Biomedical Engineering Sciences

/Medicinteknisk vetenskap/

SCB-codes: 20601, 20603, 10299

General description of the research area

The subject is characterized by its interdisciplinary profile, where research and education takes place in the scientific field between medicine and engineering. This mainly comprise development and evaluation of theory and methodology, with a clear engineering sciences focus, but with applications in the medical sciences.

The subject has a wide range of topics including research on a variety of modalities for data acquisition, processing, visualization and interpretation of medical and physiological data. The subject also includes basic research using engineering methods to describe and understand how biological systems function, as well as methods to affect these systems. Examples of research areas are therapeutic systems, medical sensors and imaging systems, algorithms and models for processing and visualization of images and multi-dimensional data sets, as well as systems for medical records. Other examples include research on biomaterials and mathematical models for the simulation of cellular and physiological processes. Common to all research areas within the field of *biomedical engineering sciences* is that they aim to develop technical solutions that will aid health care providers to diagnose and treat patients and to promote health.

Eligibility requirements and selection

The basic eligibility requirements as well as the general principles for selection are specified in the faculty's *Study Handbook for PhD Studies*.

Specific eligibility requirements

Admission to PhD Studies in the research area of Biomedical Engineering Sciences requires that the candidate has been awarded a master's degree, or has completed courses of at least 240 ECTS, of which at least 60 ECTS is at the master level in a field relevant for the research area, including an independent project (degree project) of at least 30 ECTS. In addition, the candidate should demonstrate the overall ability needed to complete the PhD studies. This means that the candidate should have such good knowledge of English that he/she can comprehend and grasp course literature in English, write and if needed defend the thesis in English.

Degree

PhD studies in Biomedical Engineering Sciences leads to a Degree of Doctor or a Degree of Licentiate. The latter degree can also serve as a stage in the PhD studies. The Degree of Licentiate comprises 120 ECTS, of which courses correspond to 30-45 ECTS and the remaining licentiate thesis corresponds to 75-90 ECTS. The Degree of Doctor comprises 240 ECTS, of which courses correspond to 60-90 ECTS and the remaining doctoral thesis corresponds to 150-180 ECTS.

The research area's broad and interdisciplinary nature allows for PhD studies with both theoretical and/or experimental focus. The distribution of credits between courses and thesis work is therefore determined individually based on the nature of the research project and established by the head of the department when the student is admitted to PhD studies.

Goals and implementation of the PhD studies

The general goals and objectives of PhD studies are specified in the introduction to the faculty's *Study Handbook for PhD Studies*, as well as in the Higher Education Ordinance (reprinted in the *Study Handbook*'s appendix A).

The aim of PhD studies is to give greater and more in-depth knowledge in the research area and specialised knowledge in the area of the thesis. PhD studies also aim to provide research experience and skills in research methodology. After completion of PhD studies, the PhD student should be able to independently conduct and lead research and development projects especially within the framework of the research area.

PhD studies in the research area of Biomedical Engineering Sciences will equip the PhD student with sustainable knowledge and skills to fulfill all the degree outcomes. The studies consist of research and thesis work, courses, participation in seminars, attendance at national and international conferences, and collaboration with the local community as well as industry in the specialised field.

The PhD studies will enable the PhD student to acquire both deep and broad knowledge and understanding of the research area of Biomedical Engineering Sciences by allowing the PhD student to:

- Complete a mandatory course in anatomy and physiology
- Complete broadening courses in the research area
- Complete in-depth courses that are in line with the focus of the thesis work
- Independently plan and carry out theoretical and/or experimental research work
- Actively follow the research literature in the research area

Within the framework of the PhD studies, the PhD student will be given the opportunity to develop familiarity with scientific methodology and ethics. The PhD student will also be given the opportunity to acquire and develop skills and competencies as well as develop judgement and approach in the research area by:

- Completing a mandatory course in research methodology
- Completing a mandatory course in research ethics
- Independently identifying and formulating relevant issues in his/her own research
- Independently planning and carrying out theoretical and/or experimental research work
- Regularly presenting his/her own research at the Department of Biomedical Engineering's seminars
- Regularly presenting his/her own research at national and international conferences in the research area
- Actively participating in seminar series and conferences in order to discuss and critically review his/her own as well as other participants' research work

PhD students in Biomedical Engineering Sciences will demonstrate their intellectual autonomy by individually writing a monograph thesis or a framework narrative (part of a compilation thesis).

Thesis

The PhD student will demonstrate his/her intellectual autonomy by writing a thesis. The overall rules regarding the format, submission and grading of a thesis can be found in the faculty's *Study Handbook for PhD Studies*.

Doctoral thesis

The thesis should be of such level of quality that it, in its entirety, can be judged to meet reasonable requirements to be accepted for publication in an international journal of good quality. In the thesis, the student's own research, in relation to the wider field of research, should be introduced, discussed and critically evaluated.

Licentiate thesis

The thesis should consist of a scientific essay or an investigative report conducted on scientific grounds.

Individual study plan

An individual study plan will be formulated for each PhD student. The detailed planning of courses and other components will be conducted in consultation with the supervisor and documented in the individual study plan (see *Study Handbook for PhD Studies*, section 5.3). The study plan should be established within one month after admission to PhD studies, and it should be revised at least once a year. The study plan should be formulated in a way to give the PhD student the opportunity to progress in independent and critical thinking.

Courses

Faculty course requirements

Scientific theory, methodology and ethics

All PhD students admitted as of 1 January 2010 should complete mandatory courses as decided by the faculty in methodology and ethics, or be deemed to have equivalent competencies, in order to receive a degree.

Pedagogic studies

All PhD students who teach should complete a basic course in pedagogy. At least 3 ECTS from this course should be included in the PhD studies, and any remaining credits should be counted as departmental duties (see *Study Handbook for PhD Studies*, section 5.5).

Other course requirements in the research area

Anatomy and Physiology

All PhD students admitted to the research area of Biomedical Engineering Sciences must complete a mandatory course in *Anatomy and Physiology* of at least 6 ECTS in order to receive a degree.

Additional courses

Besides the general mandatory courses, subject-specific courses should be selected so that the PhD student has the opportunity to achieve broad knowledge and understanding of the field of research. Subject-specific courses should also be selected in a way that allows the PhD student to acquire deep knowledge and understanding of the research area, with focus on the thesis' area of specialisation.

Due to the interdisciplinary nature of the research area, courses from other research areas may also be included in the portfolio of subject-specific courses if their purpose is to strengthen the PhD student's ability to solve research problems. Even general PhD courses, such as scientific writing, popular science presentation and information retrieval, can be included if their purpose is to strengthen the PhD student's ability to conduct and make visible his/her research.

Seminars

During his/her PhD studies, the PhD student should participate in seminar series in order to actively discuss and critically review his/her own and other participants' research work.

Accreditation

Accreditation of earlier studies that are deemed to correspond to the *faculty course requirements* (see the relevant section above) can be decided by the faculty's Board of PhD Studies or the Dean. Upon admission to PhD studies, the Director of PhD Studies at the department may even decide upon accreditation of other earlier courses if these do not serve to fulfill the basic or specific eligibility requirements for admission to PhD studies. Only courses that fulfill *faculty course requirements* or *courses in the research area* (see the relevant sections above) may be counted toward the degree. At most 25 ECTS from earlier studies at the undergraduate and master levels may be counted toward the degree.

Transitional provisions

Changes to the general study syllabus do not apply to those who have already been admitted to PhD studies in the research area. A change to the new general study syllabus may however be approved if both the main supervisor and the PhD student agree. In such a case, this should be documented in the individual study plan.