Biomedical Signal Processing

Programme course

6 credits
Analys av bioelektriska signaler
TBMT01
Valid from: 2020 Spring semester

Determined by
Board of Studies for Electrical Engineering,
Physics and Mathematics

Date determined
2019-09-23
Main field of study

Electrical Engineering, Biomedical Engineering

Course level

Second cycle

Advancement level

A1X

Course offered for

- Master's Programme in Biomedical Engineering
- Biomedical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Engineering Biology, M Sc in Engineering

Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites

Signal Theory, Anatomy and Physiology. Experience of Computer programming/signal processing in matlab or similar.

Intended learning outcomes

The course gives an in-depth analysis of the origin and processing of bioelectrical signals in humans. The analysis is related to differentiating between healthy and pathological conditions and emerges from clinical situations and issues. After completing the course the students are able to independently:

- Describe, apply and evaluate physical, electrical and mathematical models for the
origin of bioelectrical signals in the cell, and their conduction in nerves and in tissue.
- Give an in-depth description of bioelectricity in the heart and in the central and peripheral nervous system.
- Describe and evaluate the most important bioelectrical measurement methods: The ECG, the EEG and the EMG, in relation to normal and pathological conditions.
- Apply and evaluate different methods for signal processing of the ECG, the EEG and the EMG, with respect to time- and frequency domain analysis.
- Describe, apply and evaluate Fourier transform based methods for signal processing.

**Course content**

Signal analysis: time- and frequency, sampling, digital signals, Fourier transform (FFT), estimation of the power spectrum, input windows, leakage, aliasing, convolution and correlation properties, digital filters
Physiological and mathematical models of bioelectricity: cell membrane, resting- and action potentials, Nernst equation, volume conducting, forward- och inverse problems
Measurement of bioelectrical signals: electrode properties, measurement systems
Electrocardiography: origin of the ECG, ECG-leads, ECG analysis
Neurophysiology: nervous system, muscles, EEG, EP, EMG, ERG, EOG, signal analysis
Electrostimulation: defibrillation, pacemakers, electrostimulation
Laboratory experiment: biosignal processing

**Teaching and working methods**

The course is partly based on problem based learning and comprises lectures, problem solving individually and in various groups and laboratory work.

**Examination**

<table>
<thead>
<tr>
<th>UPG1</th>
<th>Essay assignment</th>
<th>U, 3, 4, 5</th>
<th>4 credits</th>
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</thead>
<tbody>
<tr>
<td>LAB2</td>
<td>Laboratory work</td>
<td>U, G</td>
<td>0.5 credits</td>
</tr>
<tr>
<td>MOM2</td>
<td>Tutorial sessions</td>
<td>U, G</td>
<td>0.5 credits</td>
</tr>
<tr>
<td>UPG2</td>
<td>Seminar assignments</td>
<td>U, G</td>
<td>1 credits</td>
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**Grades**

Four-grade scale, LiU, U, 3, 4, 5
Other information

Supplementary courses

- Medical Imaging
- Biomedical Modeling and Simulation

About teaching and examination language

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is Swedish, the course as a whole or in large parts, is taught in Swedish. Please note that although teaching language is Swedish, parts of the course could be given in English. Examination language is Swedish.
- If teaching language is Swedish/English, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English (depending on teaching language).
- If teaching language is English, the course as a whole is taught in English. Examination language is English.

Other

The course is conducted in a manner where both men's and women's experience and knowledge are made visible and developed.

The planning and implementation of a course should correspond to the course syllabus. The course evaluation should therefore be conducted with the course syllabus as a starting point.

Department

Institutionen för medicinsk teknik

Director of Studies or equivalent

Marcus Larsson

Examiner

Ingemar Fredriksson
Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Books
