Biomedical Engineering Sciences

/ Medicinteknisk vetenskap/

SCB koder: 20601, 20603, 10299

1 General description of the research area

The subject biomedical engineering sciences is characterized by its interdisciplinary profile, where research and education take 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 includes 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. The subject includes a clear sustainability perspective within the health area.

2 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*.

2.1 Specific eligibility requirements

Specific eligibility requirements for PhD education in Biomedical Technology Sciences are met by those who have completed course requirements of at least 60 ECTS at the master's level in a research field relevant to the subject of the PhD studies. The applicant must also be able to provide documented proficiency in English.

3 Degree

PhD studies in ÄMNE lead 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 the licentiate thesis corresponds to 90 ECTS, and courses of 30 ECTS of which at least 15 ECTS must be at PhD level. The Degree of Doctor comprises 240 ECTS, of which the doctoral thesis corresponds to 180 ECTS, and courses of 60 ECTS, of which at least 45 ECTS must be at PHD level. The distribution between the course credits and the thesis credits is regulated in the first individual study plan that is established.

4 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 goal of doctoral education is for the PhD student to independently conduct and lead research and development projects, particularly within the field's operational framework. To achieve this goal, the PhD student needs to develop advanced and deep knowledge within the subject, as well as specific expertise in the dissertation area, along with research experience and proficiency in research methodology.

PhD studies in Biomedical Technology Sciences provides the PhD student with the conditions to meet all degree objectives. The education consists of research and dissertation work, courses, participation in seminars, involvement in national and international conferences, and collaboration with society and industry within the subject area.

The education enables the PhD student to acquire both in-depth and broad knowledge and understanding within the research area of medical technology by:

- Completing broadening courses in medical technology science.
- Completing advanced courses in line with the direction of the dissertation work.
- Independently planning and conducting theoretical and/or experimental research.
- Actively following the literature within the subject.
- Actively participating in teaching within and/or outside LiU.

As part of the PhD studies, the PhD student is given the opportunity to develop familiarity with scientific methodology and ethics. The PhD student is also given the opportunity to acquire and develop skills and abilities within the subject, as well as to develop evaluative skills and approaches within the subject, by:

- Completing a faculty-required course that includes research methodology and research ethics.
- Independently identifying and formulating relevant research questions within their own research.

- Independently planning and conducting theoretical and/or experimental research.
- Conducting a midway seminar to achieve 60% of the requirements for the doctoral degree. This applies to PhD students enrolled in a doctoral program who do not conduct a licentiate seminar.
- Regularly presenting their own research at seminars at LiU.
- Regularly presenting their own research at national and international conferences within the subject.
- Actively participating in seminar series and conferences to discuss and critically evaluate their own and others' research.

PhD students in biomedical technology science demonstrate intellectual independence by independently writing a monograph dissertation or a frame narrative (part of a compilation thesis).

The education provides the PhD student with an in-depth insight into the possibility of science to contribute to sustainable social development. This is achieved by the faculty common course requirements, as well as through participation in ongoing discussions, such as research seminars, and reflecting on the sustainability aspects of their own research work.

4.1 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*.

The PhD student demonstrates their ability to significantly contribute to the development of knowledge through their own research by writing a doctoral or licentiate thesis, the scientific quality of which must be approved by a grading committee (for the doctoral thesis) or an examiner (for the licentiate thesis).

A PhD or licentiate thesis can either be a monograph or a compilation thesis. A compilation thesis consists of a summary and a number of articles. In both types of theses, however, it is the overall scientific contribution that is assessed, and the requirement in both cases is that the thesis contains scientific contributions that are considered publishable in established scientific forums.

4.1.1 PhD Thesis

The thesis should be of such a quality that it is deemed to meet reasonable requirements for acceptance for publication in a high-quality international journal. In the thesis, the student's own research should be introduced, discussed, and critically evaluated in relation to the broader research field.

4.1.2 Licentiate Thesis

The thesis should consist of a scientific paper or a research report based on scientific principles.

4.2 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.

4.3 Supervision

The general regulations for supervision can be found in the *Study Handbook for PhD Studies*, section 4, and in the faculty's policy for supervision of PhD studies.

4.4 Courses

4.4.1 Faculty course requirements

Scientific theory, methodology, ethics, gender equality and sustainability
All PhD students admitted should complete mandatory courses as decided by the faculty in Scientific theory, methodology, ethics, gender equality and sustainability, 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).

4.4.2 Subject related courses

Anatomy and Physiology

Understanding physiological principles is important in medical technology science. PhD students who have not completed a course in Anatomy and Physiology, or an equivalent course, during their undergraduate studies must complete such a course during their doctoral studies.

Other Courses

In addition to general mandatory courses, subject-specific courses should be selected so that the PhD student is provided with the opportunity to achieve broad knowledge and understanding within the research field. The selection of subject-

specific courses should also ensure that the PhD student acquires in-depth knowledge and understanding of the subject, with a focus on the dissertation's direction. The interdisciplinary nature of the subject means that courses from other fields can also be included in the subject-specific course section if they aim to enhance the PhD student's ability to solve the research problem. General doctoral education courses, such as scientific writing, popular science communication, and information retrieval, may also be included if they aim to strengthen the PhD student's ability to conduct and showcase their research.

4.4.3 Accreditation

Accreditation of course credits is regulated by the *Study Handbook for PhD studies*, section 5.6.

5 Other information

5.1 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.

6 Commencement

1. The General study plan comes into force 01 07 2024.