**Institute for Plant Biotechnology**
**Stellenbosch University**

# Plant Biotechnology BSc Honours Course Outline 2008

## Introduction

Postgraduate studies in Plant Biotechnology at the University of Stellenbosch (US) are undertaken at the Institute for Plant Biotechnology (IPB, http://www.sun.ac.za/ipb). The BSc Honours degree is regarded as the minimum training requirement needed to work as a professional scientist. Students may choose to follow a one year BSc Honours or a two year MSc program directly after a BSc degree, provided that they have obtained at least 60% for the final year of the BSc degree (exceptions may be made for students with additional relevant experience). Students registering directly for an MSc degree after a BSc are required to fulfill **ALL** of the requirements of the Honours program before being allowed to proceed with the second year of the MSc program. These students will not graduate with a BSc Honours degree after the first year. Once the Honours program is complete, the students who registered for a direct MSc will be required to continue their research work and submit a full MSc thesis of which the Honours write-up may form an introductory component. All students in their first post-BSc year will be subject to the same rules and expectations. Since there is no distinction between the BSc Honours and the first year of an MSc directly after a BSc, both are considered and referred to as the Honours course. Students who abandon their MSc program may obtain a BSc Honours degree, provided they have completed all the requirements for that degree.

The Honours course introduces students to advanced biotechnological concepts, and prepares them for independent research in plant biotechnology. It is structured to meet the interests of all Plant Biotechnologists within the scope of expertise available at the IPB. During the course the emphasis is placed on four important facets of science:

- Gaining the necessary knowledge base in plant biotechnology.
- Gaining expertise in a wide range of practical and cognitive skills.
- The development of professional scientific methodology and ethics.
- Developing a professional attitude.

The Honours course lasts a single academic year, starting in February and ending in late November, and is coordinated by Dr Paul Hills (Natural Sciences Building, Room 2064, Tel: (021) 808 3837, phills@sun.ac.za).

## Course structure

The course comprises of three major components, namely (1) a techniques module, (2) three theory modules and (3) a research project. Students must pass (final mark of more than 50%) all of these components in order to complete the course.

### 1. Molecular Techniques module

The aim of this module is to provide Honours students with the philosophical and practical skills required to perform independent research from planning, though implementation and analysis to reporting. Students will be assessed throughout the course and on specific assignments to obtain a mark that will represent 20% of the final mark.

## 2. Theory modules

Three theory modules on current topics in plant biotechnology will be presented. Few, if any, formal lectures will be given. The course leaders will function as facilitators in guiding the students rather than in teaching the students. Where possible, lectures by experts from industry will be used to complement the course content. Current literature will form the basis of discussion classes and students will prepare seminars and/or essays on specific topics. Students are expected to spend two and a half days per week (one half of their time) on the theory courses. Each module will be assessed separately, based on specific assignments and an examination at the end of the module. The mark for each module will represent 10% of the final mark.

## 3. Research project

Students may choose to conduct a research project with any of the academic staff associated with the IPB. The research project should be discussed with potential supervisors and the project title and supervisor must be registered with the course coordinator (Dr Paul Hills). The student will then be required to submit a formal project proposal and give a seminar on the project proposal. Fifty percent of the student's time, i.e. two and a half days per week, is allocated to the research project throughout the whole year. On completion of the practical work a report must be written and presented as a seminar to the Institute and the Genetics department. The report must be written in the format of a research article for publication in a journal specified by the IPB. The project is assessed on the basis of the project proposal (5%), the proposal seminar (5%), the project write-up (25%) and the final seminar (15%).

**Mark allocation**

| **Module** | **Component** | **%** |
|---|---|---|
| Molecular techniques module | | 20 |
| Theory module 1 | Assignments<br>Examination | 5<br>5 |
| Theory module 2 | Assignments<br>Examination | 5<br>5 |
| Theory module 3 | Assignments<br>Examination | 5<br>5 |
| Research project | Written proposal<br>Proposal seminar<br>Research article<br>Final seminar | 5<br>5<br>25<br>15 |
| **Total** | | **100** |

## Description of the Molecular Techniques module

The Techniques module covers the principles, practical execution and applications of a variety of techniques that are used in Molecular Biology, including general laboratory safety, isolation of nucleic acids from various tissues, cloning with plasmid vectors, genetic transformation, blotting and hybridization analysis, polymerase chain reaction (PCR), ELISA techniques, the construction and use of various forms of DNA libraries, spectrophotometry and chromatographic methods.

## Description of theory modules

### Theory module 1: Plant Molecular Biology & Genetic Engineering

**Lecturer: Dr N Ludidi**

The aim of this course is to make sure students are familiar with the principles of plant molecular biology and genetic engineering and then to expose them to the current status and trends. Current literature will therefore form an integral part of the references. Emphasis will be placed on assignments and group discussions under the following general headings:

- Plant genomes, gene structure, gene expression, recombinant DNA technology and gene silencing;
- Plant tissue culture, transformation systems, crop improvement and plants as bioreactors;
- The -omics era (the genome, transcriptome, proteome, metabolome, fluxome & systems biology);
- Current status of plant genetic manipulation and public acceptance.

### Theory module 2: Plant Physiology / Mineral Nutrition

**Lecturers: Prof V Smith, Prof J Kossmann and Dr P Hills**

This module is divided into two sub-modules. The first sub-module deals with the use of chlorophyll fluorescence and gas exchange as tools in plant physiology and plant biotechnology research and aims, through the combined use of practical and discussion sessions, to give students:

- An understanding of the basics of pulse-modulated and time-resolved fluorescence kinetics;
- Confidence in the use of a pulse-modulated fluorimeter;
- Use of fluorimeter with automated gas-exchange equipment;
- The ability to interface the fluorimeter and gas exchange apparatus with the computer – development of experimental protocols and data logging;
- The ability to calculate fluorescence parameters, quenching, photochemical efficiency, electron transport rate, proportion of reduced reaction centers and the concept of excess PFD;
- The ability to calculate photosynthesis rate, transpiration rate, intercellular airspace $CO_2$ concentration and stomatal conductance.

The second sub-module considers current topics in plant nutrition, hormonal control of plant development, and mechanisms of plant resistance to abiotic stress to engineer crop productivity. The general aim is to introduce plant abiotic stress physiology with special emphasis on mechanisms that plants undergo to react to limiting nutrients or water supply, and temperature stress, in order to:

- Generate an understanding on the mechanisms by which plants are acquiring nutrients that are limiting growth with special emphasis on the different interactions with microorganisms (mycorrhiza, symbiotic $N_2$ fixation) in which plants are investing a large proportion of the carbon they have assimilated;

• Study recent advances in the molecular physiology of plant hormones in order to investigate possibilities for bioengineering hormonal control of crop productivity. Special emphasis is placed on newly discovered substances that promote plant growth;
• Introduce general mechanisms by which plants react to other abiotic stresses such as drought, heat or cold temperatures to investigate possibilities for bioengineering crop productivity.

**Theory module 3: Integrated Plant Metabolism**
**Lecturers: Prof J Kossmann and Dr J Lloyd**
The Integrated Plant Metabolism module examines the role of carbon metabolism in plants. Aspects that will be addressed are photosynthesis, starch metabolism, respiration and the compartmentation of metabolism. The module will involve discussion groups designed to help the student understand these aspects of plant metabolism.

*Note: The precise contents of these modules may change.*

## Application for admission

Prospective students should fill in the application form for entry into the Honours program by no later than 30 November of the year prior to registration. The IPB will then decide on the application and inform the students whether they are admitted to the course or not within the first two weeks of December. Students should note that the decision to admit students is dependent on the availability of places. Completed application forms should be submitted by e-mail to Elke Deluse (edeluse@sun.ac.za) or by fax to 021 808 3835.

## Tuition fees and bursaries

For detailed information on tuition costs and/or information about postgraduate fees, consult the enquiries list or contact the relevant faculty officers. A complete Student Fees Book can also be requested from the Enquiries Desk, Administration Building A, Stellenbosch (tel: 021 808-9111). Depending on availability, the IPB may be able to offer grantholder-linked NRF bursaries or bursary top-ups to deserving students.

## Expected student participation

The following is expected from all students:
1) To abide by all the rules and regulations of the US and the IPB.
2) The course will require dedication, hard work and long working hours. It runs from mid-January until the end of November. A short mid-year holiday can only be taken in consultation with the project supervisor. Although students are not expected to keep strictly to normal office hours (08:00 to 17:00), they should be available at least part of each day for meetings and interactions with their supervisor and other students.
3) Students must attend all seminars, journal club meetings, and any other research/teaching-related functions specified by the course leader(s).
4) All tests and examinations can be written in either Afrikaans or English but, in order to develop the student's scientific communication skills, all documentation and presentations (e.g. project proposals, reports and presentations) must be done in English.
5) Students who are not competent users of computers for data analysis, graphical representation and word processing will be required to learn these skills on their own time.

**Contact details for lecturers**

| Name | Office | Telephone | e-mail address |
|---|---|---|---|
| Prof Jens Kossmann | 2063 | 021 808 3834 | kossmann@sun.ac.za |
| Dr James Lloyd | 2064 | 021 808 3837 | lloyd@sun.ac.za |
| Dr Paul Hills | 2064 | 021 808 3837 | phills@sun.ac.za |
| Dr Ndiko Ludidi | 1057 | 021 808 3066 | ludidi@sun.ac.za |
| Prof Valdon Smith | 1090 | 021 808 3111 | vs2@sun.ac.za |