Biomedical Signal Processing

Programme course

6 credits

Analys av bioelektriska signaler

TBMT01

Valid from: 2017 Spring semester

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

Date determined
2017-01-25

Main field of study
Electrical Engineering, Biomedical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Biomedical Engineering, Master's Programme
- Computer Science and Engineering, M Sc in Engineering
- Information Technology, M Sc in 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.

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 condiitions.
- 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 Fouriertransform based methods for signal processing.

Course content

Signal analysis: time- and frequency, sampling, digital signals, Fouriertransform (FFT), estimation of the power spectrum, input windows, leakage, aliasing, convolution and correlation properties, z-transform, 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

UPG2	Seminar assignments	1 credits	U, G
MOM2	Tutorial sessions	0.5 credits	U, G
LAB2	Laboratory work	0.5 credits	U, G
UPG1	Essay assignment	4 credits	U, 3, 4, 5

Grades
Four-grade scale, LiU, U, 3, 4, 5

Other information
Supplementary courses: Medical Imaging

Department
Institutionen för medicinsk teknik

Director of Studies or equivalent
Marcus Larsson

Examiner
Ingemar Fredriksson

Course website and other links
https://www.imt.liu.se/edu/courses/TBMT01/

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

Course literature

Additional literature

Books

Malmivuo J. and Plonsey R, (1995) *Bioelectromagnetism, principles and applications of bioelectric and biomagnetic fields* Oxford University Press, NY
Sörnmo L. and Laguna P, (2005) *Bioelectrical Signal Processing in Cardiac and Neurological Applications* Academic Press (Elsevier)
Tortora G, Derrickson B., (2011) *Principles of Anatomy and Physiology* 13th ed Wiley
ISBN: ISBN 9780470929186

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.