

## MASTER OF BIOMEDICAL ENGINEERING

### 1. Background

The purpose of the proposal is to:

1. To introduce a new course, the Master of Biomedical Engineering, as a twelve month Masters program of eight 12.5 point subjects – consisting of four core subjects and four electives. It is envisaged that applicants who do not possess the prerequisites for direct entry to the Masters, but who are academically good students of Science, Engineering or other similar disciplines, could be offered admission to the Master of Engineering Science or Master of Applied Science Preliminary Study Programs as a pathway to the Masters. These programs exist. The Preliminary Studies Programs would be tailored by the course co-ordinator to fit the particular needs of an individual applicant.
2. To add a Biomedical stream to the existing eighteen months coursework programs the Master of Engineering Science (for students from Engineering backgrounds) and the Master of Applied Science (for students from Science and related backgrounds) (by the addition of a 50 point research project subject/semester).

The Faculty of Engineering recently developed Biomedical streams of the Bachelor of Engineering Degree. The rationale for postgraduate study in the area of Biomedical Engineering is similar to that of the undergraduate degree. There is increasing interest in and awareness of the various areas in the biotechnologies by the general public and academia.

The purpose of the degree can be succinctly stated as follows: “Biomedical engineering aims to train engineers who can analyze a problem from both an engineering and biological perspective; they should be able to anticipate special difficulties in working with living systems and evaluate a wider range of possible approaches to solutions.” (John Hopkins University website)

The Master of Biomedical Engineering will provide a scholar with the opportunity to study topics at an advanced level. Through the existing Masters Preliminary Studies Programs engineers and other suitably qualified graduates who are not eligible for direct entry to the masters, will be provided with an opportunity for transition to the field of biomedical engineering and ultimately to the Masters.

### **Course Rationale**

- Biomedical engineering is a fast growing discipline that intersects science, medicine and mathematics to solve biological and medical problems.
- Biomedical engineering dovetails into the bio science area that is part of the strategic development plan/vision for Victoria, the University of Melbourne and the Faculty of Engineering.
- The Faculty of Engineering has recently developed undergraduate Engineering streams of Biomedical Engineering (with the four strands of Bioinformatics, Biomechanics, Biocellular or Biosignals to choose from) and Chemical and Biomolecular engineering. The development of a postgraduate biomedical program is a natural progression given that undergraduate initiative.
- The Faculty of Engineering, apart from the Master of Environmental Engineering, has no other postgraduate coursework programs at present to satisfy the demand for higher study from graduates from a Chemical Engineering background.

### **Support for the Proposed Course Structure in Medicine and Science**

Professor Smith has consulted key people associated with the Biomedical Science course including Professors Stephen Harrap and Tony Goodwin. They see strong synergies between engineering and biomedical science, synergies that need to be realised if the university is to realise its aspiration of being “one of the finest universities in the world”. They are all very supportive of developing

collaborative research projects between the faculties to complement the postgraduate program. In fact, they have agreed to provide one of the subjects (Anatomy and Physiology for Engineers) for this proposed masters degree.

**Target students**

It is expected that students entering the masters degree program will normally have a first degree in engineering, and wish to further develop their knowledge in this specialised area or be wishing to make a transition to this specialised area. The emphasis will be on developing capacities for applying technical engineering knowledge (especially quantitative mathematical analysis) in biomedical applications. The primary aim will be to facilitate transition pathways from traditional engineering to biomedical engineering. Other suitably qualified students may enter the masters program through the pathway of Masters Preliminary Studies (an existing program).

Courses offered in the field of Biomedical Engineering in Australia are mostly 5-year duration combined BE/BSc (Medical Science). We are proposing a new postgraduate masters course to provide a transition pathway from traditional engineering disciplines into biomedical engineering. The subjects have been developed from international best practice (four of the subjects are based on existing subjects in postgraduate courses at leading US universities (MIT, University of California (San Diego) University of Texas), while the remaining four subjects reflect local expertise in selected areas).

**2. Entry Requirements**

- A four year undergraduate degree in Engineering or an honours degree in Science, which include mathematics and chemistry at second year level, with an average grade of at least H2B(70%) or equivalent; or
- a 3 year degree in an Engineering or Science related discipline and a Graduate/Postgraduate Diploma in Engineering with an average grade of at least H2B (70%) ; or
- a 3 year degree in an Engineering or Science related discipline with an average grade of at least H2B (70%) and two years of relevant, documented, work experience.

**3. Course Structure**

To participate in this new approach to biomedical engineering (one based on quantitative modelling of biological systems), it is essential that engineering students develop capacities in both languages of biology and engineering modelling relevant to biomedical applications.

The Masters program will be available both on a part time and full time basis.

*Four core subjects. Two in 1<sup>st</sup> semester and two in 2<sup>nd</sup> semester.*

<b>Degree Type</b>	<b>Core Subjects (four subjects) All of 12.5 points except where indicated.</b>	<b>Elective Subjects All of 12.5 points except where indicated.</b>
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<p>Master of Biomedical Engineering. (100 points)</p>	<p><b>4316xx</b> Biomedical Engineering – 1, 2005  <b>4YY-6xx</b> Forces, Fields and Flows in Biol Systems – 1, 2005  <b>4216xx</b> Biological Systems Engineering – 2, 2005  <b>4216xx</b> Anatomy and Physiology for Engineers - 2, 2005</p>	<p>50 points (four subjects of electives from the electives below)</p> <p><b>In semester 1, 2005</b> only <b>4365xx</b> Musculoskeletal Biomechanics and <b>433692</b> Algorithms for Biological Sequences <u>will be available</u></p> <p><b>In semester 2, 2005</b> only Tissue <b>4116xx</b> Engineering/Bionanotechnology, <b>4316xxx</b> Auditory Processing and Hearing Bionics and <b>4316xx</b> Clinical Engineering <u>will be available.</u></p>
<p>Master of Engineering Science or Applied Science in Biomedical Engineering (150 points)</p>	<p>4316xx Biomedical Engineering – 1, 2005  4YY-6xx Forces, Fields and Flows in Bio Systems – 1, 2005  4216xx Biological Systems Engineering – 2, 2005  4216xx Anatomy and Physiology for Engineers - 2, 2005</p> <p>421644 Research Project (50 points)</p>	<p><b>In semester 1, 2005</b> only <b>4365xx</b> Musculoskeletal Biomechanics and <b>433692</b> Algorithms for Biological Sequences <u>will be available</u></p> <p><b>In semester 2, 2005</b> only Tissue <b>4116xx</b> Engineering/Bionanotechnology, <b>4316xx</b> Auditory Processing and Hearing Bionics and <b>4316xx</b> Clinical Engineering <u>will be available.</u></p> <p>Three subjects from the above five plus <b>421642</b> Research Project 12.5 points (50 points)</p> <p><i>Progression to the 50 point research project in the third semester is contingent upon an average of 70% in the Research Project 421642</i></p>

### Masters Electives:

4116xx Tissue Engineering/Bionanotechnology – semester 2, 2005  
4316xx Auditory Processing and Hearing Bionics - semester 2, 2005  
4316xx Neural Info- Processing and Learning - 2006  
4336xx Computational Sequence Analysis – 2, 2005  
4336xx Computational Genomics - 1, 2006  
436-5xx Musculoskeletal Biomechanics 1, 2005  
4316xx Clinical Engineering.2, 2005  
421644 Research Project.

Management courses dealing with innovation, entrepreneurship, product development and other as may be approved by the course co-ordinator of the Master of Biomedical Engineering.

### Pathway to Masters:

Students who do not meet academic requirements for direct entry to Masters study may be offered Preliminary Studies through the existing Master of Engineering Science (Preliminary) and the Master of Applied Science (Preliminary).

Subjects for preliminary studies will be prescribed on a case by case basis in accordance to what may be required to provide an appropriate foundation for the study of the Master of Biomedical Engineering. In some cases six months (four subjects) may be prescribed, while in other cases twelve months (eight subjects) may be prescribed. Applicants with a three year degree and with no relevant documented work experience would be required to undertake a twelve month preliminary

while those with at least one year of relevant documented work experience would need to take a six months preliminary.

#### **4. EFTSU and Budgetary Consequences**

See Business Case for further detail. The course will be available to international and Australian fee-paying students. Semester one and semester two entry is possible.