

# POSTGRADUATE INSTITUTE OF SCIENCE

## UNIVERSITY OF PERADENIYA



## M.Sc. Programme in Experimental Biotechnology

### 2011/2012

#### 1. INTRODUCTION

Biotechnology is a rapidly developing area of science that has made a great impact on human lives in one way or another. Its broadest definition encompasses activities of many scientific fields, and has brought about a revolution in the understanding of biological systems and their interactions with the environment at a molecular level. In the production line, creating organs for transplant, animals and plants as pharmaceutical factories, production of edible vaccines at low risk to the recipient and high nutrient containing food items are becoming demand value driven industries. Thus, the speed of the technology's development has sparked a great debate among the advocates and those who oppose it.

Today, around the world, this technology is contributing to the understanding and advancements in the fields of medicine, agriculture and the environment. The momentous achievements within the past decade have brought in newer challenges propelling the goals of the discipline even further. Thus, the impacts of biotechnology are multifaceted, and a wealth of information has been generated within the last few decades. The outcomes of activities of biotechnology benefit developed and developing countries alike. However, there is a vast gap in knowledge and skills between the two categories with respect to research and development. Thus, it is important to develop programmes that enhance the knowledge and skills of the potential researchers in our own country as the positive aspects could be manipulated to suite a country's national needs.

It is also noteworthy, that having realized the potential of biotechnology research, the government of Sri Lanka has recognized biotechnology as a thrust area for development. As a step towards developing human resources, the Board of Study in Biochemistry and Molecular Biology has been given the mandate to conduct courses that are beneficial to the country. This programme is therefore aimed as providing the theoretical as well as practical skills for those who are embarking on the teaching, research application based activities in this field.

#### 2. OBJECTIVES OF THE PROGRAMME

1. To introduce graduates to the science of biotechnology.
2. To impart and enhance the knowledge and skills of graduates who are involved in research and development in the field of biotechnology.
3. To update and contribute to the National research and development programmes on national issues.
4. To liaise with ongoing research programmes in the country.

### 3. PROGRAMME ELIGIBILITY

Candidates having a bachelors degree in medical, dental, agricultural, veterinary, biological, engineering and physical sciences, or equivalent qualification are eligible to follow the programme. Those without the necessary background on the discipline of biotechnology may have to follow additional courses prior to the main programme. Priority will be given to those candidates, embarking on research degrees related to the field, or requires on the job training. Once the candidates are short-listed, they will have to face a selection examination, conducted by the PGIS. Employed candidates who are 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

(N.B. The Programme fees given below may be revised.)

	M.Sc. programme fee
local candidates	Rs. 200000/-
SAARC countries	US \$ 7300/-
other countries	US \$ 14600/-

Programme fees shall be paid in two installments (*50% at the registration and the balance 50% within six months from registration*). 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.

### 5. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted over a period of two semesters of 15 - weeks each, which will involve about 12 months. The entire programme duration will be about 15 - 18 months inclusive of further 3 - 6 months for the research project. Satisfactory completion of a minimum of 24 credits of course work (with a GPA of not less than 3.00) is required for the programme in addition to the 6 credits allocated for the full-time research project (*The student who does not satisfy the above criteria but obtains a GPA in the range 2.75 to 2.99 for course work is eligible for the Diploma in Experimental Biotechnology but not the M.Sc. Degree*). Continuous attendance is compulsory during the period of research work. After successful completion of the research project, the student is eligible for the award of the M.Sc. Degree.

An academic advisor shall be appointed to each candidate enrolling for the programme. The advisor and the candidate must at all times keep in touch with the programme coordinator for the smooth conduct of the programme. English will be the medium of instruction. IT facilities are available for the programme.

#### Programme Summary

Course Code	Course	Lecture hrs.	Practical hrs.	No. of credits
<b>Semester I</b>				
MB 531	Overview on biotechnology	15	-	-
MB 532	Issues related to biological resources	5	20	1
MB 533	Molecular cell biology	30	30	3
MB 534	Protein chemistry	15	45	2
MB 535	Molecular genetics	15	30	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	5	50	2
MB 540	Bioinformatics	15	30	2
<b>Semester II</b>				
MB 546	Advance immunology*	15	30	2
MB 547	Advanced Biochemistry*	15	30	2
MB 548	Animal Cell culture* <sup>1</sup>	10	40	2
MB 549	Animal Developmental biology* <sup>1</sup>	10	40	2
MB 550	Animal Transgenics* <sup>1</sup>	15	-	1
MB 551	Recent applications in animal biotechnology* <sup>1</sup>	10	40	2
MB 552	Biotechnology in medicine* <sup>1</sup>	15	30	2
MB 553	Plant Developmental biology* <sup>2</sup>	10	10	1
MB 554	Plant tissue culture* <sup>2</sup>	10	55	2
MB 555	Biotechnology in plant breeding* <sup>2</sup>	15	30	2
MB 556	Plant Transgenics* <sup>2</sup>	15	-	1
MB 557	Recent applications in Plant biotechnology* <sup>2</sup>	10	40	2
MB 558	Biostatistics	15	30	2
MB 597	Seminar	-	-	1
MB 599	Research Project	(3 - 6 months)		6

\* *Optional Courses*

\*<sup>1</sup> *Optional Courses - Animal biotechnology*

\*<sup>2</sup> *Optional Courses - Plant biotechnology*

*Students are required to obtain 3 credits from optional courses.*

## 6. PROGRAMME CONTENTS

### **MB 531: Overview on biotechnology (15 hours, no credits)**

Biotechnology; current definitions, key concepts, current focus, research priorities, current status, use of computational tools, crossing the boundaries of scientific disciplines - medicine, agriculture and industry - multidisciplinary research.

### **MB 532: Issues related to biological resources (1 credit)**

Issues such as Environmental impacts, GMOs, Seed technology, Bio-safety, Bioethics, Access to biotechnology, Intellectual Property Rights, Sustainable use of biological resources, Access and benefit sharing. Multilateral conventions in these areas. Effect of the World Trade Organization. Sri Lankan national legislation and obligations. Developing Country concerns.

### **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 secretory products. Regulation in relation to different infectious agents. Immunogenetics. Pathology associated with immune responses. Vaccination. Immunopathology - immunodeficiency. Hypersensitivity, Autoimmune diseases. Transplantation and rejection. Tumour 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 subculturing 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, mitochondrial, 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<sub>2</sub> 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.

**MB 597: Seminar (1 credit)**

Each student is required to present a literature seminar based on the current developments in the area of Experimental Biotechnology chosen.

### **MB 599: Research Project (6 credits)**

Each student is required to complete a research project on an appropriate topic falls within the disciplines of Experimental Biotechnology. A dissertation and a seminar on the project will be evaluated for the final grades. Students are expected to present a pre-proposal at the commencement of the project. The selection and planning of the project should commence during the second academic semester.

## **7. PROGRAMME EVALUATION**

Programme evaluation will be as stipulated in the PGIS Handbook.

## **8. PANEL OF TEACHERS**

Dr. P H Amerasinghe, Dept. of Molecular Biology and Biotechnology, Faculty of Science,  
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## **PROGRAMME COORDINATORS**

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