press, UK.

Semester	7		
Course Code	PLBL 41833		
Course Name	**Forest Management and Soil Nutrient Dynamics**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain the forestry practices, (ii) identify the utility of forest products, and conservation of forest resources, (iii) describe use of agroforestry and community forestry in rehabilitation of abandoned land, (iv) explain ecological disturbances and forest regeneration, (v) explain the process of nutrient cycling in terrestrial ecosystems with emphasis on the role of microorganisms and soil fauna and (vi) explain how anthropogenic activities affect soil quality and microbial diversity.

Course Content:
Status of forests in Asia. Forestry policy, principles of sustainable forestry and current forestry practices in Sri Lanka. Ecological disturbance, natural regeneration, restoration of degraded ecosystems. Principles of silvicultural management. Seed biology, nursery growth and harvesting. Agroforestry, community forestry. Non-wood forest products, timber and timber processing and preservation. Environmental impacts in human disturbed forests. Conservation strategies of selected plants.

Litter input, accumulation and organic matter turnover in relation to the role of fungi and bacteria in the decomposition processes in forest ecosystems. Life supporting ecological interactions in soil, and methods of studying nutrient cycling. Impact of anthropogenic activities on soil quality, microbial community and decomposition process. Effects of forest fire on soil physico-chemical and biological properties.

Teaching /Learning Methods: Lectures, tutorials, practical assignments, field assignments, computer assisted learning

Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 35%	Final Assessment 65%		
Details: Field visit reports 15%, Practical assignment 15%, CAL based assignments 5%	Theory (%) 65%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Poffenberger, M. (ed.). 2000. *Communities and Forest Management in South Asia*, IUCN, Switzerland.
2. Richard B., 2005. *The Biology of Soil*. Oxford University Press.
3. Richards, P.W., 1996. *The Tropical Rain Forest*, 2nd edition. Cambridge University Press.
4. Schinner F., Öhlinger, R., Kandeler, E. and Margesin, R., 1996. *Methods in Soil Biology*. Springer-Verlag.
5. Whitmore, T.C. 1998. *An Introduction to Tropical Rain Forests*. Oxford University Press.

Semester	7		
Course Code	PLBL 41844		
Course Name	**Fungi in Ecosystem Processes**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	125 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) critically discuss the potential of fungi as biocontrol agents, (ii) explain the strategies adopted by fungi for improvement of forest and crop cultivations, (iii) develop skills in formulation and stabilization of fungi for commercial utilization and (iv) inculcate team working skills.

Course Content:

Fungal growth. Nutrient requirement and metabolism. Fungal interactions and their applications as biocontrol agents. Sustainable aspects of fungi in agriculture, their cultivation and conservation strategies. Advanced bioconversion technologies of fungi and modern biotechnological interventions. Formulation and stabilization of potential fungal biocontrol agents and their commercial products. Fungal endophytes and symbionts for improvement of forest and crop cultivations. Industrial utilization of fungal enzymes.

Teaching /Learning Methods: Lectures, tutorials, practical assignments, field assignments, problem based learning and presentations

Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 30%	Final Assessment 70%		
Details: Field visit assignments 5%, practical reports 5%, Problem based learning 10%, Presentations 10%	Theory (%) 70 %	Practical (%) -	Other (%) -

References/Reading Materials:

1. Buft, T. M., Jackson, C. W. and Magan, N., 2001. *Fungi as Biocontrol Agents*. CABI Publishers.
2. Deacon, J., 2004. *Fungal Biology*. 4th Edition. Blackwell Science.
3. Esser, K., 2007. *The Mycota*. Springer-Verlag, New York.
4. Gehlot, G. and Singh, J., 2018. *Fungi and their role in sustainable development; current perspectives*. Springer.

Semester	8		
Course Code	PLBL 42853		
Course Name	**Ecology of Sustainability**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, analyze ecological patterns and propose sustainable solutions for ecological and developmental issues.

Course Content:

Life-supporting ecological interactions, functions and services, physical and functional structure of ecosystems, their measurement, factors affecting food web structure and community/ecosystem stability, plant diversity within area, alpha, beta and gamma diversity, keystone species, functional diversity, magnitude and assessment of plant diversity, optimizing material usage and minimizing ecological impact of human activities to levels that natural systems can sustain (Green revolution vs. "ecological farming"). Industrial designs as living systems interdependent with nature, fundamentals of 'Ecological Foot Printing'.

Teaching /Learning Methods: Lectures, field visits, practical assignments, computer assisted learning			
Assessment Strategy: Continuous assessment and end of the course unit written and practical examinations			
Continuous Assessment 10%	Final Assessment 90%		
Details: Assignment reports 10%	Theory (%) 70%	Practical (%) 20%	Other -

References/Reading Materials:

1. Begon, M., Herper, J. L. and Townsend, C. R., 1990. *Ecology*, 3rd Edition, Blackwell Science.
2. Bormann, F. H. and Keliert, S. R., 1991. *Ecology, Economics and Ethics*. Yale University.
3. Chambers, N., Simmons, C. and Wackernagel, M., 2000. *Sharing Nature's Interest*. Earthscan Publishers.
4. Heywood, V. H. (ed)., 1995. *Global Biodiversity Assessment*, UNEP.
5. Krebs, C. J., 1999. *Ecological Methodology*. Addison-Welsy Publishers, USA.
6. National Science Foundation, 2000. *Natural Resources of Sri Lanka*.
7. Osborne, P. L., 2000. *Tropical Ecosystems and Ecological Concepts*. Press Syndicate of the University of Cambridge, UK.
8. Snedaker, S. C. and Snedaker, J. G., 1984. *Mangrove Ecosystem; Research methods*. UNESCO.

Semester	8		
Course Code	PLBL 42863		
Course Name	**Bioremediation**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) describe concepts of bioremediation process and strategies of biodegradation, (ii) explain the use of fungi, bacteria and plants in remediating contaminated sites, (iii) calculate the rates of biodegradation process and inputs for phytoremediation and (iv) inculcate team working skills.

Course Content:

Fundamental concepts and principles of bioremediation. Factors of bioremediation: microbial population capable of degrading pollutants, availability of contaminants to microbial population, environment factors and nutrients. Bioremediation strategies: *in situ* bioremediation (bioventing, biodegradation, biosparging, bioaugmentation), *ex situ* bioremediation (land farming, composting, biopiles, bioreactors). Application of microorganisms (bacteria, fungi, microalgae) in bioremediation.

Concepts of phytoremediation. Hyper accumulators. Bio-availability for uptake. Site evaluation for phytoremediation and site cleanup. Factors affecting contaminant biodegradability. Mechanisms of phytoremediation: Phytoremediation techniques: phytoextraction, rhizofiltration, phytostabilization, phytotrasformation, phytostimulation, phytovolatalization, constructed wetlands and engineered phytoremediation, merits and demerits of phytoremediation methods. Site evaluation and guidelines for site remediation. Applications, limitations, advantages, disadvantages and issues related to phytoremediation. Designing proposals on applications of bioremediation through team activities. Ethical, environmental, societal and safety issues related to bioremediation.

Teaching /Learning Methods: Lectures, laboratory sessions, case studies, tutorials			
Assessment Strategy: Continuous assessment and end of course unit written and practical examination			
Continuous Assessment 35%	Final Assessment 65%		
Details: Quizzes and assignment 15%, Laboratory reports 10%, Reports on case studies and presentations 10%	Theory (%) 40%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Bauddh, K., Singh, B. and Korstad, J. (Eds.)., 2017. *Phytoremediation Potential of Bioenergy Plants*. Springer.
2. Das, S., 2014. *Microbial Biodegradation and Bioremediation*. Elsevier.
3. Varjani, S. J., Gnansounou, E., Gurunathan, B., Pant, D. and Zakaria, Z. A. (Eds.). 2018. *Waste Bioremediation*. Springer.
4. Wackett, L. P. and Hershberger, C. D., 2001. *Biocatalysis and Biodegradation: Microbial Transformation of Organic Compounds*. ASM Press.

Semester	7 and 8		
Course Code	PLBL 43872		
Course Name	**Field Botany**		
Credit Value	2		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	05 hrs	60 hrs	35 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) conduct botanical field work, (ii) demonstrate skills in techniques of plant collection and preparation of herbarium specimens, (iii) develop skills in characterization of plants and field identification, (iv) use diagnostic keys for plant identification, and (v) use and develop databases on plant diversity.

Course Content:
Identification of flowering plants using diagnostic keys and construction of diagnostic keys; multi-access keys. Plant family concepts related to identification. Herbarium techniques.

Teaching /Learning Methods: Field exercises, assignments and mini projects

Assessment Strategy: Reports, presentations and plant collections

Continuous Assessment 100 %	Final Assessment -		
Details: Database preparation 25%, Presentations 25%, Herbarium specimens 50%	Theory (%) -	Practical (%) -	Other (%) -

References/Reading Materials:
Forman, L. and Bridson, D. (eds)., 1989. *The Herbarium Handbook*. Royal Botanic Gardens, Kew.

Semester	6 and 7		
Course Code	PLBL 43882		
Course Name	**Term Paper and Presentation**		
Credit Value	2		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	05 hrs	-	95 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, de monstrate the ability for critical, self-directed learning, and skills in oral and written scientific communication.

Course Content:
Systematic review and critical evaluation of research papers, reviews and text books. Different modes in effective scientific communication.

Teaching /Learning Methods:
Survey of literature related to a prescribed topic and subsequent presentation in written and oral form.

Assessment Strategy: Seminar, two written papers and oral presentations on topics related to sub disciplines of Plant Biology.

Continuous Assessment -	Final Assessment 100%		
Details: -	Theory (%) -	Practical (%) -	Other (%) Written paper 50%, Oral presentation 50%

References/Reading Materials:
References related to prescribed seminar and term paper topics.

Semester	7 and 8		
Course Code	PLBL 43898		
Course Name	**Research Project - Dissertation**		
Credit Value	8		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	-	800 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to demonstrate competence in (i) planning and carrying out a research project scientifically, (ii) presenting the research in the form of a dissertation, and (iii) defending the work carried out and outcomes.

Course Content:
Research related to sub disciplines of the Plant Biology curriculum.

Teaching /Learning Methods:
A 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, 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. Alley, M., 2018. *The Craft of Scientific Writing*. 4th Edition. Springer Science & Business Media.
2. Katz, M.J., 2009. From research to manuscript: A guide to scientific writing. Springer Science & Business Media.
3. Reference material relevant to each research topic.

Course unit contents – Molecular Biology and Plant Biotechnology (MBBT)

Semester	5		
Course Code	MBBT 31514		
Course Name	**Principles and Techniques in Plant Biotechnology**		
Credit Value	4		
Core/Optional	Core		
Pre-requisites	PLBL 21541		
Co-requisites	MBBT 31522		
Hourly Breakdown	Theory	Practical	Independent Learning
	60 hrs	-	140 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, (i) explain underpinning principles and strategies of plant biotechnology, (ii) explain limitations of traditional plant breeding that are overcome by plant genetic engineering and applications of plant genetic engineering, (iii) analyze pros and cons and bio-safety implications of plant genetic engineering and (iv) identify a current global problem, formulate hypothesis and propose solutions *via* plant genetic engineering.			
Course Content: Plant genome. DNA manipulative enzymes. DNA cloning and cloning vectors. DNA libraries, library screening and techniques used for identification of plant genes or gene clusters: modern molecular markers and high-throughput genotyping techniques. Ti plasmid, vectors derived from Ti plasmid and *Agrobacterium* mediated gene transfer into plant cells. Other methods used to transfer genes into plant cells. Expression vectors. Analysis of transgenic plants. Transgenic plants with improved agricultural and horticultural values. Safety aspects of genetically modified crops. Selectable marker genes and reporter genes. Introduction to antisense RNA technology and its applications in plant genetic engineering.			
Teaching/Learning Methods: Lectures, tutorials, assignments, research paper discussions, research proposal and defense			
Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 30%	Final Assessment 70%		
Details: Research proposal and oral presentation 30%	Theory (%) 70%	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. Setlow, J.K., 2000. *Genetic Engineering: Principles and Methods.* Kluwer Academic. 4. Stewart, C.N., 2008. *Plant Biotechnology and Genetics: Principles, Techniques and Application.* Wiley. 5. Related review and research articles			

Semester	5		
Course Code	MBBT 31522		
Course Name	**Principles and Techniques in Plant Biotechnology Laboratory**		
Credit Value	2		
Core/Optional	Core		
Pre-requisites	PLBL 21541		
Co-requisites	MBBT 31514		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	75 hrs	25 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, (i) explain the principles of the techniques used in plant biotechnology and (ii) demonstrate skills in using techniques used in DNA cloning and plant genetic engineering.			
Course Content: Extraction of plasmid DNA from bacteria. Restriction digestion of DNA and restriction mapping. Southern transfer and other blotting techniques. DNA ligation and cloning. Bacterial transformation (chemical and electroporation techniques) and selection of recombinants. *Agrobacterium*-mediated plant transformation and selection of recombinants. Protein isolation and SDS PAGE. DNA sequence analysis and introduction to bioinformatics: DNA databases, accession of information from GenBank, multiple sequence alignments.			
Teaching/Learning Methods: Laboratory exercises and research paper discussions			
Assessment Strategy: Continuous assessments and end of course unit practical examination			
Continuous Assessment	Final Assessment		

30%	70%		
Details: Assignments reports 15%, Oral presentations 15%	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:
Upon successful completion of this course unit, the student should be able to, (i) demonstrate knowledge and understanding of a selected science based area of industrial/ agricultural relevance, and / or concepts of entrepreneurship and (ii) 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, the student's technical report describing the nature of the training and presentations.

Continuous Assessment -	Final Assessment 100%		
Details: -	Theory (%) -	Practical (%) -	Other (%) Trainer's report 30%, Trainee's report 50%, Diary 10%, Oral presentation 10%

References/Reading Materials:
Reading and reference materials recommended/ provided by the relevant industry.

Semester	6		
Course Code	MBBT 32533		
Course Name	**Plant Pathology**		
Credit Value	3		
Core/Optional	Core		
Pre-requisites	PLBL 21513		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	30 hrs	90 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe key disease symptoms and diseases of important crops in Sri Lanka, and formulate suitable management strategies for specific plant diseases, (ii) explain molecular nature of plant-pathogen interactions at individual and population level and (iii) construct gene-for-gene models and discuss recent advances of molecular plant pathology.

Course Content:
Factors influencing plant diseases. Compatible and incompatible plant-pathogen interactions. Disease cycle and pathogenicity determinants, pathogen survival and dissemination. Elicitation of defense and constitutive, induced, chemical, structural host defense. Plant disease management and potential for disease management using bio-control agents. Disease epidemiology. Construction of gene-for-gene models for resistance. Molecular nature of plant pathogen

interactions, *R* and *Avr* genes in defense signaling. Population genetics of plant pathogens and population genetic structure.

Laboratory: Disease symptoms and diagnostic techniques, Estimation of disease incidence, Effect of fungicides, Biological control of plant pathogens.

Teaching /Learning Methods: Lectures, laboratory exercises, field visits, presentations, group projects and problem based learning

Assessment Strategy: Continuous assessment and end of course unit written and practical examinations

Continuous Assessment 35%	Final Assessment 65%		
Details: Laboratory reports 05%, Field visit report 10%, Oral presentations 10%, Group project 10%	Theory (%) 40%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Agrios, G. N., 2005. *Plant Pathology*. 5th Edition. Academic Press.
2. Sambamurty, A. V. S. S., 2010. *A Textbook of Plant Pathology*. I. K. International Publishing House Pvt. Limited.
3. Schumann, G. L. and D'Arcy, C., 2009. *Essential Plant Pathology*. 2nd Edition. APS Press.
4. Related review and research articles

Semester	6		
Course Code	MBBT 32541		
Course Name	**Tissue Culture**		
Credit Value	1		
Core/Optional	Core		
Pre-requisites	PLBL 21513		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	15 hrs	10 hrs	25 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe tissue culture systems and their applications and (ii) demonstrate skills in *in vitro* culture of plant tissues and aseptic techniques.

Course content:
Concepts and principles 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. *Laboratory:* Techniques used in the *in vitro* culture of plant tissues and organs.

Teaching/Learning Methods: Lectures, laboratory sessions, field visits and assignments

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

Continuous Assessment 30%	Final Assessment 70%		
Details: Assignments 25%, Laboratory reports 05%	Theory (%) 45%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Dodds, J. H. and Roberts, L. W., 2004. *Experiments in Plant Tissue Culture*. Cambridge University.
2. Razdan, M. K., 2003. *Introduction to Plant Tissue Culture*. Science Publishers Inc. USA.
3. Reinert, J. and Yeoman, M. M., 1982. *Plant Cell and Tissue Culture - A Laboratory Manual*. Springer-Verlag.

Semester	6		
Course Code	MBBT 32552		
Course Name	**Principles and Practices of Horticulture**		
Credit Value	2		
Core/Optional	Core		
Pre-requisites	PLBL 21513		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	20 hrs	30 hrs	50 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe the concepts of horticultural principles and practices, (ii) apply skills in growing and managing horticultural crops, (iii) demonstrate skills required in modern horticultural and landscaping practices and (iv) inculcate team working skills.

Course Content:
Introduction to horticulture: Divisions of horticulture, importance and future scope. Propagation of horticultural plants: Principles and practices of sexual and asexual (vegetative) propagation methods, micro cutting technique for rapid rooting and mass propagation, Horticultural crop production and factors affecting horticultural production. Maintenance of vegetable plot. Growing plants indoors, Protected cultivation of crops, Hydroponic cultivation methods. Cultivation of mushrooms. Seeds in horticulture, Soil nutrient monitoring and fertilizer applications, Composting. Diagnosing and treating plant diseases. *In situ* identification of insects and insect disorders. Irrigation methods for horticultural crops. Breeding of horticultural plants. Applications of biotechnology in horticulture. Landscape designing and maintenance. National horticultural products: Survey of the local trade and production of horticultural foods, herbs, spices, floricultural crops, and landscape plants, Important export and import crops, Legal and environmental issues.

Teaching /Learning Methods: Lectures, laboratory sessions, field exercises, tutorials, interactive discussions, field visits, individual assignments and review of research articles

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

Continuous Assessment 35%	Final Assessment 65%		
Details: Assignment reports and oral presentation 15%, Field visit report 10%, Laboratory reports 10%	Theory (%) 40%	Practical (%) 25%	Other (%) -

References/Reading Materials:

1. Adams, C.R., Bamford, K.M. and Early, M.P., 2008. *Principles of Horticulture*, 5th Edition, Elsevier.
2. Peter, K.V., 2013. *Biotechnology in Horticulture: Methods and Applications*. New India Publishing Agency.
3. Singh, D. K. and Peter, K. V., 2013. *Protected Cultivation of Horticultural Crops*. New India Publishing Agency.
4. Waterman, T., 2009. *The Fundamentals of Landscape Architecture*. AVA Publishing.

Semester	5		
Course Code	MBBT 41763		
Course Name	**Cell Biology and Biochemistry**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:
On successful completion of this course unit, the student should be able to, (i) describe the structure and function of biological membranes, cytoskeleton, cell wall, extracellular matrix and motile appendages, (ii) explain basic processes of cell signaling and signal transduction and (iii) explain plant metabolic regulation.

Course Content:
Cell Biology: Biological membranes: structure, functions, transport and vesicular trafficking. Molecular basis of cytoskeleton, cell wall, extracellular matrix and motile appendages. Cell cycle checkpoints, aging and cell death. Stem cells and tissue renewal. Biotic and abiotic signal perception, cell signaling and signal transduction. Introduction to cytogenetics.

Plant Biochemistry: Metabolism: metabolic fuel and regulation. Lipid metabolism and regulation: β oxidation, fatty acid synthesis. Pathways and regulation of gluconeogenesis, pentose phosphate pathway, cyanide -resistant respiration. Secondary metabolites and plant defense. Enzymology: enzyme kinetics, isozymes, isoforms of enzymes, allosteric enzymes and regulation of enzyme activity.

Teaching/Learning Methods: Lectures, tutorials and practical assignment

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

Continuous Assessment 40%	Final Assessment 60%		
Details: Practical assignments 40%	Theory (%) 60%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D. Raff, M., Roberts, K. and Walter, P., 2014. *Molecular Biology of the Cell*. 6th Edition. Garland Science.
2. Becker, W.M., Kleinsmith, L.J. and Hardin, J., 2009. *The World of the Cell.* 7th Edition. Benjamin Cummings.
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M. P. 2012. *Molecular Cell Biology*. 7th Edition. W. H. Freeman.
4. Moran, L.A., Horton, H.R., Scrimgeour, K.G. and Perry, M.D., 2012. *Principles of Biochemistry*. Pearson.
5. Plummer, D.T., 2012. *An Introduction to Practical Biochemistry.* McGraw-Hill.
6. Related review and research articles

Semester	5		
Course Code	MBBT 41773		
Course Name	**Molecular Plant Breeding**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	45 hrs	75 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe reproductive biology and breeding systems of selected crops (ii) explain methods used in hybrid seed production and recent advances, (iii) differentiate classical breeding from molecular breeding, (iv) construct and interpret linkage/Quantitative Trait Locus (QTL) maps.

Course Content:
Pollination syndrome and floral biology of selected plant species. Pollen biology, heritability. Procedure of breeding programmes, hybridization and controlled pollination methods. Hybrid seed production and plant breeding: mass selection, pure line selection and backcrossing for dominance genes, etc. Linkage drag, gene pyramiding. Introduction to contemporary molecular markers and genotyping techniques. Segregation distortion, linkage mapping, QTL mapping and Marker Assisted Selection (MAS). Genome-wide Association Studies (GWAS) and recent advances in plant breeding research.

Laboratory: Identification of pollinators and pollination syndrome. Pollen viability and germination tests. PCR for a selected molecular marker type, scoring gel images and estimation of segregation distortion. Linkage mapping and QTL mapping using commonly used software and interpret maps.

Teaching /Learning Methods: Lectures, tutorials, laboratory and field exercises, report writing on selected topics, practical assignments, debates, videos, computer assisted learning and discussion of recent research papers

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

Continuous Assessment 35%	Final Assessment 65%		
Details: Assignments/creating a video 15%, Laboratory/field reports 10%, Debate 10%	Theory (%) 65%	Practical (%) -	Other (%) -

References/Reading Materials:
1. Acquaah, G., 2012. *Principles of Plant Genetics and Breeding*, Second Edition, Wiley-Blackwell.
2. Related review and research articles

Semester	6		
Course Code	MBBT 42784		
Course Name	**Microbial Genetics**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	15 hrs	140 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) compare and contrast different transcriptional regulatory mechanisms in bacteria and (ii) critically review genetic aspects of transposition, mutagenesis and recent developments in fungal genetic research.

Course Content:
Bacterial genetics: Molecular mechanisms of bacterial gene expression regulation (alternative sigma factors, *E. coli* galactose operon, *E. coli* and *B. subtilis* tryptophan operon, *E. coli* riboswitches). Molecular aspects of transformation, conjugation, genome mapping and strain construction by conjugation. Generalized and specialized transduction. Mutagenesis, genetic characterization of mutants and complementation. Calculating mutation rates. Bacterial transposons and transposition. Genetic recombination and DNA repair.

Viral genetics: Organization of viral genomes. Mechanisms of viral nucleic acid replication. Phage DNA replication and regulation of gene expression during lytic and lysogenic cycles.

Fungal genetics: Fungal melanin biosynthetic pathways and tetrad analysis. Parasexuality, mating types and *MAT* idiomorphs of selected fungal genera, uni directional and bidirectional mating type switching. Genetics of vegetative compatibility and incompatibility of fungi (VCG and MCG). Methods of studying vegetative incompatibility and study of

Heterokaryon formation using Nit mutants and barrage formation.			
Teaching/Learning Methods: Lectures, assignments and research paper discussions			
Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 30%	Final Assessment 70%		
Details**:** Assignment reports 15%, Oral presentations 15%	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. Maloy, S., 2004. *Microbial Genetics.* Jones and Bartlett Series in Biology. Jones and Bartlett Publishers.
3. Snynder, L., Peters J**.** E., Henkin, T**.** M. and Champness, W., 2013. *Molecular Genetics of Bacteria*. 4th edition. American Society for Microbiology press.
4. Related review and research articles

Semester	6		
Course Code	MBBT 42793		
Course Name	**Bioethics and Intellectual Property Rights**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course unit, the student should be able to, (i) discuss in depth the principles of bioethics, (ii) review and analyze conceptual-logical system, which helps them to address ethical questions and to resolve ethical dilemmas in an efficient way and (iii) understand the importance of different international agreements and protocols for biotechnology and their importance to Sri Lanka.

Course Content:

Modern biotechnology and questions of ethical and social importance, Principals of bioethics and tools of bioethics, The environment as an ethical question: ethical reasons for concern, Nature and the environment. Normative ethics: Moral theories, Consequentialism, Virtue ethics, Kantianism. Deep Ecology, Social Ecology, Ecofeminism. National and international conventions on biosafety and regulations of biotechnological applications. Structure and practice of research ethics committees. Criteria and principles for good research practice: Authorship, Plagiarism, Peer review, Meaning of scientific misconduct and fraud, Conflict of interest. Cases and procedures for establishing misconduct, preventions and sanctions. Data management, Responsibility for research and the results and consequences of research. Genetics and biotechnology: Organ transplantation, Regenerative medicine, Genetic testing and screening, Bio-banking, Behavioral genetics. Intellectual property rights, patents.

Teaching /Learning Methods: Interactive lectures, essays and reviews, case studies, presentations and debates			
Assessment Strategy: Continuous assessment and end of course unit written examination			
Continuous Assessment 30%	Final Assessment 70%		
Details: Movie review 05%, Case study 05%, Presentations 10%, Critical review 5%, Debate 5%	Theory (%) 70%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Bouregy, S., Grigorenko, E. L., Latham, S. R. and Tan, M., 2017. *Genetics, Ethics and Education*. Cambridge University Press.
2. Budinger, T. F. and Budinger, M. D., 2006. *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*. 1st Edition. Wiley.
3. Emanuel, E., Crouch, R., Arras, J., Moreno, J. and Grady, C., 2003. *Ethical and Regulatory Aspects of Clinical Research: Readings and Commentary.* Johns Hopkins University Press.
4. European Commission Directorate-General for Research. 2010. *European Textbook on Ethics in Research*. Luxembourg.
5. Gert, B., 2006. *Bioethics: A systematic approach*. 2nd Edition. Oxford University Press.
6. Jamieson, D., 2008. *Ethics and the Environment*. 1st Edition, Cambridge University Press.
7. Veatch, R. M., 2012. *The Basics of Bioethics.* 3rd Edition. Prentice-Hall Press.
8. Wiles, R., 2012. *What are Qualitative Research Ethics?* 1st Edition. Bloomsbury Academic press.
9. Other reading materials and audios/videos provided by the lecturer

Semester	7		
Course Code	MBBT 41804		
Course Name	**Bioinformatics**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	15 hrs	140 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) describe the contents and properties of the most important bioinformatics databases (ii) use different bioinformatics' technologies to manipulate DNA and protein sequences using stand-alone PC programs and online programs, (iii) construct phylogenetic tress with molecular data and interpret their evolutionary relationships and (iv) critically analyze, evaluate and assemble obtained results from large-scale sequence analyses.

Course Content:
Analyzing DNA, RNA, protein sequences and NGS. Bioinformatics software: Web based software, command-line software, programming for bioinformatics. Central Bioinformatics Resources: NCBI and EBI, RefSeq project, Locus Reference Genomic Project, CCDS Project, VEGA Project. Algorithms and Sequence Alignment: Biological Algorithms versus Computer Algorithms, Algorithm Design Techniques, Advanced database searching, Scoring Matrices, Pairwise sequence alignment, Multiple sequence alignment, Exhaustive Algorithms, Heuristic Algorithms, Markov Model and Hidden Markov Model. Molecular Phylogenetics: Terminology, Gene Phylogeny versus Species Phylogeny, Molecular Evolution and Molecular Phylogenetics. Phylogenetic Tree Construction Methods and Programs: Distance-Based Methods, Character-Based Methods, MP, ML, Bayesian Methods, Phylogenetic Analysis, Phylogenetic Tre e Evaluation, Large scale data visualization, Role of Bioinformatics in Taxonomy. Genome-wide RNA and protein: Bioinformatics of RNA, Microarray and RNA sequence data analysis. Protein structures: prediction, alignment, classification.

Teaching /Learning Methods: Lectures, computer-assisted learning and assignments

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

Continuous Assessment	Final Assessment		
30%	70%		
Details: Assignments 10%, Computer-based exercises 10%, Interactive discussion 10%	Theory (%)	Practical (%)	Other (%)
	70%	-	-

References/Reading Materials:

1. Baxevanis, A. D. and Ouellette, B. F. F., 2001. *BIOINFORMATICS: A Practical Guide to the Analysis of Genes and Proteins*. 2nd edition. John Wiley & Sons.
2. Jones, N. C. and Pevzner, P. A., 2004. *An Introduction to Bioinformatics Algorithms.* The MIT Press.
3. Mount, D. W., 2004. *Bioinformatics: Sequence and Genome Analysis*. 2nd Edition. Cold Spring Harbor Laboratory.
4. Pevsner, J., 2015, *Bioinformatics and Functional Genomics*. 3rd Edition, John Wiley & Sons.
5. Xiong, J., 2006. *Essential Bioinformatics,* 1st Edition, Cambridge University Press.

Semester	7		
Course Code	MBBT 41813		
Course Name	**Agricultural, Environmental and Industrial Biotechnology**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain the use of biological systems for efficient manufacture or processing of useful products and (ii) recognize recent advances in biotechnology.

Course Content:
Development of modern biotechnology. Fermentation technologies. Principles and technologies of the use of bio systems in the production of single-cell proteins, microbial pesticides, metabolites, enzymes, antibiotics, vaccines, hormones, antibodies, biogas and biodiesel. Recent developments in gene therapy, drug delivery, biofilms, biopolymers, biosurfactants, biomining, biofertilizers and bioremediation. Nano biotechnology.

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

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

Continuous Assessment	Final Assessment
40%	60%

Details: Assignments reports 20%, Oral presentations 20%	Theory (%) 60%	Practical (%) -	Other (%) -
References/Reading Materials: Related review and research articles			

Semester	7		
Course Code	MBBT 41824		
Course Name	**Developmental Gene Regulation**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	15 hrs	140 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, (i) explain genetic regulatory mechanisms operating at different developmental stages of eukaryotes, and (ii) 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 research paper discussions			
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. Griffiths, A. J. F., Wessler S. R., Carroll, S. B. and Doebley, J., 2012. *An Introduction to Genetic Analysis*. 10th Edition. WH Freeman. 2. Krebs, J. E., Goldstein, E. S., Kilpatrick, S. T. and Lewin, B., 2014. *Lewin's Genes XI*. Jones & Bartlett. 3. Lodish, H. and Berk, A., 2012. *Molecular Cell Biology*. 7th Edition. Macmillan Higher Education, International edition. 4. Related review and research articles			

Semester	7		
Course Code	MBBT 41834		
Course Name	**Genetic Manipulation of Microorganisms**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	15 hrs	140 hrs
Course Aim/Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, discuss the application of the knowledge of microbial genetics and genetic engineering to produce strains applicable in biotechnology.			
Course Content: Microorganisms as genetic resources for biotechnology. Gene cloning, targeting, expression 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 (eg. infectious clones). Fungal transformation and gene cloning emphasizing on *Neurospora* and *Saccharomyces*: cloning by complementation, cloning from a known protein, cloning with a heterologous gene, insertional mutagenesis and chromosome walking.			
Teaching/Learning Methods: Lectures, assignments and research paper discussions			
Assessment Strategy: Continuous assessments and end of course unit written examination			
Continuous Assessment	Final Assessment		

30%	70%		
Details: Assignments 30%	Theory (%) 70%	Practical (%) -	Other (%) -

References/Reading Materials:

1. Freifelder, D., 1997. *Microbial Genetics.* Jones and Bartlet.
2. Maloy, S., 2004. *Microbial Genetics.* Jones and Bartlett Series in Biology. Jones and Bartlett Publishers.
3. Snynder, L., Peters J. E., Henkin, T. M. and Champness, W., 2013. *Molecular Genetics of Bacteria* 4th Edition. American Society for Microbiology press.
4. Related review and research articles

Semester	7		
Course Code	MBBT 41844		
Course Name	**Omics Technologies**		
Credit Value	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	45 hrs	15 hrs	140 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, (i) explain principles behind genome sequencing techniques and applications, (ii) explain recent developments in transcriptomics, proteomics and metabolomics and (iii) critically review recent research papers on omics technologies.

Course Content:
Genomics: Evolution of sequencing chemistries and platforms. Library preparation methods, BAC by BAC genome sequencing, Whole genome shotgun sequencing, High throughput sequencing. Deep sequencing. Genome sequencing projects. Introduction to structural genomics, functional genomics, epigenomics and meta genomics. *Transcriptomics*: ESTs, Microarray analysis, Serial Analysis of Gene Expression (SAGE), Massively Parallel Signature Sequencing (MPSS), RNA-Seq analysis. *Proteomics*: Protein modifications. Protein separation techniques. Protein detection and identification: Immunological methods, Mass spectrometry, Protein microarrays. Detection of protein-protein interactions. Applications of proteomics. *Metabolomics*: Techniques used to study the metabolome. Applications of metabolomics.

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

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

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

References/Reading Materials:

1. Brown, T.A., 2002. *Genomes.* John Wiley and Sons, NY
2. Cullis, C.A., 2004. *Plant Genomics and Proteomics*. John Wiley and Sons.
3. Lesk, A.M., 2007. *Introduction to Genomics*. Oxford University Press.
4. Related review and research articles

Semester	8		
Course Code	MBBT 42853		
Course Name	**Molecular Ecology**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, identify and describe the use of molecular markers to address basic ecological questions, analyze and interpret data used in molecular ecological studies, and interpret and effectively communicate research findings.

Course Content:
Introduction to classical and molecular ecology, species concepts, genetic diversity: concepts and methods of characterizing genetic diversity, estimating genetic diversity in single and multiple populations. Allele frequency and changes in allele frequency. Population assignment and detection of recombination. Conservation genetics and other applications in molecular ecology and phylogeography.

Teaching/Learning Methods: Lectures, assignments, field visits and research paper discussions

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

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

References/Reading Materials:

1. Freeland, J. R., Heather, K. and Petersen, S. D., 2011. *Molecular Ecology*. 2nd Edition. Wiley-Blackwell.
2. Related review and research articles

Semester	8		
Course Code	MBBT 42863		
Course Name	**Immunology and Cancer Biology**		
Credit Value	3		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	30 hrs	15 hrs	105 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, describe the functioning of the immune system and immune responses against infectious agents and cancer.

Course Content:
Immunology: Overview of the immune system, cells and organs of immune system, innate immunity, antigens and immunogens, antigen-antibody interactions, complement system, adaptive immunity, major histocompatibility complex, expression of immunoglobulin genes, T and B cell activation, autoimmunity, vaccination, cancer and immune system. *Cancer Biology:* Cancer genome project, Cancer genetics, Cell signaling. Techniques in cancer research.

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

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. Murphy, K., 2011. *Janeway's Immunobiology*. 8th Edition. Garland Science.
2. Related review and research articles

Semester	6 and 7		
Course Code	MBBT 43872		
Course Name	**Term Paper and Presentation**		
Credit Value	2		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	05 hrs	-	95 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to, demonstrate the ability for critical, self-directed learning, and skills in oral and written scientific communication.

Course Content:
Systematic review and critical evaluation of research papers, reviews and text books. Different modes in effective scientific communication.

Teaching /Learning Methods:
Survey of literature related to a prescribed topic and subsequent presentation in written and oral form.

Assessment Strategy: Seminar, two written papers and oral presentations on topics related to sub disciplines of Molecular Biology & Plant Biotechnology.

Continuous Assessment -	Final Assessment 100%		
Details: -	Theory (%) -	Practical (%) -	Other (%) Written paper 50%, Oral presentation 50%

References/Reading Materials: References related to prescribed seminar and term paper topics.

Semester	7 and 8		
Course Code	MBBT 43888		
Course Name	**Research Project - Dissertation**		
Credit Value	8		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	-	800 hrs

Course Aim/Intended Learning Outcomes:
Upon successful completion of this course unit, the student should be able to demonstrate competence in (i) planning and carrying out a research project scientifically, (ii) presenting the research in the form of a dissertation, and (iii) defending the work carried out and outcomes.

Course Content:
Research related to sub disciplines of the Molecular Biology & Plant Biotechnology curriculum.

Teaching /Learning Methods:
A 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, 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. Alley, M., 2018. *The Craft of Scientific Writing*. 4th Edition. Springer Science & Business Media.
2. Katz, M.J., 2009. From research to manuscript: A guide to scientific writing. Springer Science & Business Media.
3. Reference material relevant to each research topic.