POSTGRADUATE INSTITUTE OF SCIENCE
UNIVERSITY OF PERADENIYA

Master of Experimental Biotechnology Degree Programme (SLQF Level 9)

Master of Science (M.Sc.) in Experimental 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 Experimental 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 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 Experimental Biotechnology, students from a variety of backgrounds with varied levels of 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 Experimental Biotechnology is often beyond the scope of such curricula, mainly due to time constraints. The absence of properly trained 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 Experimental 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 Experimental 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 Experimental 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 Experimental 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 Experimental Biotechnology (in the form of thesis and publications).

Attributes to Qualification Holders

- Demonstrate critical awareness and current issues in Experimental Biotechnology and apply relevant techniques.
- Make judgment in issues in Experimental Biotechnology and communicate with specialist and non-specialist groups.
- Demonstrate self-directions, originality and problem solving skills and accomplish tasks in experimental 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 Experimental Biotechnology.
- Demonstrate critical awareness of current issues and recent developments in Experimental Biotechnology.

Practical Knowledge and Application

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

Communication

- Communicate the findings/conclusions of Experimental 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 Experimental Biotechnology and test them in a scientific manner.
- Demonstrate self-direction and originality in solving problems of Experimental Biotechnology.

- Make decisions in complex and unpredictable contexts coming under Experimental 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 Experimental 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 Experimental 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 Experimental 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 Experimental Biotechnology.
- Critically analyze data, make judgments and propose solutions to problems.

Practical Knowledge and Application

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

Communication

- Demonstrate awareness of the current developments in Experimental 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

- Work in teams, give leadership, and promote social and professional engagement.

Adaptability and Flexibility

- Plan and execute appropriate strategies for adapting to changing environments.

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 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 Experimental Biotechnology Degree Programme	M.Sc. in Experimental Biotechnology Degree Programme
Local candidates	Rs. 225,000/=	Rs. 350,000/=
Candidates from other countries	Rs. 450,000/=	Rs. 700,000/=

** 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. An additional payment of Rs. 100,000/- (or Rs. 200,000/- form foreign students) should be made at the end of the first year to continue for the M.Sc. in Experimental Biotechnology degree programme. 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 Experimental 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 Experimental 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, totalling 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 Experimental Biotechnology Degree - SLQF Level 10 (Students who do not complete the research project within the stipulated time period shall be awarded the Master of Experimental 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).

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Programme Summary

Course Code	Course Title	Lecture hrs.	Practical hrs.	No. of credits
	Semester I			
MB 533	Molecular cell biology	30	30	3
MB 534	Protein chemistry	15	45	2
MB 535	Molecular genetics	20	20	2
MB 536	Molecular microbiology	15	45	2
MB 537	Immunology	15	45	2
MB 538	Recombinant DNA technology	15	30	2
MB 539	Industrial biotechnology	05	50	2
MB 540	Bioinformatics	15	30	2
MB 565	Molecular Biotechnology	30	-	2
	Semester II			
MB 546	Advanced immunology*	15	30	2
MB 547	Advanced biochemistry*	15	30	2
MB 548	Animal cell culture*	10	40	2
MB 549	Animal developmental biology*	10	40	2
MB 550	Animal transgenics*	15	-	1
MB 551	Recent applications in animal biotechnology*	10	40	2
MB 552	Biotechnology in medicine*	15	30	2
MB 553	Plant developmental biology*	10	10	1
MB 554	Plant tissue culture*	10	55	2
MB 555	Biotechnology in plant breeding*	15	30	2
MB 556	Plant transgenics*	15	-	1
MB 557	Recent applications in plant biotechnology*	10	40	2
MB 558	Biostatistics	15	30	2
MB 599	Independent Study**[1]	500 notional hours		5
MB 699	Research Project**[2]	3000 notional hours		30

** Optional Courses*
**1 Optional Courses - Animal biotechnology*
**2 Optional Courses - Plant biotechnology*
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

Course Code	MB 565
Course Title	Molecular Biotechnology
Credits	2
Compulsory/Optional	Compulsory
Prerequisites	
Time Allocation	Lectures: 30 hrs
Aims	1. Introduce 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. plan general experiments routinely used in Molecular Biotechnology.
Content	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; 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.

Assessment criteria: Continuous Assessment

Component	**% marks**
Continuous Assessment	40%
End-Semester Examination	60%

Recommended Texts:

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.

Course Code	MB 599
Course Title	Independent Study
Credits	5
Compulsory/Optional	Compulsory
Time Allocation	500 notional hours
Aims	The overall aim is to familiarize the student with concepts and methods involved in scientific research. **Specific aims:** 1. To learn the scientific process in the conduct of research. 2. To develop skills to write s review paper and a scientific research proposal. 3. To develop skills to make a presentation. 4. To carry out a case study in Experimental Biotechnology related problem.
Intended Learning Outcomes	At the end of the successful completion of the course module, students will be able to, 1. Conduct an independent review of literature on a selected topic in the area of Experimental Biotechnology. 2. Write a formal scientific report conforming to the guidelines provided. 3. Transfer the knowledge gained through (1) and (2) above in the form of a presentation. 4. Complete a research proposal conforming to the guidelines provided. 5. Explain the ethics in scientific writing and undertaking research.
Content	*Review paper*: Review of literature; Development of the review paper in concise and professional manner and logical presentation of results that have been reported, writing the abstract, compilation of the list of references. *Proposal writing*: Interpretation and critical evaluation of results of published research; Formulation of a research problem: Concise literature review, justification, time frame, identification of resources, budgeting, etc. *Seminar*: Presentation of literature and data collected on given topic; Preparation of abstract, preparation of slides. *Case study*: Presentation of the results and conclusions of the case study.

Assessment criteria: Continuous Assessment

Component	% marks
Review paper	20
Proposal writing	10
Case study	40
Seminar	30

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

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

PROGRAMME CONTENTS OF OTHER COURSES

MB 533: Molecular cell biology (3 credits)
Cell basics - biomolecules and their assemblies, enzymes. Bioenergetics - metabolism, regulation and its control. Cell division - mitosis and meiosis, DNA replication, transcription and protein synthesis. Cell communication. Cell fractionation and constituent detection. Enzyme kinetics.

MB 534: Protein chemistry (2 credits)
Amino acids. Protein structure. Glycoproteins. Lipoproteins. Protein purification. Protein analysis. Protein design. Enzyme kinetics. Practicals based on the above.

MB 535: Molecular genetics (2 credits)
Introduction to genetics-Mendalism and chromosomal theory, population genetics and molecular genetics, Chemistry of the gene, Prokaryotic and eukaryotic; molecular transcription and translation, Quantitative and evolutionary genetics.

MB 536: Molecular microbiology (2 credits)
Fundamentals of microbial cell structure and function, Principles of microbial cultivation in industrial process brewing antibiotic production and genetically engineered products. Novel food resources. Biodegradation. Fermentation process

MB 537: Immunology (2 credits)
Cells and organs of the immune system. Types and basis of immunity. Antibody diversity and their biological activities. Antigens. Antigen processing and presentation. Major histocompatibility complex. Complement. Antigen and antibody detection methods.
Biotechnology aided advancements in immunology.

MB 538: Recombinant DNA technology (2 credits)
Cloning vectors, Purification and manipulating of DNA, Introduction of DNA into living cells, Production and analysis of gene libraries, Isolation and Identification of clone genes, Gene function, Production of protein of clone genes, Introduction of generation and analysis of transgenic plants and animals.

MB 539: Industrial biotechnology (2 credits)
Fermentation process, modeling and control in bioprocess systems, novel microorganisms Natural products and quantitative techniques. microbial transformation of organic pollutants.

MB 540: Bioinformatics (2 credits)
Introduction of bioinformatics, basic 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, gene expression. Bimolecular computing.

MB 546: Advance Immunology (2 credits)
Development of the Immune System. Evolution of Immunity. Immunology of infectious diseases including viruses, bacteria and parasites with emphasis on acquired immune response – Lymphocyte activation. Effect of lymphocyte secretary products. Regulation in relation to different infectious agents. Immunogenetics. Pathology associated with immune responses. Vaccination. Immunopathology - immunodeficiency. Hypersensitivity, Autoimmune diseases. Transplantation and rejection. Tumor Immunology. Isolation and purification of agents of infectious diseases. Immunological techniques – immunochemical and cellular techniques. Serological and DNA based diagnostic tests.

MB 547: Advanced Biochemistry (2 credits)
Biomolecules (Carbohydrates, lipids, proteins and nucleic acids), Advanced Enzymology, Integrated Metabolism, Molecular Biology, Signal Transduction, Immunology

MB 548: Animal Cell culture (2 credits)
Animal Cell Culture: Introduction to animal cell culture- importance, equipment, techniques and safety in the laboratory, media formulations and preparation, use of serum free medium. Biology of animal cells, cellular interactions and growth kinetics. Organ and cell culture Culturing and sub culturing of animal cells. Monolayer and suspension cultures. Cell quantitation. Cell line preservation and characterization. Flow cytometry.
Cryopreservation. Applications of cell culture.

MB 549: Animal Developmental biology (2 credit)
Theory of evolution - chemical, biological and cellular. Reproduction and development in plants and animals. Systems and their control - Respiratory, circulatory and digestive systems. Nervous system. Senses. Homeostasis and the internal environment.
Cell programming - development, differentiation, death, cancer, onco-genes & suppressor genes.

MB 550: Animal Transgenics (1 credit)
Introduction to transgenic animals. Transferring genes into animal oocytes/eggs, embryos and specific animal tissues. Production of transgenic mice, cattle, sheep, goats, and pigs. Applications of transgenic technology.

MB 551: Recent applications in animal biotechnology (2 credits)
Gene probes for identification of invading microbes for development of immuno histochemical methods, genetic application to overcome genetic disorders, use of microbes for development of antibiotics and future drugs.

MB 552: Biotechnology in medicine (2 credits)
Production of antibodies, vaccines, Biopharmaceuticals, Proteins, enzymes and human organs. Molecular analysis of human diseases. Prenatal diagnosis. Gene therapy. Post genome projects. Environmental biotechnology. Gene mapping. DNA finger printing. Molecular diagnostic methods.

MB 553: Plant Developmental biology (2 credits)
General topics of developmental biology. Ontogenesis of higher plants considering results by comparative-descriptive methods (developmental morphology) and by casual analytical and genetic methods. (casual morphology/ developmental physiology, molecular biology of development). Plant growth, differentiation and morphogenesis. Introductory embryology. Meristem development. Structure and function of apical meristems, flower development pollination and incompatibility. Senescence and dormancy. Controlling factors of development.

MB 554: Plant tissue culture (2 credits)
History; Principles of Tissue culture; Pathways of regeneration; Micropropagation; Types of culture (Protoplast, Cell, Tissue, Organ) Conservation of germplasm (in vitro micrografting, in vitro conservation, cryopreservation); Application of tissue culture; Trouble shooting; Advantages and disadvantages of tissue culture.

MB 555: Biotechnology in plant breeding (2 credit)
Introduction to breeding (principles and practices) and biodiversity; Somatic hybridization; haploid plant production (Androgenesis, gynogenesis); In vitro fertilization and embryo rescue; Somaclonal variation; Plant transformation, Marker aided selection of genetic material; Genetic variation and detection.

MB 556: Plant Transgenics (1 credits)
Plant genomes (nuclear, michondrial, chloroplast); Isolation of genes; Characterization of genes; Construction of cDNA libraries; Transformation- using Agrobacterium and biolistic method; GMO's and environmental issues; legal issues.

MB 557: Recent applications in plant biotechnology (2 credits)

Biodiversity conservation, exchange, management and utilization; GM foods; Biotechnology of N_2 fixation; Molecular plant systematic; Molecular techniques in crop improvement; Molecular Diagnostics, Biovillages; Bioprospecting; Industrial biotechnology.

MB 558: Biostatistics (2 credits)
Principles of probability, introduction to statistical terms; measures of center dispersion; population distribution types; test of significance, t-test, z-test, goodness of fit; non-parametric tests; correlation & linear regression; analysis of variance & experimental design; suitability of standard designs for specific experiments; time series data handling.

MB565 Molecular Biotechnology (2 credits)
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; 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.

MB599 Independent Study (5 credits)
Review paper: Review of literature; Development of the review paper in concise and professional manner and logical presentation of results that have been reported, writing the abstract, compilation of the list of references.
Proposal writing: Interpretation and critical evaluation of results of published research; Formulation of a research problem: Concise literature review, justification, time frame, identification of resources, budgeting, etc.
Seminar: Presentation of literature and data collected on given topic; Preparation of abstract, preparation of slides.
Case study: Presentation of the results and conclusions of the case study.

MB 699: Research Project (30 credits)
Each student is required to complete a research project on an appropriate topic falls within the disciplines of Experimental Biotechnology. 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.

7. PROGRAMME EVALUATION

Evaluation of Course work

Based on the scheme given below, the overall performance of a student in a given course shall be evaluated by the respective instructor(s) and a grade shall be assigned.

Evaluation Scheme

- For all courses a minimum of 80% attendance is expected.
- The evaluation of each course (except independent study and research project) shall be based on within course and end of course examinations, and assignments. The weightage of marks given below can generally be used as a guideline in the computation of the final grade, except for Independent Study and Research Project.

End of course examination	50 - 60%
Continuous assessments (mid-semester examination, assignments, etc.)	40 - 50%

- Courses with laboratory and/or fieldwork shall be evaluated, where applicable, on a continuous assessment basis.
- The minimum grade a student should achieve to pass a course is C.
- Students will be informed of the evaluation scheme by the instructor at the beginning of a given course.

Grade Points and Grade Point Average (GPA)
The Grade Point Average (GPA) will be computed using the grades earned for core courses and optional courses, taken for credit.

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
D	1.0
E	0.0

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

$$GPA = \frac{\Sigma c_i g_i}{\Sigma c_i},$$

where c_i = number of credit units for the i^{th} course, and
g_i = grade point for the i^{th} course

Make-up Examinations
'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.

Repeat Courses
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 M.Sc. 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 five credits of coursework free-of-charge. The maximum number of credits a candidate is allowed to repeat is fifteen. 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.

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

No.	Name, qualifications and affiliation	Area of Specialization
1	Prof. C.N.R.A. Alles *B.VSc. (Perad.), Ph.D. (Tokyo Medical and Dental University)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
2	Ms. M.P.C.S. Dhanapala *B.Sc. (Perad.), M.Sc. (Saga)* Dept. of Molecular Biology and Biotechnology, Faculty of Science, UOP	Plant Molecular Biology
3	Dr. P. H. P. Fernando *B.VSc. (Perad.), Ph.D. (Kagoshima)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
4	Prof. S.H.P.P. Karunarathne *B.Sc. (Perad.), Ph.D. (London)* Dept. of Zoology, Faculty of Science, UOP	Molecular Entomology
5	Dr. K. Maduwage, *MBBS (Perad*.) *M.Phil. (Perad.), Ph.D. (Newcastle)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
6	Dr. S.P. Kodithuwakku *B.Sc. (Perad.), Ph.D. (Hong Kong)* Dept. of Animal Science, Faculty of Agriculture, UOP	Molecular Reproductive Biology
7	Prof. D.N. Magana-Arachchi *B. Sc. (Colombo.), Ph.D. (Colombo)* National Institute of Fundamental Studies, Kandy	Molecular Biology
8	Prof. M. P.B. Meegaskumbura *B.Sc. (Perad), Ph.D. (Boston, USA)* Dept. of Molecular Biology and Biotechnology, Faculty of Science, UOP	Molecular Systematics
9	Prof. H. K. I. Perera (*B.VSc. (Perad.), Ph.D. (Glasgow)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
10	Prof. R. G. S. C. Rajapakse *B.Sc. (Perad.), M.Phil. (Perad.), Ph.D. (Hokkaido)* Dept. of Molecular Biology and Biotechnology, Faculty of Science, UOP	Protein Chemistry/Cell Biology

11	Prof. J.G.S. Ranasinghe *B.VSc. (Perad.), M.Phil., Ph.D. (Japan)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
12	Prof. P. Samaraweera *B.Sc. (Perad.), Ph.D. (Arizona, USA)* Dept. of Molecular Biology and Biotechnology, Faculty of Science, UOP	Biochemistry
13	Prof. R. Sivakanesan *B.V.Sc. (Cey.), Ph.D. (Hull)* Dept. of Biochemistry, Faculty of Medicine, UOP	Biochemistry
14	Prof. S. D. S. S. Sooriyapathirana *B.Sc. (Perad.), M.Sc. (Perad.), Ph.D. (Michigan State, USA)* Dept. of Molecular Biology and Biotechnology, Faculty of Science, UOP	Genetics, Breeding and Biotechnology
15	Dr. Y. A. M. S. Wickramasinghe *B.V.Sc. (Perad), MS (Oklahoma), Ph.D. (California Davis)* Dept. of Basic Veterinary Science Faculty of Veterinary Medicine & Animal Science, UOP	Animal Genomics and Bioinformatics

9. PROGRAMME COORDINATOR

Prof. RGSC Rajapakse
Department of Molecular Biology and Biotechnology
Faculty of Science
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