

# 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 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 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

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

## 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://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).