

Guide for Prospective Students

Routes into Biomedical Engineering at Stellenbosch University

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1 Introduction

This guide was compiled by the Institute for Biomedical Engineering (IBE) for you if you either are

- at school and wish to study towards biomedical engineering, but have to choose an undergraduate discipline to start your studies; or
- already enrolled in an undergraduate programme and wish to plan your route into biomedical engineering.

The information below aims to help you make a decision by describing the options provided at Stellenbosch University (SU).

2 What is biomedical engineering?

Biomedical Engineering is the application of science, technology, engineering and mathematics to provide for health-related needs. Biomedical Engineering is inherently multidisciplinary (persons from multiple disciplines contribute) and interdisciplinary (expertise from multiple disciplines must be integrated).

There are multiple routes into biomedical engineering at SU. Some of these routes are provided by the IBE, while the Faculty of Engineering, the Faculty of Science and the Faculty of Medicine & Health Sciences also offer routes into biomedical engineering.

3 What is the skills profile of a biomedical engineer?

The graduates of the IBE's MEngSc and PhD programmes have a strong base in their undergraduate discipline, with broader multidisciplinary appreciation of biomedical interface with their undergraduate discipline. They are able to develop complex biomedical engineering sciences and systems by integrating the medical and the engineering domains. The graduates can contribute to the development of new systems and to improve existing systems, for the benefit of humans and/or animals, addressing healthcare needs of South Africa and global communities.

As explained below, there are also routes into biomedical engineering other than that offered by the IBE. The non-IBE routes develop graduates' skills more focussed on one discipline, such as mechatronic engineering or physiology. These graduates will, through their research, also develop an understanding of biomedical engineering.

4 Routes towards biomedical engineering

4.1 Overview: start with a strong base in one discipline

There are multiple routes into biomedical engineering at Stellenbosch University because biomedical engineering is a broad and multidisciplinary area of science and technology. If you study biomedical engineering, you will have to specialize in some aspect of this broad discipline. We do not offer undergraduate biomedical engineering programmes, but we

require that you first establish a strong base in one of the disciplines that contribute to biomedical engineering. These disciplines are typically offered by the Faculty of Engineering, the Faculty of Sciences and the Faculty of Medicine & Health Sciences.

Your disciplinary base provides a starting point for study in biomedical engineering, but also provides career options if, after studying biomedical engineering, you do not want to or cannot find work in biomedical engineering (worldwide many more students study biomedical engineering than there are jobs in the field). Also, we receive more applications from students wanting to study biomedical engineering than what we can accommodate. Therefore, developing a strong disciplinary base gives you important options to develop your career path.

The most common routes into biomedical engineering at Stellenbosch University currently are through a BEng degree, a BSc in Biological Sciences with Physiology as major and a new interdisciplinary Biomedical Mathematical Sciences BSc programme.

4.2 BEng routes

If you have the aptitude and interest to study engineering, a Bachelor of Engineering (BEng) is a good route into biomedical engineering. The BEng will provide you with many employment opportunities, also outside of biomedical engineering.

The most common route into biomedical engineering is through mechanical engineering and mechatronic engineering, but we also have master's students from electrical & electronic engineering, industrial engineering and chemical engineering that do research in biomedical engineering. We encourage you to choose the engineering discipline in which you are most interested (the BEng programs are demanding and it is important to be interested in the work to maintain motivation).

After completing a BEng, you can choose between doing a master's of engineering (MEng) or a masters of engineering science (MEngSc) for further study in biomedical engineering. Note that graduates of a BEng or BScEng programme, who meet the requirements regarding marks achieved in those programmes, do not need to complete a postgraduate diploma before entering into a master's programme.

More information about the master's programmes is given below.

4.3 Routes through a three-year BSc and BScHons in Sciences

If your aptitude and interest is in the basic sciences, a Bachelor of Science (BSc) followed by an honours (BScHons) in the Faculty of Sciences is a good route into biomedical engineering.

In the past, the most common science-based route at Stellenbosch University has been a BSc in Biological Sciences, with Physiology as a major. Stellenbosch University also recently started offering an interdisciplinary BSc programme, i.e. the Biomedical Mathematical Sciences stream. This new programme is well suited to specialising in biomedical engineering.

All students with a BSc qualification that has a normal minimum duration of three years, must complete a BScHons or a Postgraduate Diploma¹ (PGDip) before they can be admitted to a master's programme. The Faculty of Science and the Faculty of Medicine and Health Sciences offer various BScHons programmes. We recommend that students choose a BScHons or

¹ Note that the IBE does not intend offering such a PGDip in the foreseeable future.

PGDip that strengthens their undergraduate discipline before entering into the interdisciplinary MEngSc programmes of the IBE.

The IBE's MEngSc programmes are, in principle, accessible through any BSc programme, irrespective of the majors chosen. As part of the admission process to the IBE's MEngSc programmes, a student must find a supervisor and research topic (the topic is normally proposed by the supervisor). A student's background knowledge may play an important role at that stage. Students with a significant undergraduate mathematics background are more likely to be accepted for topics and supervision closer to engineering.

There may also be opportunities for students to do an MSc in their honours discipline in the Faculty of Science and the Faculty of Medicine and Health Sciences. Some of these options may offer a research topic related to biomedical engineering.

More information about the master's programmes is given below.

4.4 Routes through Medicine and Health Sciences

The Faculty of Medicine and Health Sciences offers different routes into biomedical engineering. One of these routes is through the three-year BSc programme in Sport Science. Its nature is similar to the Science Faculty's routes described above and also requires that students complete a BScHons or PGDip before they can enter into master's programmes.

The Faculty also offers four-year BSc programmes, such as in Physiotherapy. Graduates from these programmes do not need further qualifications before entering into master's programmes. Similarly, graduates from the MBChB programme can also enter into master's programmes without further qualifications.

The IBE's MEngSc programmes are, in principle, accessible through all of the mentioned routes but, as with the routes through the Faculty of Science, when a student must find a supervisor and research topic (the topic is normally proposed by the supervisor), the student's background knowledge may play an important role. Students with a significant undergraduate mathematics background are more likely to be accepted for topics and supervision closer to engineering.

There are also many opportunities for students to do an MSc in various areas of biomedical sciences, and it is likely that some research topics will be related to biomedical engineering.

4.5 Routes to a PhD in Biomedical Engineering

Any research-based master's degree will be an acceptable prior qualification for a PhD in Biomedical Engineering, but the research focus for the PhD will normally be aligned with the PhD candidate's prior area of study.

5 How do the MScEng, MEng, MSc and MMed programmes differ?

Students can study biomedical engineering, not only within the IBE's MScEng programmes, but also within the MEng, MSc or MMed programmes of the Faculties of Engineering, Science and Medicine & Health Sciences. The most significant differences amongst these programmes are outlined here.

The routes leading up to these master's programmes are described above.

5.1 MEngSc in Biomedical Engineering offered by the IBE

A brief outline is given in Section 6 of the IBE's two options for an MScEng in Biomedical Engineering, but here the focus is on the differences between the MScEng and the other master's programmes.

The MEngSc programmes (both the research and the structured/modular options) are explicitly interdisciplinary. The thesis topics in the research option must therefore be interdisciplinary, which is reflected in the requirement that each student should have supervisors from at least two faculties (for example from Electronic Engineering in the Engineering Faculty and Physiology in the Science Faculty, or from Mechanical Engineering in the Engineering Faculty and Sport Science in the Medicine & Health Sciences Faculty). Because the MEngSc programmes are interdisciplinary, students will not reach the same technical depth in any single disciplines, as they would in an MEng or MSc but, on the other hand, they will be expected to bring at least two disciplines to bear on their research work. One of the disciplines typically will be from engineering, but this is not a prerequisite.

The MEngSc in Biomedical Engineering is a relatively new qualification (the first graduates are expected early 2022) that still has to establish a reputation in industry.

5.2 MEng programmes offered by the Faculty of Engineering

The MEng programmes are programmes that typically specialise in one engineering discipline (e.g. mechatronic engineering), with the technical and engineering-sciences depth and character of a mono-disciplinary programme. This implies that students that enter into these programmes will normally be required to hold a BEng or BScEng.

Many of the engineering departments (particularly Mechanical & Mechatronic Engineering, Electrical & Electronic Engineering and Industrial Engineering) offer biomedical engineering topics as part of their MEng options. These topics will allow you to study towards an MEng in an engineering discipline (e.g. an MEng in Mechatronic Engineering), with a thesis topic that is biomedical oriented. The emphasis and disciplinary depth will be in engineering, with less emphasis on the interdisciplinary character of biomedical engineering.

Through this route, you can then obtain an MEng qualification, which has a well-established reputation in the engineering industry, and can enter the biomedical engineering world or choose another route. Our experience is that graduates get recognition for the MEng degree even when they work in knowledge areas different from that of their thesis research.

5.3 MSc programmes offered by the Faculties of Science

The MSc programmes are science programmes that typically specialise in one discipline of natural sciences. The scientific depth and character of a mono-disciplinary programme are reflected in the research done in these programmes. This implies that students that enter into these programmes will normally be required to hold a BScHons degree with a major in the particular science discipline (e.g. physiology or anatomy). When biomedical engineering related research is done in the MSc programmes, the emphasis and disciplinary depth will be in science, with less emphasis on the interdisciplinary character of biomedical engineering.

These MSc programmes are, like the MEng programmes, well established.

5.4 MSc and MMed programmes offered by the Faculty of Medicine & Health Sciences

The Faculty of Medicine & Health Sciences offers MSc and MMed programmes. The nature of this faculty's MSc programmes is similar to those of the Science Faculty, but inclined to medical and health sciences.

The MMed programmes are medical sciences programmes, that follow after an MBChB. In other words, you must have qualified as a medical doctor before you can enter in the MMed programmes. The emphasis and scientific depth in an MMed will be in the medical or biomedical sciences, with no or lesser emphasis on engineering aspects.

6 MEngSc programmes of the Institute for Biomedical Engineering

Details about the IBE's programmes are given in the IBE Programme Guide (which is available on the IBE's website, www.ibe.sun.ac.za). An outline is given below, but please note that the details may change over time.

The IBE's MEngSc in Biomedical Engineering is presented in two formats: research-based and module-based (structured). The research format requires that students complete one semester's modules (75 credits of courses), followed by three semesters of research (equivalent to 180 credits) culminating in a thesis. In the structured format, students must complete modules (courses) totalling 120 credits and complete a research project of 60 credits.

The admission requirements for the two formats of the MEngSc are the same. For students with South African degrees:

- Students with a four-year BEng or BSc must have completed the programme in minimum time, with an overall average of at least 60, a final year average of at least 60 and must have completed a major project in the final year with a mark of at least 65.
- Students with a three-year BSc must have completed the programme in minimum time with an overall average of at least 60. In addition, they must complete a BScHons or PGDip in minimum time with an average of at least 60 and a major project with a mark of at least 65.

Students with qualifications from outside South Africa are evaluated on an equivalence basis.

7 More information

For more detailed information about the IBE's programmes, please consult the IBE Programme Guide (which is available on the IBE's website, www.ibe.sun.ac.za) or log a query on the "Contact" page of the website.