POSTGRADUATE INSTITUTE OF SCIENCE
UNIVERSITY OF PERADENIYA

Master of Molecular Biology and Biotechnology Degree Programme (SLQF Level 9)

Master of Science (M.Sc.) in Molecular Biology and Biotechnology Degree Programme (SLQF Level 10)

1. INTRODUCTION

Biotechnology is defined as the application of scientific and engineering principals to the processing of material by biological agents to provide goods and services. Biotechnology comprises a number of technologies based upon increasing understanding of biology at the cellular and molecular level. Biotechnology is the third wave in biological science and represents an interface of basic and applied sciences, where gradual and subtle transformation of science into technology can be witnessed. The practice of Molecular Biology and Biotechnology has now become an integral and essential component in many diverse spheres, such as Health Care & Medical Technology, Agriculture, Food & Beverage industry, Pharmaceutical industry and Environmental management. The application of Molecular Biology and Biotechnology can result in adding modifications to existing products with improved outcomes and benefits as well as in producing innovative products.

By reading a Masters Degree in Molecular Biology and Biotechnology, students from a variety of backgrounds with varied levels of Molecular Biology and Biotechnology experience will develop an understanding of contemporary Molecular Biology and Biotechnology principles and practices. Moreover, one can gain the skills and knowledge required for employment in the Biotechnology industry. In many instances, for the efficient discharge of their duties, it is necessary that such graduates possess the ability to understand clearly the nature of a given problem, use a variety of molecular biological methodologies and techniques (both manual and instrumental) to obtain accurate and precise measurements and interpret the results to arrive at appropriate conclusions. Although undergraduate curricula provide a strong background in Molecular Biology and Biotechnology with a basic training in experimental aspects, a sound hands-on experience together with advanced principles of Molecular Biology and Biotechnology is often beyond the scope of such curricula, mainly due to time constraints. The absence of properly trained molecular biologists and biotechnologists in Sri Lanka is a major drawback in the realization of our industrial and scientific potential, especially in the current atmosphere of increasing industrialization. The Board of Study in Biochemistry and Molecular Biology of the Postgraduate Institute of Science (PGIS) has updated the Masters Degree Programme in Molecular Biology and Biotechnology, introducing new courses to timely national demands. This proposal introduces a five-credit independent study module to improve writing / oral communication skills and a thirty-credit Research Project to improve experimental / analytical skills applied to Molecular Biology and Biotechnology.

This Masters Degree Programme will thus prepare the candidate to take the challenge of meeting not only national needs in diverse areas as stated above, but also to continue toward a higher degree anywhere in the world.

2. OBJECTIVES OF THE PROGRAMME

At the end of the successful completion of the M.Sc. in Molecular Biology and Biotechnology Degree (by Research), the graduate will be able to (listed under major qualification and level descriptors of SLQF),

The Purpose and Scope of Qualification

- Advance the knowledge, research skills and abilities in Molecular Biology and Biotechnology to make them prepare for higher specialized professional degrees, employment opportunities to enhance managerial, administrative and technological capacities.
- Provide the research experience under qualified supervisors and to make novel academic contribution to Molecular Biology and Biotechnology (in the form of thesis and publications).

Attributes to Qualification Holders

- Demonstrate critical awareness and current issues in Molecular Biology and Biotechnology and apply relevant techniques.
- Make judgment in issues in Molecular Biology and Biotechnology and communicate with specialist and non-specialist groups.
- Demonstrate self-directions, originality and problem solving skills and accomplish tasks in molecular biology and biotechnology in professional manner.
- Deal with complex issues systematically and creatively and make sound judgments and communicate decisions clearly to others.

Progression

- Place at SLQF level 10. The early exit is possible according to SLQF guidelines and PGIS regulations.

Subject / Theoretical Knowledge

- Analyze and evaluate current research in Molecular Biology and Biotechnology.
- Demonstrate critical awareness of current issues and recent developments in Molecular Biology and Biotechnology.

Practical Knowledge and Application

- Use practical skills efficiently and effectively and enquiry within Molecular Biology and Biotechnology.
- Construct and sustain arguments and use these arguments, ideas and techniques appropriately in solving problems of Molecular Biology and Biotechnology by conducting an independent research / thesis.

Communication

- Communicate the findings/conclusions of Molecular Biology and Biotechnology research in orally and written format to specialist and non-specialist groups.

Teamwork and Leadership

- Demonstrate leadership skills in planning and implementing tasks in professional, technical and academic settings.

Creativity and Problem Solving

- Deal with complex issues systematically and make sound judgments.
- Construct new hypotheses in Molecular Biology and Biotechnology and test them in a scientific manner.
- Demonstrate self-direction and originality in solving problems of Molecular Biology and Biotechnology.

- Make decisions in complex and unpredictable contexts coming under Molecular Biology and Biotechnology and also in general life.

Managerial and Entrepreneurship

- Plan and implement tasks efficiently and effectively in professional, technical or academic settings.
- Take initiative, assume personal responsibility and demonstrate accountability and ability to instill entrepreneurship.

Information Usage and Management

- Be thorough in transferable skills including ICT skills and information literacy with the capability of organizing and processing data.

Networking and Social Skills

- Ability to work in teams, give leadership, and promote social and professional engagement
- Plan and execute appropriate strategies for adapting to changing environments.
- Make decisions in complex and unpredictable contexts.

Attitudes, Values and Professionalism

- Exercise initiative, personal responsibility and accountability in tasks performed. Demonstrate positive attitudes and social responsibility.

Vision for Life

- Clearly identify where one wants to be, where the society should be and develop long term goals accordingly.

Updating Self / Lifelong Learning

- Undertake further training and develop additional skills that will enable them to make sound decisions.
- Advance knowledge and understanding, and develop additional skills. Engage in independent learning using scholarly reviews and secondary sources of information. Demonstrate skills in independent learning for continuous professional development.

At the end of the successful completion of the M.Sc. Degree in Molecular Biology and Biotechnology (Course Work), the graduate will be able to (listed under major qualification and level descriptors of SLQF),

Purpose and Scope of Qualification

- Enhance the capacity to advance their knowledge and investigative skills, for academic advancement or enhancing the managerial, administrative and technological aspects, and other abilities relevant to areas within Molecular Biology and Biotechnology enabling conversion into a different discipline / profession. This qualification demands a high level of theoretical engagement and guided independent study of 5 credits.

Attributes of Qualification Holders

- Demonstrate thorough understanding of theoretical knowledge.
- Display critical awareness of current issues in Molecular Biology and Biotechnology.
- Apply techniques relevant to their professional practice.
- Demonstrate self-direction and originality in tackling and solving problems and be able to plan and implement tasks at professional levels

Progression

- Use the earned MSc in Molecular Biology and Biotechnology (Course Work) as an entry requirement to SLQF level 10 or 11 in the same field of specialization.

Subject / Theoretical Knowledge

- Demonstrate a comprehensive and substantive level of knowledge and understanding in Molecular Biology and Biotechnology.
- Critically analyze data, make judgments and propose solutions to problems.

Practical Knowledge and Application

- Use efficiently and effectively, practical skills and enquiry within Molecular Biology and Biotechnology.
- Construct and sustain arguments and use appropriately these arguments, ideas and techniques in problem solving.

Communication

- Demonstrate awareness of the current developments in Molecular Biology and Biotechnology through written and oral communication. **Teamwork and Leadership**
- Exercise leadership in the professional environment/work place.
- Demonstrate ability in creativity and problem solving
- Deal with complex issues in a systematic manner and make sound judgments.

Managerial and Entrepreneurship

- Plan and implement tasks at professional and managerial levels.
- Take initiative, assume personal responsibility and demonstrate accountability and ability to instill entrepreneurship.

Information Usage and Management

- Be thorough in transferable skills including ICT skills and information literacy with the capability of organizing data.

Networking and Social Skills Adaptability and Flexibility Attitudes, Values and Professionalism

- Work in teams, give leadership, and promote social and professional engagement.
- Plan and execute appropriate strategies for adapting to changing environments.
- Exercise initiative, personal responsibility and accountability in tasks performed.
- Demonstrate positive attitudes and social responsibility.

Vision for Life

- Clearly identify where one wants to be, where the society should be and develop long term goals accordingly.

Updating Self / Lifelong Learning

- Undertake further training and develop additional skills that will enable them to make sound decisions.
- Advance knowledge and develop additional skills.
- Demonstrate skills in independent learning for continuous professional development.

3. PROGRAMME ELIGIBILITY

Candidates having a bachelor's degree with 30 credits including relevant modules of Biology or equivalent accredited prior learning experience are eligible to follow the programme. Eligible applicants shall face a selection examination followed by an interview, conducted by the PGIS. Employed candidates eligible for admission should produce evidence of leave granted to follow the programme and a letter of release from the Head of the Department/Institution.

4. PROGRAMME FEE

Category	Programme Fee*	
	Master of Molecular Biology and Biotechnology Degree Programme	M.Sc. in Molecular Biology and Biotechnology Degree Programme
Local candidates	Rs. 500,000.00	Rs. 800,000.00
Candidates from other countries	USD 3,325.00	USD 5,325.00

** To be decided each year.*

Students registered for the M.Sc. degree by course work shall pay the Programme fee in full or in two *(1/2 at the registration and the balance at the end of the first semester)* or three *(1/3rd at the registration, another 1/3rd after 4 months from the date of registration and the balance after 8 months from the date of registration)* installments. Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS. (N.B. The Programme fees given above may be revised as per recommendation of the Board of Management of the PGIS.)

5. THE PROGRAMME STRUCTURE AND DURATION

This programme consists of three options for completion.

5.1 Masters Degree by Course Work (SLQF Level 9)

The Master of Molecular Biology and Biotechnology Degree can be obtained by completing course work only (without conducting any research project).

Course work, comprising of theory courses, and laboratory and/or fieldwork, shall be conducted over a period of two semesters of 15 weeks each. The total duration of the degree, including examinations, shall be about 12 months. Satisfactory completion of a minimum of 30 credits of course work with a GPA of not less than 3.00 is required for the successful completion of the degree - SLQF Level 9 (Students who do not satisfy the above criteria but obtain a GPA in the range 2.75 to 2.99 for course work of 25 credits are eligible for the Postgraduate Diploma in Molecular Biology and Biotechnology - SLQF Level 8, and those who obtain a GPA in the range 2.75 to 2.99 for course work of 20 credits are eligible for Postgraduate Certificate - SLQF Level 7).

5.2 Masters Degree by Course Work and Research (SLQF Level 10)

In addition to Masters Degree with course work (5.1), the Masters Degree (Research) requires a research project. The duration of the entire programme shall be 24 months inclusive of 5.1. Completion of all the requirements of 5.1 with a GPA of not less than 3.00 is a prerequisite for the Masters Degree (Research). The research project for this degree should be conducted on full-time basis, and completed during the second year.

The research component is allocated 30 credits, totaling 60 credits for the entire programme. After successful completion of the research project, the student shall be eligible for the award of the M.Sc. in Molecular Biology and Biotechnology Degree - SLQF Level 10 (Students who do not complete the research project within the stipulated time period shall be awarded the Master of Molecular Biology and Biotechnology Degree - SLQF Level 9).

5.3 Extension of the programme for M.Phil. (SLQF Level 11) or Ph.D. (SLQF Level 12) After conducting research for a period of six months in the M.Sc. degree (research) programme, students who have demonstrated exceptional progress may apply for upgrading the degree status to M.Phil. The student should continue the research project and any additional research work/assignments recommended by the PGIS for a total of two years (60 credits of research) to qualify for the award of the M.Phil. degree (SLQF Level 11).

During the second year of research, students who have demonstrated exceptional and continuous progress may apply for upgrading the degree status from M.Phil. to Ph.D. The student should continue the research project and any additional research work/assignments recommended by the PGIS for another year on full-time basis (additional 30 credits) to qualify for the award of the Ph.D. degree (SLQF Level 12).

Master of Molecular Biology and Biotechnology Degree Programme (SLQF Level 9)

Master of Science (M.Sc.) in Molecular Biology and Biotechnology Degree Programme (SLQF Level 10)

Programme Summary

Course Code	Course Title	Lecture hrs.	Practical hrs.	No. of credits
	Semester I			
MB 571	Biochemistry and molecular biology of cell	30	30	3
MB 572	Principles of heredity*	30	-	2
MB 573	Molecular genetics	45	-	3
MB 574	Molecular microbiology	20	30	3
MB 575	Recombinant DNA technology	30	-	2
MB 576	Bioinformatics	30	-	2
MB 577	Molecular immunology*	30	30	3
MB 578	Molecular Biotechnology	30	-	2
	Semester II			
MB 579	Biostatistics	30	-	2
MB 580	Molecular systematics*	30	-	2
MB 581	Biotechnology industry	30	-	2
MB 582	Protein chemistry*	20	50	3
MB 583	Molecular biology of development and cancer*	45	-	3
MB 584	Biometrical genetics*	45	-	3
MB 585	Ethical regulations and legal aspects of biotechnology*	15	-	1
MB 586	Plant tissue culture*	15	60	3
MB 599	Independent Study**[1]	500 notional hours		5
MB 699	Research Project**[2]	3000 notional hours		30

** Optional Courses*
Students are required to obtain 3 credits from optional courses.
***[1] Compulsory for Master of Experimental Biotechnology degree* (*SLQF Level 9*) ***[2] Compulsory for M.Sc. in Experimental Biotechnology degree* (*SLQF Level 10*)

NC – No change

6. PROGRAMME CONTENTS

Semester	**1**		
Code	MB 571		
Title	Biochemistry and Molecular Biology of Cell		
Credits	3		
Notional hours	150		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	30	90
Prerequisites	None		

Aims:

1. Impart the knowledge and necessary skills on the structure of biological molecules, molecular forces involved in the formation of the biological molecules and their interactions within a cell.
2. Explain the mechanisms of metabolism, biochemical reactions, enzymes, ATP as the energy currency and cellular mechanisms for harvesting energy.
3. Provide the key concepts in Biochemistry and Molecular Biology.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe the structure and synthesis of biological molecules and their interactions in performing cellular functions,
2. explain the mechanisms of metabolism of cell, bioenergetics, cell signaling and transport across membranes and central dogma of Molecular Biology and
3. conduct routine experiments to study biomolecules (carbohydrates, lipids, nucleic acids and proteins).

Course Content: (Main topics, Subtopics)

The cell as a basic unit of life, major intracellular organelles and their functions. Structure, function, formation and metabolism of biomolecules (carbohydrates, lipids, nucleic acids and proteins) in plant and animal cells; pH and buffers. Cell basics, biomolecules and their assemblies, structure of eukaryotic and prokaryotic cells, cell organelles and functions; cell membrane, function and transport across membranes, protein trafficking, organelle biogenesis, cytoskeleton and cell motility; extracellular matrix and cell adhesion; cell to cell signaling, signaling in the sensory system, cell cycle, regulation and apoptosis. Bioenergetics, metabolism, regulation and its control; cell division, mitosis and meiosis; DNA replication, transcription and protein synthesis; cell communication, cell fractionation and constituent detection.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons and 30 hours of student centered demonstration aided interactive practical sessions will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 practical assignments will be given to be submitted within a week. Midsemester examination will be given after completion of 20 hours and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials

and midsemester exam. Final comprehensive examination will carry the rest of 50%.					
Assessment Strategy					
Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester Exam 25%	Theory 60%	Practical 40%	Others (specify) --

References/Reading Materials:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014) Molecular Biology of the Cell, (Sixth Edition). Garland Science.
2. Voet, D., Voet, J.G., Pratt, C.W. (2012) Fundamentals of Biochemistry: Life at the Molecular Level, (Fourth Edition). Wiley Plus.

Semester	**1**		
Code	MB 572		
Title	Principles of Heredity		
Credits	2		
Notional hours	100		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	None		

Aims:

1. Explain the structure and function of the DNA molecule in comparison to its functional role in inheritance.
2. Describe the principles of inheritance and deviations to the Mendelian inheritance.
3. Provide a comprehensive overview of the applications of genetics and genetic relationships among species.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. outline and explain the classical theories and molecular basis of the inheritance,
2. solve the complex genetic issues and problems arisen in the living organisms,
3. explain the applications of genetics in daily needs,
4. apply the genetic knowledge to unravel the evolutionary mysteries and to design genetic measures in biodiversity conservation.

Course Content: (Main topics, Subtopics)

Introduction to principles of inheritance, Mendelian genetics, alterations of Mendel laws, classical genetic theory; meiosis, mitosis, linkage; recombination, sex determination and cytoplasmic inheritance, cytogenetics; macro and micro mutations; polyploidy and aneuploidy; population genetics and evolution; quantitative genetics; heterosis and hybrid vigor; introduction to DNA technologies, principles and practical aspects of breeding, conservation and evolutionary genetics, applications of genetics in medicine, agriculture etc.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Hall, B.K., Hallgrimsson, B. (2007) Strickberger's Evolution, (Fourth Edition). Jones and Bartlett Publishers.
2. Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A. (2015) Concepts of Genetics, (Eleventh Edition). Pearson Education Inc.

Semester	**1**		
Code	MB 573		
Title	Molecular Genetics		
Credits	3		
Notional hours	150		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	45	--	105
Prerequisites	None		

Aims:

1. Provide advanced knowledge in the regulation of gene expression.
2. Explain the structural and functional properties of proteins.
3. Describe the basis of DNA repair.
4. Explain the usefulness of Molecular Genetics in genetic manipulations, diagnosis and treating diseases.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. outline and explain the steps of gene expression and its regulation,
2. state the structure and functions of proteins,
3. explain the mechanism of DNA repair in maintaining the integrity of genetic material and
4. apply the knowledge in Molecular Genetics in Genetic Engineering, diagnosis and treating diseases.

Course Content: (Main topics, Subtopics)

Molecular basis of genetics and chromosomal theory; organization of prokaryotic and eukaryotic genomes, genes and chromosomes, mitochondrial and chloroplast DNA, mobile genetic elements;

genome replication, genetic recombination; DNA repair; RNA synthesis, processing and metabolism; the genetic code, protein synthesis and regulation of gene expression; DNA cloning and microarrays; genetic disorders and gene therapy; molecular basis of quantitative and evolutionary genetics; structural and functional genomics.

Teaching /Learning Methods:

Delivery: 45 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 tutorials will be given to be submitted within a week. Midsemester examination will be given after completion of 20 hours and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials/Assignments 10%	Report 15%	Midsemester Exam 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Nelson, D.L., Cox, M.M. (2012) Lehninger Principles of Biochemistry, (Sixth Edition). Worth Publishers Inc.
2. Weaver, R.F. (2011) Molecular Biology, (Fifth Edition). McGraw-Hill.

Semester	**1**		
Code	MB 574		
Title	Molecular Microbiology		
Credits	3		
Notional hours	150		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	20	50	80
Prerequisites	None		

Aims:

1. Impart knowledge and skills on molecular approaches in Experimental Microbiology.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the structure and function of microorganisms,
2. list the applications of Microbiology in diverse fields,
3. conduct routine experiments to isolate, culture and diagnose diverse microbes and
4. describe the important role of microbes in Environmental Biotechnology and Bioremediation

Course Content: (Main topics, Subtopics)

Microbial cell structure and function; microbial cultivation in industrial processes, fermentation and large scale fermenters, brewing and alcoholic beverages, antibiotic production and genetically engineered products, organic acids, amino acids, enzymes, vitamins, novel food resources, animal feed, single cell proteins; Biodegradation, fuel and energy, waste water treatment and utilization.

Teaching /Learning Methods:

Delivery: 20 hours of student-centered interactive theory lessons and 50 hours of student centered demonstration aided interactive practical sessions will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 practical assignments will be given to be submitted within a week. Midsemester examination will be given after completion of 10 hours of theory and 25 hours of practicals and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester Exam 25%	Theory 60%	Practical 40%	Others (specify) --

References/Reading Materials:

1. Glazer, A.N., Nikaido, H. (2007) Microbial Biotechnology. Fundamentals of Applied Microbiology, (Second Edition). Cambridge University Press.
2. Madigan, M.T., Martinko, J.M., Stahl, D., Clark, D.P. (2010) Brock Biology of Microorganisms, (Thirteenth Edition). Pearson Education Inc.
3. Persing, D.H., Tenover, F.C., Tang, YW, Nolte, F.S., Hayden, R.T., Belkum, A.V. (Eds.) (2011) Molecular Microbiology: Diagnostic Principles and Practice, (Second Edition). ASM Press.

Semester	**1**		
Code	MB 575		
Title	Recombinant DNA Technology		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	MB 571, MB 573		

Aims:

1. Impart the knowledge and skills in Recombinant DNA Technology.
2. Provide specific training on laboratory techniques in Molecular Biology.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the procedure of Recombinant DNA Technology to achieve cloned genes / DNA and Genetically Modified Organisms and
2. to conduct experiments required in manipulating DNA molecules and analyzing transgenic organisms.

Course Content: (Main topics, Subtopics)

Introduction to Recombinant DNA Technology; purification and manipulation of DNA; cloning vectors; introduction of DNA into living cells; establishment and analysis of gene libraries; isolation, identification and characterization of cloned genes; restriction mapping; gene expression; RNA interference; gene function; introduction of regeneration and analysis of transgenic organisms.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Green, M.R., Sambrook, J. (2012) Molecular Cloning – A Laboratory Manual, (Fourth Edition). Cold Spring Harbor Laboratory Press.
2. Kurnaz, I.A. (2015) Techniques in Genetic Engineering. CRC Press.
3. Brown, T. A. (2010) Gene Cloning and DNA Analysis: An Introduction, (Sixth Edition). Wiley-Blackwell.

Semester	**1**		
Code	MB 576		
Title	Bioinformatics		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	MB 573		

Aims:

1. Explain Bioinformatic algorithms / concepts and their implementations.
2. Impart the aptitude to cast a Molecular Biology problem as a Bioinformatic problem, selecting relevant tools, optimize their settings, and building pipelines to solve the set problems.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe the terms used in Bioinformatics,
2. state the applications of Bioinformatics in biological research and
3. use Bioinformatic tools, software and online resources to store, retrieve and analyze molecular data.

Course Content: (Main topics, Subtopics)

Bioinformatics in nut shell, terminology; computer analysis of genome sequences, sequence analysis methods, sequence alignment; phylogenetic tree reconstruction; prediction of RNA and protein structure, gene finding and sequence annotation and motif identification, gene expression; bimolecular computing, molecular databases; Bioinformatics and Computational Biology software; DNA micro arrays; drug design.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Baxevanis, A.D., Ouellette, B.F. (2004) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, (Third Edition). Wiley-Interscience.
2. Pevzner, P., Shamir, R. (Eds.) (2011) Bioinformatics for Biologists, (First Edition). Cambridge University Press.

Semester	**1**		
Code	MB 576		
Title	Bioinformatics		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	MB 573		

Aims:

3. Explain Bioinformatic algorithms / concepts and their implementations.
4. Impart the aptitude to cast a Molecular Biology problem as a Bioinformatic problem, selecting relevant tools, optimize their settings, and building pipelines to solve the set problems.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

4. describe the terms used in Bioinformatics,
5. state the applications of Bioinformatics in biological research and
6. use Bioinformatic tools, software and online resources to store, retrieve and analyze molecular data.

Course Content: (Main topics, Subtopics)

Bioinformatics in nut shell, terminology; computer analysis of genome sequences, sequence analysis methods, sequence alignment; phylogenetic tree reconstruction; prediction of RNA and protein structure, gene finding and sequence annotation and motif identification, gene expression; bimolecular computing, molecular databases; Bioinformatics and Computational Biology software; DNA micro arrays; drug design.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

3. Baxevanis, A.D., Ouellette, B.F. (2004) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, (Third Edition). Wiley-Interscience.
4. Pevzner, P., Shamir, R. (Eds.) (2011) Bioinformatics for Biologists, (First Edition). Cambridge University Press.

Semester	**1**		
Code	MB 577		
Title	Molecular Immunology		
Credits	3		
Notional hours	150		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	30	90
Prerequisites	None		

Aims:

1. Describe the molecular and cellular basis of the immune system.

2. Impart the skills required to conduct immunological experiments.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the molecular and cellular basis of the immune system and importance of immune system to protect against the diseases,
2. conduct routine immunological experiments and
3. state the recent advances in immunological research.

Course Content: (Main topics, Subtopics)

The immune system, structure and function of immunoglobulins, cells of lymphoid systems; response to antigenic stimulation, antigenic determinants, antigen processing and presentation; intercellular interactions; compliment system and its function, biology of the major histocompatibility complex; mechanisms of immunity and hypersensitivity; immune modulatory products of parasites; diagnostic assays using antibodies, polyclonal and monoclonal antibodies, phage antibody production; immunochemical methods, antigen and antibody detection methods, Biotechnology mediated advancements in Immunology.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons and 30 hours of student centered demonstration aided interactive practical sessions will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 practical assignments will be given to be submitted within a week. Midsemester examination will be given after completion of 15 hours of theory and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester Exam 25%	Theory 60%	Practical 40%	Others (specify) --

References/Reading Materials:

1. Murphy, K. (2011) Janeway's Immunobiology, (Eighth Edition). Garland Science.
2. Delves, P.J., Martin, S.J. Burton D.R., Roitt, I.M. (2011) Roitt's Essential Immunology, (Twelfth Edition). Willey-Blackwell.
3. Abbas, A.K., Lichtman, A.H.H., Pillai, S. (2014) Cellular and Molecular Immunology, (Eighth Edition). Elsevier Saunders.

Semester	**1**		
Code	MB 578		
Title	Molecular Biotechnology		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	MB 573, MB 575		

Aims:

1. Explain the concepts, areas and techniques of Biotechnology.
2. State Biotechnology as one of the tools in using biological organisms, products and processes for development.
3. Describe the outline of research methodology required to conduct research in Molecular Biotechnology.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the procedure of generating transgenic and cisgenic plants, animals and microbes for beneficial applications,
2. use molecular details to value the biological resources for potential economic uses (i.e. Bioprospecting) and
3. to plan general experiments routinely used in Molecular Biotechnology.

Course Content: (Main topics, Subtopics)

Genetic Engineering of plant and animals, and their applications; bio control of pests; recombinant microorganisms; fermentation technology; preparation of bioactive compounds in microbes and tissue / cell cultures; biological nitrogen fixation; germplasm conservation; molecular breeding; bio-fertilizers; genomics and proteomics; Gene transfer to microbial, animal cells, animals and plants as a tool for basic research and for applied biotechnology applications; production of useful molecules, transgenic animals as assay systems to investigate gene function and as Models for human diseases, transgenic plants as a tool to test gene expression and function and as a breeding method for crop improvement. DNA / protein-based techniques in forensic science and medicine; DNA barcoding for biodiversity assessment; biosafety in Biotechnology; international conventions related to Biotechnology on society and the Developing World.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%	Final Assessment: 50%

Tutorials	Practical Assignments	Midsemester	Theory	Practical	Others (specify)
10%	15%	25%	100%	--	--

References/Reading Materials:

1. Dehlinger, C.A. (2014) Molecular Biotechnology. Jones and Bartlett Learning.
2. Glick, B.R., Pasternak, J.J., Pattern, C.L. (2009) Molecular Biotechnology: Principles and Applications of Recombinant DNA, (Fourth Edition). American Society for Microbiology Press, Washington DC.
3. Theiman, W.J., Palladino, M.A. (2012) Introduction to Biotechnology, (Third Edition). Benjamin Cummings.

Semester	**2**		
Code	MB 579		
Title	Biostatistics		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	None		

Aims:

1. Describe the role of Statistics in Molecular Biological research.
2. Explain basic statistical techniques and procedures.
3. Impart the skills to run statistical software for given data sets with correct analytical procedure and interpret the results.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain and use the statistical techniques to analyze data,
2. use statistical software (SAS, Minitab, SPSS and R) to analyze data and
3. write error free concise reports based on the outputs of statistical data analysis.

Course Content: (Main topics, Subtopics)

Principles of probability; introduction to statistical terms and methodology, statistical techniques important for practical data analysis; statistical packages such as SAS, Minitab, SPSS and R; Measures of center and dispersion; probability distribution types; test of significance, z-test, t-test, F-test, goodness of fit; non-parametric tests; correlation and linear regression; analysis of variance and experimental designs; suitability of standard designs for specific experiments; principal component analysis; time series data handling.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Norman, G.R., Sreiner, D.L. (2014) Biostatistics: The Bare Essentials, (Fourth Edition). People's Medical Publishing House, USA.
2. Moore, D.S., Notz, W.I. Fligner, M.A. (2011) The Basic Practice of Statistics, (Sixth Edition). W.H. Freeman & Company.
3. Bluman, A.G. (1997) Elementary Statistics: A Step-by-Step Approach with Formula Card, (Ninth Edition). McGraw Hill Higher Education.

Semester	**2**		
Code	MB 580		
Title	Molecular Systematics		
Credits	2		
Notional hours	100		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	None		

Aims:

1. Explain the concepts of Molecular Systematics including phylogenetic tree construction and molecular evolutionary relationships among taxa.
2. Demonstrate the use of software to analyze the phylogenetic data.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe advanced details of Molecular Systematics and analyses,
2. use the intended software for phylogenetic data analysis and
3. explain the process of evolution as a series of accumulated molecular changes in the genetic material.

Course Content: (Main topics, Subtopics)

Theory and procedures of modern systematic analysis, conducting a phylogenetic analysis; character construction, character weighting, characters in Molecular Systematics; methods of tree construction, methods of choosing among alternate optimal or nearly optimal trees, tree statistics, Bayesian inference, maximum likelihood alignment, molecular dating.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Wiley, E.O., Liebermann, B.S. (2011) Phylogenetics: Theory and Practice of Phylogenetic Systematics, (Second Edition). Wiley-Blackwell.
2. Stuessy, T.F., Crawford, D.J., Soltis, D.E., Soltis, P.L. (2014) Plant Systematics. The Origin, Interpretation, and Ordering of Plant Biodiversity. Koeltz Scientific Books.
3. Desalle, R., Giribet, G., Wheeler, W. (Eds.) (2013) Techniques in Molecular Systematics and Evolution, (First Edition). Birkhauser Verlag.

Semester	**2**		
Code	MB 581		
Title	Biotechnology Industry		
Credits	2		
Notional hours	100		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	--	70
Prerequisites	MB 578		

Aims:

1. Describe the concepts and techniques that are currently being utilized in the biotechnology and pharmaceutical industries.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the value and applications of Biotechnology as a valuable industry,
2. describe the key research papers on Biotechnology,
3. apply the knowledge and skills in Biotechnology for bio entrepreneurship and industry and
4. list the current prospects and challenges of using Biotechnology to develop Sri Lankan economy.

Course Content: (Main topics, Subtopics)

Biotechnology in food and agriculture, GM crops, cloning livestock; applications of molecular techniques in medicine, drug design, drug delivery, gene therapy; bioreactors (production of pharmaceuticals); new avenues of Biotechnology; biofilm technology; biodiversity and bioprospecting for Biotechnology; embryonic stem cells and therapeutic cloning; top Biotech companies and products; current prospects of Biotechnology in Sri Lanka, key research papers of Biotechnology in the 20th and 21st centuries, transferring biotech research results to industry, bio entrepreneurship, Biotechnology Industry models.

Teaching /Learning Methods:

Delivery: 30 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class practical assignments will be given to practice applications. 4-5 Tutorials will be given to test theoretical concepts. Midsemester examination will be given after completion of 15 hours and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Kent, J.A. (2013) Handbook of Industrial Chemistry and Biotechnology, (Twelfth Edition). Springer.
2. Austin, M. (2008) Business Development for the Biotechnology and Pharmaceutical Industry, Grower Publishing Limited, England
3. Flickinger, M.C. (Ed.) (2013) Downstream Industrial Biotechnology: Recovery and Purification, (First Edition). Willey.

Semester	**2**		
Code	MB 582		
Title	Protein Chemistry		
Credits	3		
Notional hours	150		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	20	50	80
Prerequisites	MB 571		

Aims:

1. Explain the advanced details of structure and function of protein molecules.
2. Impart the skills on laboratory analysis of proteins.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe structure and function of proteins and
2. conduct experiments on protein extraction, purification and analysis.

Course Content: (Main topics, Subtopics)

Amino acids.; protein structure; glycoproteins; lipoproteins; protein purification; protein analysis; protein design; enzyme kinetics. Practicals based on the above.

Teaching /Learning Methods:

Delivery: 20 hours of student-centered interactive theory lessons and 50 hours of student centered demonstration aided interactive practical sessions will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 5-10 practical assignments will be given to be submitted within a week. Midsemester examination will be given after completion of 10 hours of theory and 25 hours of practicals and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester Exam 25%	Theory 60%	Practical 40%	Others (specify) --

References/Reading Materials:

1. Berg, J.M., Tymoczko, J.L., Stryer, L. (2010) Biochemistry, (Seventh Edition). Freeman, W.H. and Company.
2. Nelson, D.L., Cox, M.M. (2012) Lehninger Principles of Biochemistry, (Sixth Edition). Worth Publishers Inc.
3. Schulz, G.E., Schirmer, R.H. (2013) Principles of Protein Structure. Springer.

Semester	**2**		
Code	MB 583		
Title	Molecular Biology of Development and Cancer		
Credits	3		
Notional hours	150		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	45	--	105
Prerequisites	None		

Aims:

1. Describe the terms in Developmental Biology, experimental model organisms, differential gene expression and genetic control in Development.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the molecular mechanism of Development and associated genetic mechanisms
2. describe the stem cell technology and
3. outline the molecular mechanism of cancer development.

Course Content: (Main topics, Subtopics)

Regulatory mechanisms of animal development with vertebrate and invertebrate model organisms; genomic constancy; differential gene expression during development, maternal and zygotic control of gene expression; formation of the early body plan, determination of the cell types, organogenesis and morphogenesis, sex determination and differentiation; aging and programmed cell death; stem cells, cloning; Molecular Biology, Cancer related topics.

Teaching /Learning Methods:

Delivery: 45 hours of student-centered interactive theory lessons will be conducted.
Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 tutorials will be given to be submitted within a week. Midsemester examination will be given after completion of 20 hours and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials/Assignments 10%	Report 15%	Midsemester Exam 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Gilbert, S.F. (2013) Developmental Biology, (Sixth Edition). Sinauer Associates.
2. Wolpert, L., Tickle, C. (2011) Principles of Development, (Fourth Edition). OUP Oxford
3. Streelman, J.T. (Ed.) (2014) Evolutionary Advances in Evolutionary Developmental Biology, (First Edition). Wiley Blackwell.

Semester	**2**		
Code	MB 584		
Title	Biometrical Genetics		
Credits	3		
Notional hours	150		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	45	--	105
Prerequisites	MB 573		

Aims:

1. Explain the mathematical models of the inheritance of quantitative traits.
2. Demonstrate software used in analyzing quantitative genetic data.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe the nature of quantitative traits by analyzing them for various genetic hypothesis and
2. use QTL mapping procedure to find the linked markers and underlying genes of complex traits in eukaryotes.

Course Content: (Main topics, Subtopics)

Identify the effects of the evolutionary forces on populations on the basis of their departure from the HWE model; genetic analysis of statistical data relative to a quantitative trait, possible types of gene actions and number of genes controlling a quantitative trait, variation in mean and variability of a

population due to changes in allele frequencies, selection response of populations; principles and theory of QTL mapping, use of QTL as a tool in marker assisted breeding and mapping genes in humans and other organisms; post genomic era; structural and functional genomics.

Teaching /Learning Methods:

Delivery: 45 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 4-5 tutorials will be given to be submitted within a week. Midsemester examination will be given after completion of 20 hours and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials/Assignments 10%	Report 15%	Midsemester Exam 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Khatib, H. (2015) Molecular and Quantitative Animal Genetics. Wiley Blackwell.
2. Altman, A., Hasegawa, P.M. (Eds.) (2011) Plant Biotechnology and Agriculture: Prospects for the 21st Century, Academic Press.
3. Liu, B. H. (2011) Statistical Genomics, Linkage Maps. CRC press, Bocca, New York.

Semester	**2**		
Code	MB 585		
Title	Ethical, Regulatory and Legal Aspects of Biotechnology		
Credits	1		
Notional hours	50		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	15	--	35
Prerequisites	MB 578, MB 581		

Aims:

1. Explain ethical standards, laboratory safety rules, regulatory, legal and business aspects of the Biotechnology Industry.
2. Provide a training on decision making in commercial release of GM products.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe the ethical, safety, regulatory and business aspects of Biotechnology,

2. formulate draft documents on ethical frameworks, prevention of plagiarism and scientific fraud, avoidance of conflict of interest, patent applications and
3. use Biotechnology only for the good causes of the mankind.

Course Content: (Main topics, Subtopics)

Ethical, legal and regulatory issues; ethics that protect Biotechnological inventions; procedures required to establish a Biotech company, intellectual property and licensing; ethics in research: sources of errors in science, scientific fraud, plagiarism and misrepresentation, conflicts of interest and confidentiality.

Teaching /Learning Methods:

Delivery: 15 hours of student-centered interactive theory lessons will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 2-3 tutorials will be given to be submitted within a week. Midsemester examination will be given after completion of 8 hours and grades will be distributed within a week. In addition, students are required to prepare a summary report on a selected journal article.

Overall Assessment: 50% of the final grade will be taken from the assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials/Assignments 10%	Report 15%	Midsemester Exam 25%	Theory 100%	Practical --	Others (specify) --

References/Reading Materials:

1. Bin R., Lorenzon S., Lucchi N. (Eds.) (2012) Biotech Innovations and Fundamental Rights. Springer.
2. Murray, T., Mehlman, M. (2000) Encyclopedia of Ethical, Legal and Policy Issues in Biotechnology. John Wiley and Sons.

Semester	**2**		
Code	MB 586		
Title	Plant Tissue Culture		
Credits	3		
Notional hours	150		
Compulsory / Optional	Optional		
Hourly Breakdown	Theory	Practical	Independent Learning
	15	60	75
Prerequisites	None		

Aims:

1. Explain the principles of tissue culture, laboratory requirement, organization and techniques.
2. Impart the skills on plant tissue culture, experimental design and quantification of results.
3. Apply plant tissue culture at commercial scale for the betterment of the world.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. describe the tissue culture, techniques and laboratory handling,
2. conduct experiments of plant tissue culture and
3. design and undertake tissue culture experiments to develop environmentally and economically important plant species.

Course Content: (Main topics, Subtopics)

Introduction, definition and technologies; potential application of organ culture, meristem culture, anther / pollen culture, callus, suspension cultures and protoplast culture; regeneration through meristem and callus cultures; somatic embryogenesis: production, preservation and use of somatic embryos as propagules; embryo culture; haploid plant production; cryopreservation, storage of germplasm; protoplast culture; somatic hybridization; induction and utilization of somatic variants; application of tissue culture; trouble shooting; advantages and disadvantages of Tissue Culture; commercialization of Tissue Culture technology, concept of commercialization and the need, design of typical Tissue Culture laboratory and its management.

Teaching /Learning Methods:

Delivery: 15 hours of student-centered interactive theory lessons and 60 hours of student centered demonstration aided interactive practical sessions will be conducted.

Continuous Assessment: In class group or/and individual assignments will be given at the end of each topic and feedbacks are taken at end of the class. 10-15 practical assignments will be given to be submitted within a week. Midsemester examination will be given after completion of 8 hours of theory and 30 hours of practicals and grades will be distributed within a week.

Overall Assessment: 50% of the final grade will be taken from the practical assignments, tutorials and midsemester exam. Final comprehensive examination will carry the rest of 50%.

Assessment Strategy

Continues Assessment: 50%			Final Assessment: 50%		
Tutorials 10%	Practical Assignments 15%	Midsemester Exam 25%	Theory 60%	Practical 40%	Others (specify) --

References/Reading Materials:

1. Gamborg, O.L., Phillips, G.C. (Eds.) (2013) Plant Cell, Tissue and Organ Culture: Fundamental Methods. Springer Lab Manuals.
2. Bhojwani, S.S., Dantu, P.K. (2013) Plant Tissue Culture: An Introductory Text. Springer.

Semester	**2**		
Code	MB 599		
Title	Independent Study		
Credits	5		
Notional hours	500 notional hours		
Compulsory / Optional	Compulsory		
Hourly Breakdown	Theory	Practical	Independent Learning
	--	--	500

Prerequisites	None

Aims:

1. Describe the Scientific Writing process, its key stages land importance of publishing data promptly.
2. Impart skills to analyze and review scientific papers in terms of key message, consistency and justification.
3. Provide the importance on the benefits of working towards scientific accomplishments and career development.
4. Provide the rules of co-authorship and the ethics in Scientific Writing and undertaking research.
5. Impart skills to write and present routine forms of scientific publications.
6. Impart skills to conduct an independent review of literature, summarization and presentation.
7. Explain the conventions and standards in planning and delivering a scientific oral seminar.
8. Provide an opportunity to conduct an independent study on a novel topic.

Intended Learning Outcomes:

At the end of the successful completion of the course students will be able to,

1. explain the scientific process and forms of publications in research work,
2. able to review scientific communiques for the quality, write and present diverse forms of publications such as primary research articles and oral seminars,
3. work in teams towards scientific accomplishments and
4. explain the rules of co-authorship and ethics in Scientific Writing and undertaking research.
5. conduct an independent review of literature on a selected topic in Molecular Biology and Biotechnology, summarize and present to an audience and
6. describe the standard practices in formulating and delivering a scientific Seminar.
7. carry out independent studies on scientific issues and problems and
8. report the details and opinions derives from independent studies effectively to the scientific audience.

Course Content: (Main topics, Subtopics)

Review of research area, introduction to project, types, purposes, components and structure of project proposals, justifying and presenting a problem, literature review and development of proposal, time frame, resource identification and budgeting; writing project reports and journal articles, standard formats, principles and structuring the reports for degree requirements, using scientific jargon and logical presentation of data; writing concise, specific and detailed abstracts; documenting a scientific paper and presenting scientific material, conventions in designing research posters.

Each student is required to present a Seminar based on the current developments in an area of Biochemistry, Molecular Biology and Biotechnology chosen.

The student will work on a selected Molecular Biology or Biotechnology topic of interest under the guidance of a faculty member who agrees to supervise such work and write a comprehensive report according to the specifications provided by the Lecturer in-charge. This could preferably be a library research.

Teaching /Learning Methods:

Delivery: Student led background and literature review, case studies.

Continuous Assessment: Mid-review presentation will test the students' progress of literature review related to the selected topic and presentation skills. The mid-review report assignment will test the students' ability in summarizing skills and technical writing skills.

Overall Assessment: 50% of the final grade will be taken from the mid-review presentation and report. Final presentation and report will carry the rest of 50%.				
Assessment Strategy				
Continues Assessment: 50%		Final Assessment: 50%		
Report 20%	Mid-review Presentation 30%	Theory 60%	Practical 40%	Others (specify) Presentation: 25% Report: 25%
References/Reading Materials: 1. Blackwell, J., Martin, J. (2011) A Scientific Approach to Scientific Writing, Springer.				

Course code	MB 699
Course title	Research Project
Credits	30
Compulsory/optional	Compulsory
Prerequisites	GPA of 3.00 at M.Sc. (Course work)
Time allocation	3000 notional hrs.
Aims	The overall aim is to prepare the student to conduct a research independently. **Specific aims:** 1. To train students to apply scientific method in scientific research. 2. To train students to generate researchable hypotheses. 3. To train students to plan, design and conduct scientific research. 4. To train students to gather reliable scientific data, analyse, and interpret. 5. To develop skills in scientific writing.
Intended learning outcomes	At the end of the successful completion of the course, students will be able to, 1. Apply the scientific method. 2. Design a research project. 3. Complete a research project. 4. Describe ethical issues in scientific research. 5. Explain the patenting process in research. 6. Make presentations at national/international conferences. 7. Produce a thesis conforming to the requirements of the PGIS. 8. Write manuscripts for publication in refereed journals.
Content	The students will conduct sufficient amount of laboratory/field work on a chosen research topic under the guidance provided by an assigned supervisor/s, make a presentation of research findings at a national/international conference, and produce a thesis.

Assessment criteria

Continuous assessment	End-semester examination

30%	Oral examination (20%) Thesis (40%) Conference presentation (10%)

Recommended Texts:

1. Backwell, J., Martin, J. (2011) A Scientific Approach to Scientific Writing, Springer.
2. Postgraduate Institute of Science (2016) Guidelines for Writing M.Sc. Project Report/M.Phil. Thesis/Ph.D. Thesis

7. PROGRAMME EVALUATION Evaluation of Course work

Formative and summative examinations in the program:

The course work will consist of compulsory courses and optional courses. Courses will be taught by classroom lectures and laboratory practical work and fieldwork depending on the course unit. In addition, the students are expected to write tutorials and conduct seminars. The students may also be assigned independent learning tasks, essays, and library searches. A theory course will, in general, consist of two to three credits where one credit is equivalent to fifteen (15) hours of instruction. For laboratory work and fieldwork, where applicable, thirty (30) to forty-five (45) hours of work is considered as one credit. Students are required to earn a minimum 30 credits for the Master of Molecular Biology and Biotechnology Degree Programme.

Scheme of Grading (Grades/Grade Points/ Marks ranges):

On completion of the end of course examination the instructor(s) is/are required to hand over the grades of a given course to the programme coordinator who will assign the Grade Points using the following table:

Grade	Grade Point
A+	4.0
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
F	0.0

Calculation of Grade Point Average (GPA):

The Grade Point Average (GPA) will be computed using the formula:

$$GPA = \frac{\sum c_i g_i}{\sum c_i}$$

Where c_i = Number of credit units for the i^{th} subject and

g_i = grade points for the i^{th} subject

Contribution by each semester to final GPA:

50% from each semester

Contribution by in-plant training etc. to final GPA:

None for Master of MBB Degree Programme.

Repeat/Make up examinations:
If a student fails a course or wishes to improve his/her previous grade in a course, he/she shall repeat the course and course examinations at the next available opportunity. However, he/she may be exempted from repeating the course, and repeat only the course examinations if recommended by the teacher-in-charge or Programme Coordinator. The student may repeat the same course or a substituted (new) optional course in place of the original course. A student is allowed to repeat four credits of coursework free-of-charge. The maximum number of credits a candidate is allowed to repeat is twelve. The maximum grade, a candidate could obtain at a repeat attempt is a B and he/she is allowed to repeat a given course only on two subsequent occasions.

'Make-up' examinations may be given only to students who fail to sit a particular examination due to medical or other valid reasons acceptable to the PGIS.

Guidelines on thesis proposal, presentation and defense: Not relevant for Masters (Molecular Biology and Biotechnology)

Guidelines on conduct of research: Not relevant for Masters (Molecular Biology and Biotechnology)

Guidelines on comprehensive examination:
On completion of the course, the instructor(s) is/are required to conduct the final comprehensive examination and hand over the grades of a given course to the programme coordinator.

Guidelines on thesis defense examination: Not relevant for Masters (Molecular Biology and Biotechnology)

Awarding the Masters (Molecular Biology and Biotechnology):
A student who have successfully completed a minimum of 30 credits with a minimum overall GPA of 2.75 will be awarded the Master of Molecular Biology and Biotechnology.

Evaluation of Research Project

Research project will be evaluated on the basis of a written report (M.Sc. project report) and oral presentation (see Section 6.0 of the PGIS Handbook for the format of the project report).

8. PANEL OF TEACHERS

Name of the Lecturer	Designation	Average No. of Teaching Hours/Week					
		Internal Programmes (i)		External Programmes (ii)		Proposed Programme (iii)	Total Hrs. (i)+(ii)+(iii)
		Undergraduate	Postgraduate	Undergraduate	Postgraduate		
Dr. M.P.C.S. Dhanapala, Dept. of Molecular Biology and Biotechnology, Faculty of Science, Univ. of Peradeniya. *B.Sc. (Perad.), M.Sc. (Saga), Ph.D. (SL); Specialization: Plant Molecular Biology*	Senior Lecturer	6	3			3	12
Prof. P. H. P. Fernando, Dept. of Biochemistry, Faculty of Medicine, Univ. of Peradeniya. *B.VSc. (Perad.), Ph.D. (Kahoshima); Specialization: Biochemistry*	Professor	7	3			3	13
Prof. S.H.P.P. Karunarathne, Dept. of Zoology, Faculty of Science, Univ. of Peradeniya. *B.Sc. (Perad.), Ph.D. (London); Specialization: Molecular Entomology*	Senior Professor	6	3			3	12
Dr. S.P. Kodithuwakku, *Dept. of Animal Science, Faculty of Agriculture,* Univ. of Peradeniya. *B.Sc. (Perad.), Ph.D. (Hong Kong); Specialization: Molecular Reproductive Biology*	Senior Lecturer	6	3			3	12
Prof. P.A.J. Perera, Dept. of Biochemistry, Faculty of Medicine, Univ. of Peradeniya. *B.Sc. (Cey.), Ph.D. (Glas.); Specialization: Biochemistry*	Emeritus Professor		3			3	6
Prof. R.G.S.C. Rajapakse, Dept. of Molecular Biology and Biotechnology, Faculty of Science, Univ.of Peradeniya. *B.Sc. (Perad.), M.Phil. (Perad.), Ph.D. (Hokkaido); Specialization: Protein Chemistry*	Professor	7	3			3	13
Prof. J.G.S. Ranasinghe, Dept. of Biochemistry, Faculty of Medicine, Univ. of Peradeniya. *B.VSc. (Perad.), M.Phil., Ph.D. (Japan); Specialization: Biochemistry*	Professor	6	3			3	12
Prof. P. Samaraweera, Dept. of Molecular Biology and Biotechnology, Faculty of Science, Univ. of Peradeniya. *B.Sc. (Perad.), Ph.D. (Arizona, USA); Specialization: Biochemistry*	Professor	6	3			3	12
Prof. R. Sivakanesan, Dept. of Biochemistry, Faculty of Medicine, Univ. of Peradeniya *B.V.Sc. (Cey.), Ph.D. (Hull); Specialization: Biochemistry*	Emeritus Professor		3			3	6
Dr. Y.A.M.S. Wickremasinghe Dept. of Basic Veterinary Sciences, Faculty of Veterinary Medicine & Animal Science, Univ. of Peradeniya. *B.VSc., (Perad.), M.Sc. (Oklahoma, USA), Ph.D.*	Senior Lecturer	6	3			3	12

Name of the Lecturer	Designation	Average No. of Teaching Hours/Week					
		Internal Programmes (i)		External Programmes (ii)		Proposed Programme (iii)	Total Hrs. (i)+(ii)+(iii)
		Undergraduate	Postgraduate	Undergraduate	Postgraduate		
(California Davis, USA); Specialization: Molecular Genetics							
Dr. T.M.I.U.K. Tennakoon Dept. of Pharmacy, Faculty of Allied Health Sciences, Univ. of Peradeniya. *B.Sc. (Perad.), Ph.D. (Queensland, Australia); Specialization: Pharmaceutical Microbiology*	Senior Lecturer	6	3			3	12
Dr. H.R.N. Jinadasa Dept. of Pharmacy, Faculty of Science, Univ. of Peradeniya. *B.VSc.,(Perad.), MSc (Nebraska) Ph.D. (Cornell); Specialization: Molecular Diagnostics*	Senior Lecturer	6	3			3	12
Prof. C.D. Gamage Dept. of Microbiology, Faculty Medicine, Univ. of Peradeniya. *B.VSc., (Perad.), Ph.D. (Japan) Specialization: Microbiology*		6	3			3	12
Prof. J.A.M.S. Jayathilake Dept. of Oral Medicine and Periodontology, Faculty of Dental Science, Univ. of Peradeniya. *B.DS. (Perad.), Ph.D. (Hong Kong); Specialization: Microbiology*	Professor	6	3			3	12
Prof. H.K.I. Perera Dept. of Biochemistry, Faculty Medicine, Univ. of Peradeniya. *B.VSc., (Perad.), MPhil., (Perad), Ph.D. (Glasgow, UK) Specialization: Biochemistry*	Professor	6	3			3	12
Dr. W.I.T. Fernando, Dept. of Biochemistry, Faculty Medicine, Univ. of Peradeniya. *B.VSc., (Perad.), MPhil., (Perad), Ph.D. (Glasgow, UK); Specialization: Biological Chemistry*	Senior Lecturer	6	3			3	12
Prof. A. Wanigasekera Dept. of Basic Veterinary Sciences, Faculty of Veterinary Medicine & Animal Science, Univ. of Peradeniya. *B.Sc., MPhil. (Perad.), Ph.D. (Kyoto, Japan); Specialization: Biological Chemistry*	Professor	6	3			3	12
Dr. N.U. Jayawardane Dept. of Agric. Biology, Faculty of Agriculture, Univ. of Peradeniya. *B.Sc. (Perad.), M.Sc. (Perad), Ph.D (Melbourne, Australia); Specialization: Genetics and Biotechnology*	Senior Lecturer	7	3			3	13
Dr. D.V. Jayathilake Dept. of Agric. Biology, Faculty of Agriculture, Univ. of Peradeniya. *B.Sc. (Perad.), M.Sc. (Kansas, USA, Ph.D. (Adelaide, Australia); Specialization: Agronomy and Molecular Sciences*	Senior Lecturer	6	3			3	12
Dr. D.R. Uduwela Dept. of Chemistry, Faculty of Science, Univ. of Peradeniya. *B.Sc. (Perad.), Ph.D.*	Senior Lecturer	6	3			3	12

Name of the Lecturer	Designation	Average No. of Teaching Hours/Week					
		Internal Programmes (i)		External Programmes (ii)		Proposed Programme (iii)	Total Hrs. (i)+(ii)+(iii)
		Undergraduate	Postgraduate	Undergraduate	Postgraduate		
(ANU, Australia); Specialization: Biochemistry							

Panel of Teachers/External Resource Persons [cntd.]

Name	Qualification	Affiliation
Prof. M.P.B. Meegaskumbura,	*B.Sc. (Perad), Ph.D. (Boston, USA)*	Professor, College of Forestry, Guangxi University, China.
Dr. D.N. Magana-Arachchi	*B. Sc. (Colombo.), Ph.D. (Colombo)*	*Associate Research Professor, Institute of Fundamental Studies, Sri Lanka.*
Dr. K.D.B. Ukuwela	*B.Sc. (Perad), Ph.D. (Australia)*	Senior Lecturer, Faculty of Applied Sciences, University of Peradeniya, Peradeniya
Prof. A.M.J.B. Adikari	*B.Sc. (Perad), M.Sc. (New Delhi) Ph.D. (VPSU, USA)*	Professor, Faculty of Agriculture, University of Peradeniya, Peradeniya
Dr. M.A.B. Ranathunga	*B.Sc. (Perad), M.Sc. (New Delhi) Ph.D. (Perad)*	Head, Plant Breeding Division, Tea research Institute, Talawakele
Dr. Sumith de Z. Abesiriwardane	*B.Sc. (Perad), Ph.D. (VPSU, USA)*	Senior Scientist, CIC Agri Industries, Palwehera
Dr. R.R. Rathnayake	*B. Sc. (Perad), Ph.D. (Perad)*	*Associate Research Professor, Institute of Fundamental Studies, Kandy, Sri Lanka.*
Dr. U.A.K.S. Udawela	*B.Sc. (Perad), Ph.D. (China)*	Assistant Director – Research, Rice Research and Development Institute, Bathalagoda, Ibbagamuwa

9. PROGRAMME COORDINATOR

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