

MELBOURNE GRADUATE SCHOOL OF SCIENCE/FACULTY OF SCIENCE

PROPOSAL FOR NEW COURSE:

MASTER OF SCIENCE

Including the following streams:

- Master of Science (Biotechnology)**
- Master of Science (Environmental Science)**
- Master of Science (Management Science)**
- Master of Science (Nanotechnology)**

1. BACKGROUND

The MSc creates an educational framework for graduates of the BSc and equivalent degrees to obtain postgraduate training in science. This postgraduate coursework degree offers students a novel and innovative curriculum that is characterised by three key modules: the *Core Discipline Module*; the *Project Module*; and the *Professional Tools Module*. The suite of MSc streams and programs, to be administered by the Melbourne Graduate School of Science, is designed for two kinds of BSc (or equivalent) graduates. The MSc is for students intending to pursue a research career, offering an expanded coursework and research experience, together with access to the Professional Tools module. The MSc (Biotechnology), MSc (Environmental Science), MSc (Management Science), and MSc (Nanotechnology) are designed for students who want training in scientific disciplines that are likely to provide employment and/or promotion opportunities. While the weightings of the three modules across the different streams may differ according to their different objectives, all of the streams are strongly linked by their inclusion of the professional tools module.

It is intended to draw on the best available expertise to teach into the MSc. The streams and programs will integrate scientific research capabilities with other disciplinary expertise from across the University of Melbourne: students will be taught by experts from the Faculty of Architecture, Planning and Development; the Faculty of Arts; the Faculty of Economics and Commerce; the Faculty of Education; the Faculty of Land, Food and Resources; the Faculty of Medicine, Dentistry and Health Science; the Faculty of the Victorian College of Arts; the Melbourne Business School, and the Melbourne School of Engineering.

The Melbourne Graduate School of Science recognises that none of the MSc nomenclature established in this preliminary proposal would preclude other Faculties/Graduate Schools from introducing programs in the same named areas. Further, joint cross-faculty/school marketing will minimise any risk of market confusion arising from more than one program being offered in any particular discipline. In particular, the MSc (Environmental Science) could be a program within both the Graduate School of Science and the Graduate Environment Program of the Office of Environmental Programs.

MSc

A key feature of the *Melbourne Model* is the emphasis on a 3+2 pathway to a research career, which may include completion of a PhD. Such a pathway is the international standard, with less than a handful of nations outside Australia offering a shorter pathway to a research higher degree. There are a number of other significant benefits to students enrolling in the MSc, in addition to providing students with a qualification that is internationally recognized. These include the opportunity to engage in:

- research over a substantially longer time, thereby allowing students to complete a significant project that is more likely to be published in quality journals;

- discipline-specific coursework subjects that will provide a more sophisticated and deeper understanding of topics related to the research project;
- professional tools coursework subjects, specifically tailored to facilitate a career in scientific research.

MSc (Biotechnology), MSc (Environmental Science), MSc (Management Science), MSc (Nanotechnology)

A large cohort of graduates of the BSc wishes to retain a professional connection with science but do not want to conduct research. This degree provides opportunities for these graduates to obtain further qualifications that allow them to gain skills that are entirely appropriate for the workplace, and gain scientific knowledge that employers are seeking among their workforce. Thus, the choice of discipline areas for each of these streams (Biotechnology, Environmental Science, Management Science, and Nanotechnology) is directly informed by the demand identified by potential employers from business, industry and government. Members of these employer groups have evaluated the specific components of the curriculum to ensure that the degree provides training in areas that will enhance the employment and promotional prospects of the students.

2. COURSE/PROGRAM OBJECTIVES

MSc

This postgraduate degree offers training for students aspiring to a career in scientific research. Students will join a ‘program’, offered by an academic unit(s), which will define a mix of research, core discipline and professional tools coursework. Thus, students will obtain an individually tailored program comprising advanced coursework that complements the research project, and professional tools subjects that will provide appropriate research skills. Graduates of this program will be qualified for employment in research positions, or for further training in a research higher degree.

Assumed Knowledge

Students will have completed a Bachelors degree with majors in a discipline that is appropriate to the program.

MSc (Biotechnology)

This postgraduate degree prepares students for professional employment while equipping them with advanced fundamental knowledge of the techniques and technologies important in different aspects of biotechnology. Graduates will become familiar with both current and emerging “frontier” technologies and their application in different public and private sector enterprises. Students will integrate aspects of their knowledge by engaging directly with the biotechnology industry through an industry-focussed syndicate project. They will be capable of critically evaluating biotechnological innovations and their deployment in existing and new businesses.

Graduates from the course will be in particular demand as chief technical officers of biotechnology start-up companies; program managers in funding agencies; technical directors and product development managers; and managers in government agencies responsible for the control and certification of biotechnologies.

Assumed Knowledge

A student entering this degree will have completed a BSc (or equivalent), with some background in biology. While prescribed subjects do not require specific knowledge in any particular scientific discipline, the electives will be advanced subjects that assume particular pre-requisite knowledge (which may be filled by completing 300-level undergraduate subjects).

MSc (Environmental Science)

This postgraduate degree will develop students' scientific skills to help deal with conflicts surrounding environmental issues. Graduates will have the capacity to translate advances in scientific research to guide companies and government agencies to progress practical, sustainable solutions to complex environmental management problems. They will understand the nature of environmental issues and their policy context, and have the capacity to provide scientific insights into their resolution.

Core competency in environmental science will be combined with the development of business acumen and communication skills. Core knowledge will be gained in key areas of environmental management including the natural environment systems, contaminants, resilience, environmental risks, biodiversity, environmental monitoring and assessment, and pests and pestilence. As well as acquiring core skills, students will also be able to develop some specialized knowledge in biological, chemical and physical science areas. The course also encourages an appreciation of the social, political, institutional and economic dimensions of environmental problems and their solutions.

Assumed knowledge

A student entering this degree will have completed a BSc (or equivalent), with a background in biology and/or chemistry. While prescribed subjects do not require specific knowledge in any particular scientific discipline, the electives will be advanced subjects that assume particular prerequisite knowledge (which may be filled by completing 300-level undergraduate subjects).

MSc (Management Science)

This postgraduate degree prepares students for professional employment while equipping them with advanced fundamental skills required by professionals in applied statistics and operations research. The course is also suitable for professionals who intend to work with data or modelling and who wish to expand their practical knowledge of statistics and operations research. The degree is aimed at students with bachelors' degrees in quantitatively oriented disciplines including science, mathematics, statistics and operations research, engineering, information technology, computing, agriculture, commerce, business, and social science.

In addition to general management skills, modern managers require an understanding of Data Analysis, Operations Research and Information Technology. Graduates of this degree will have sound management skills, familiarity with modern techniques in Data Analysis, Operations Research and Information Technology and the ability to incorporate these technical skills into the decision-making processes of an organization. Data Analysis skills allow a manager to ensure data is collected correctly, verify and understand the results of a statistical analysis, and communicate the results to a wider audience. Skills in Information Technology allow a manager to oversee the efficient extraction of information from very large data sets. Skills in Operations Research allow the analysis of complex organisational and scheduling problems and the results to be brought to bear in decision-making.

MSc (Nanotechnology)

This postgraduate degree prepares students for professional employment, while equipping them with advanced knowledge of the fundamental principles of nanotechnology. In particular, graduates will have a clear understanding of how materials and devices change with size, and why making things so small offers so many new opportunities and modalities. Graduates will have obtained hands-on familiarity with the main fabrication and characterization tools used in nanotechnology; they will be capable of critically evaluating nanotechnology innovations; and have the ability to deploy nanotechnology innovations in existing and new businesses.

Graduates from the course will be in particular demand as chief technical officers of high technology start-up companies; program managers in funding agencies; technical directors and product development managers; and managers in government agencies responsible for the control and certification of nanotechnologies (for example in national measurement laboratories and toxicology laboratories).

Assumed Knowledge

Students will have completed a Bachelors degree with majors in physics, physical chemistry, engineering, or applied or pure mathematics with an emphasis in nanoscale theory and computation.

3. ENTRY REQUIREMENTS

The proposed Academic Board Resolution on Selection is as follows:

Master of Science (200 points)

1. The Selection Committee will evaluate the applicant's ability to pursue successfully the course using the following criterion:
 - an undergraduate degree in an appropriate discipline with at least an H3 (65%) in the major, or equivalent.
2. The Selection Committee may conduct interviews and tests and may call for referee reports and employer references to elucidate any of the matters referred to above.

Note: Students enrolling in the MSc must obtain approval from the co-ordinator of the program specified in the application, which may also require the agreement of a member of academic staff to supervise the project module.

4. COURSE/PROGRAM STRUCTURE

General Structure of the Degree

The curriculum of the MSc is characterised by three key modules:

- the *Core Discipline Module*, which provides students with advanced exposure to a particular scientific discipline;
- the *Project Module*, which offers students an appropriate research activity.
- the *Professional Tools Module*, which allows students to develop business, communication and technical acumen; and,

The MSc has a flexible structure that allows students to obtain a research experience appropriate for their discipline. In contrast, the MSc (Biotechnology), MSc (Environmental Science), MSc (Management Science), and MSc (Nanotechnology) streams have a more prescriptive structure, with a significant proportion of the degree being undertaken by all students, which guarantees that they have a strong cohort experience. Accordingly, the different MSc streams (and the different programs within the MSc) will vary in the emphasis of the key modules, but will generally fall into the envelopes described in Table 14.1:

Table 14.1 Indicative Structure of the MSc Streams

	MSc Stream	
	MSc	MSc (Biotechnology) MSc (Environmental Science) MSc (Management Science) MSc (Nanotechnology)
Core Discipline		
Mandatory		50.0 – 62.5 points
Elective		37.5 – 50.0 points
Total	50.0 – 137.5 points	100 points
Project		
Total	50.0 – 125.0 points	12.5 points
Professional Tools		
Business		25.0 – 37.5 points
Communication		25.0 – 37.5 points
Science		25.0 – 37.5 points
Total	12.5 – 50.0 points	87.5 points

Professional Tools Module

There are three clusters of subjects within the Professional Tools Module, including:

Business Tools

Objectives — students will understand how business and markets work and how leadership and strategy informs the workings of business. Science undertaken by a profit making company is not undertaken in a vacuum. Knowing the external context of science businesses helps students to understand how decisions are taken and strategies set that directly impact on normal science work undertaken within specific companies.

Subjects: —

Mandatory subjects: The World of Business I (Leadership and Managing People, Marketing, Economics of Markets); The World of Business II (Global Economics, Accounting and Finance, Strategy, Project Management.

Elective subject: Commercialisation and innovation management (including IP); Market research; Markets and public policy; Leadership; Financial markets; Transforming organisations through ICT.

Contributing Faculties —

The Faculty of Economics and Commerce; the Faculty of Science; and the Melbourne Business School.

Communication Tools

Objectives — students will acquire knowledge and insights into how key non-science sectors such as government (local, state and federal), industry, community, and commerce views scientific knowledge and the skills to communicate scientific knowledge effectively across all levels and sectors of society. In particular, students will acquire a wide range of speaking skills appropriate for different contexts; technical and scientific writing techniques necessary for committees, journals, grant panels, the media and public policy; and practical experience in how scientific knowledge can be communicated to the wider community through the internet, television and radio, documentaries, print media, and the visual and performing arts.

Subjects —

Science Communication in Context; Writing and Speaking about Science; Science Communication - Media and Communities.

Contributing Faculties —

The Faculty of Arts; the Faculty of Science; and the Faculty of the Victorian College of Arts.

Science Tools

Objectives — students will acquire knowledge and skills in understanding what science and scientific thinking is; its relationship to other ways of knowing; and the contribution that the scientific approach can make to a professional workplace. Students will also appreciate the nature of data, and how data analysis and information management can help in professional decision making. Students will also have the opportunity to further specialise in computational, data analysis and collaboration skills.

Subjects —

Scientists in the Workplace; Thinking and Reasoning with Data; Knowledge from Data Mining; Scientific Computing; The Scientific Web.

Contributing Faculties —

The Faculty of Arts; the Faculty of Science; and the Melbourne School of Engineering.

14.1 MSc

14.1.1 Flexible Program Design

The MSc will incorporate sufficient internal flexibility in the balance between the three key elements of the MSc degree to accommodate the kinds of training required by different disciplines of science to attain research competence. Academic Units will offer a program, which will have a defined curriculum of compulsory and elective subjects approved by the Melbourne Graduate School of Science. Academic units may not be confined to those within the Faculty of Science, and the Melbourne Graduate School of Science encourages appropriate academic units from outside the faculty to participate in this stream. Academic staff from within the Academic Unit will be supervisors of research projects, and students will require an agreement with an appropriate supervisor before enrolling in a program. Additional supervision may be obtained from outside the academic unit(s) of the program.

The precise mix of core discipline, professional tools and project subjects defined by individual programs will be constrained within the envelope in Table 14.1, but may lie somewhere between the following extremes (bold indicates maximum allocation):

<i>Research Project</i>	125.0	125.0	50.0	50.0	100.0
<i>Core Discipline</i>	62.5	50.0	137.5	100.0	50.0
<i>Professional Tools</i>	12.5	25.0	12.5	50.0	50.0

14.1.2 Coursework Subjects

Individual programs will specify core and optional coursework subjects as appropriate to their discipline. Some Professional Tools subjects may be specific to this stream, emphasising skills appropriate for emerging leaders in scientific research. Discipline-specific coursework subjects should provide students with advanced knowledge and specialist training, exposing students to the major issues in their discipline. Coursework subjects may encompass a wide range of activities and mode of teaching, including (but not limited to) practical training in specific research skills, field- or laboratory-based methods, as well as specialised knowledge delivered through lectures, tutorials, or seminars. Subjects may be offered in intensive mode or delivered over a semester.

Individual programs need not be responsible for providing all of the discipline specific coursework subjects for their students. Instead, academic units may offer, either individually or in collaboration across departments, advanced discipline subjects that would be attractive to students from their own and other programs. Such cross-department, team-taught subjects would not only provide students with exposure to a range of intellectual expertise, but also create economies of scale in terms of teaching effort against enrolment numbers. It would also create opportunities for all academic units to maximise their exposure to potential PhD students.

14.1.3 Research Project

The research project will provide students with the opportunity to develop skills in conducting independent and original research or scholarship. The research thesis will demonstrate a critical application of specialist knowledge and make an independent contribution to existing scholarship in their area of research. Activities incorporated into a research subject will include, in addition to original research, the accumulation of background knowledge (e.g. literature reviews) and presentations (oral or otherwise) of proposed and actual research outcomes. Research projects may include reviews of an existing body of knowledge that will result in original perspectives.

At least one supervisor of the research project will be a member of the academic staff of the academic unit associated with the program into which the student is enrolled. The student may also have an advisor, who need not necessarily be a member of academic staff of the academic unit associated with the program into which the student is enrolled.

Details of the specifications of the thesis and the procedures for assessment require further consideration, particularly because different programs will have different durations of research, but the intention is to ensure consistency in the assessment of the MSc thesis across the different programs by providing guidelines, and ensuring appropriate moderation both within and between programs.

14.2 MSc (Management Science) (Indicative)

The following provides an indication of the structure and subjects that will comprise this stream. This curriculum has been developed in collaboration with the Faculty of Economics and Commerce; the Melbourne School of Engineering; and the Melbourne Business School. The curriculum will be tested against the market and, based on that advice, more specific subject details will be prepared for submission to Postgraduate Coursework Programs Committee during 2008.

14.2.1 Core Discipline

62.5 points comprising:

- Statistics for Industry and Business
- Optimisation for Industry (MGSS)
- Business Forecasting (MGSS)
- Systems Modelling and Simulation (MGSS)
- Cases in Business Modelling (MBS)

Plus, 37.5 points from:

- Supply Chain Management (FEC)
- Project Management (FEC)
- Enterprise Systems (MGSS)
- Decision Support using ICT (MGSS)
- Data Warehousing (MGSS)
- Scheduling and Optimisation (MGSS; MSE)
- Evolutionary and Neural Computation (MSE)

14.2.2 Professional Tools

62.5 points comprising:

Business Tools

- World of Business I
- World of Business II
- Business Tool Elective

Communication Tools

- Science Communication in Context

Science Tools

- Scientific Computing
- Knowledge from Data Mining

Plus, 37.5 points from:

- Writing and Speaking about Science
- Science Communication: Media and Communities
- Scientists in the Workplace
- Thinking and Reasoning with Data

14.2.3 Industry Project

Syndicate Project (12.5 points)
Or (requires supervisor agreement)
Professional Research Project (25 points)

14.3 MSc (Nanotechnology) (Indicative)

The following provides an indication of the structure and subjects that will comprise this stream. This curriculum is being developed in collaboration with the Melbourne School of Engineering. The curriculum below will be tested against the market and, based on their advice, more specific subject details (including the academic units responsible for delivery) will be prepared for submission to Postgraduate Coursework Programs Committee during 2008.

14.3.1 Core Discipline Subjects

62.5 points comprising:

Quantum and Electronic Materials
Surface Science & Synchrotron Techniques
Nanocharacterization and Imaging
Nanometrology and Nanotoxicity
Applied Nanotechnology Case Studies

Plus 37.5 points from:

Advanced Spectroscopy*
Nanobiotechnology and bioelectronics
Nanomechanics & Nanomaterials
Product development
Tissue engineering
Advanced Quantum Materials and Theoretical Chemical Physics*

* *Requires Quantum and Electronic Materials as pre-requisite*

14.3.2 Professional Tools

87.5 points from:

Business Tools

World of Business I
World of Business II

Communication Tools

Science Communication in Context
Writing and Speaking about Science

Science Tools

Scientists in the Workplace
Thinking and Reasoning with Data
Knowledge from Data Mining
Scientific Computing
The Scientific Web

14.3.3 Industry Project

Syndicate Project (12.5 points)
Or (requires supervisor agreement)
Professional Research Project (25 points)

14.4 MSc (Environmental Science) (Indicative)

The following provides an indication of the subject material that will comprise this stream. A key feature of this stream is the emphasis on 'science' subjects, which distinguishes it from degree courses offered by the OEP. This curriculum will be developed in collaboration with the Faculty of Architecture, Building and Planning; the Faculty of Land and Food Resources; and the Melbourne School of Engineering. The curriculum below will be tested against the market and, based on their advice, more specific subject details (including the academic units responsible for delivery) will be prepared for submission to Postgraduate Coursework Programs Committee during 2008.

14.4.1 Core Discipline

The following material would be covered:

Natural environmental systems; contaminants (exposure pathways, restoration and remediation); resilience; sustainability; environmental risks and decisions; climate change (mitigation and adaptation); environmental monitoring and assessment; water; disease; biodiversity and conservation; management of pests.

14.4.2 Professional Tools

Business Tools

World of Business I

World of Business II

Communication Tools

Science Communication in Context

Writing and Speaking about Science

Science Tools

Scientists in the Workplace

Thinking and Reasoning with Data

Knowledge from Data Mining

Scientific Computing

14.4.3 Industry Project

Syndicate Project (12.5 points)

Or (requires supervisor agreement)

Professional Research Project (25 points)

14.5 MSc (Biotechnology) (Indicative)

The following provides an indication of the subject material that will comprise this stream. This curriculum will be developed in collaboration with the Faculty of Land and Food Resources; the Faculty of Medicine, Dentistry and Health Sciences; and the Melbourne School of Engineering. The curriculum below will be tested against the market and, based on their advice, more specific subject details (including the academic units responsible for delivery) will be prepared for submission to Postgraduate Coursework Programs Committee during 2008.

14.5.1 Core Discipline

The following material would be covered:

Frontiers of biotechnology; advanced molecular techniques; genomics, bioinformatics, proteomics; chemical biology; medicinal chemistry; tissue engineering; molecular diagnostics; reproductive Technology.

14.5.2 Professional Tools

Business Tools

World of Business I

World of Business II

Communication Tools

Science Communication in Context

Writing and Speaking about Science

Science Tools

Scientists in the Workplace

Thinking and Reasoning with Data

Knowledge from Data Mining

Scientific Computing

14.5.3 Industry Project

Syndicate Project (12.5 points)

Or (requires supervisor agreement)

Professional Research Project (25 points)

5 AVAILABILITY OF COURSE

The courses will be available on a full-time basis to CSP and Australian and international fee-paying students from 2009.