

ES97H-15 Biomedical Signal Processing

21/22

Department

School of Engineering

Level

Taught Postgraduate Level

Module leader

Nigel Stocks

Credit value

15

Module duration

10 weeks

Assessment

50% coursework, 50% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

ES97H Biomedical Signal Processing

[Module web page](#)

Module aims

To introduce students to the principles of signal processing techniques when applied specifically to biomedical signals, including: ECG, MEG, EEG, SPO2, heart rate etc.

The module will provide the student with a firm grounding in methods and tools for extracting information from digitally acquired biomedical signals.

The module will introduce the practical implementation of signal processing techniques to digitally acquired biomedical signals.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Introduction to Biomedical Signals
 - o The Nature of Biomedical Signals
 - o Examples of Biomedical Signals
 - o Objectives and Difficulties of Biomedical Signal Analysis
- Revision of pre-requisites
 - o Linear Systems Theory (continuous and discrete time)
 - o Spectral methods (FT, DTFT, DFT, PSD)
- Signal Acquisition
 - o Measurement systems
 - o Sampling theorem
 - o Analogue-digital-conversion
 - o windowing
- Filtering
 - o Filter types
 - o Analogue
 - o Digital FIR IIR
- Random Physiological Signals
 - o Signal as a Stochastic Process
 - o Averaging techniques
- Advanced Methods of Biomedical Signal Processing
 - o DSP hardware and implementation
 - o Medical Devices

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate a systematic knowledge of the complex physical and physiological principles that underpin biomedical signals.
- Demonstrate an advanced understanding of the principles of digital signal processing.
- Systematically apply methods to extract relevant information from biomedical signal measurements.
- Critically assess the appropriateness of biomedical signal processing techniques for various problems in the field.
- Evaluate the effectiveness of techniques applied to biomedical signals against specific benchmarks.

Indicative reading list

1. Ramgaraj M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach. IEEE press 2001
2. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Sons, 2000
3. A V Oppenheim & R W Schaffer, Discrete-time Digital Signal Processing, 2009, ISBN-13:

Research element

Research for Group project

Interdisciplinary

signal processing and biological signals including pathology

Subject specific skills

Matlab programming. Filter design. Noise reduction. data acquisition.

Transferable skills

Team work. presentation and communication skills.

Study

Study time

| Type | Required |
|-------------------|----------------------------|
| Lectures | 20 sessions of 1 hour (8%) |
| Practical classes | 3 sessions of 3 hours (4%) |
| Other activity | 4 hours (2%) |
| Private study | 117 hours (49%) |
| Assessment | 90 hours (38%) |
| Total | 240 hours |

Private study description

Guided independent learning 117 hours

Other activity description

Revision Classes 2x2 hours

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group C1

Weighting Study time Eligible for self-certification

Assessment component

| | | | |
|---|-----|--|----|
| Group presentation | 30% | | No |
| Group presentation of main results of the group project | | | |

Reassessment component

| | | | |
|---|--|--|----|
| individual presentation and oral exam | | | No |
| individual presentations to assess competencies, effort and understanding | | | |

Assessment component

| | | | |
|---------------------------------------|-----|----------|----|
| Worksheet based on Laboratory Classes | 20% | 30 hours | No |
| Coursework | | | |

Reassessment component is the same

Assessment component

| | | | |
|---|-----|----------|----|
| Online Examination | 50% | 60 hours | No |
| A combination of qualitative and quantitative short answers | | | |

~Platforms - AEP,QMP

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- Online examination: No Answerbook required

Reassessment component is the same

Feedback on assessment

Model solutions to past papers.
Support through office hours.
Written feedback on assignment.
Cohort-level feedback on assignment
Cohort-level feedback on final exam.
Face to face feedback in laboratories

[Past exam papers for ES97H](#)

Availability

Pre-requisites

To take this module, you must have passed:

- All of
 - [ES3C5-15 Signal Processing](#)

Courses

This module is Core for:

- Year 4 of UESA-H163 MEng Biomedical Systems Engineering

This module is Optional for:

- Year 1 of TESA-H800 Postgraduate Taught Biomedical Engineering

This module is Option list A for:

- Year 4 of UESA-H114 MEng Engineering

This module is Option list B for:

- Year 4 of UESA-HH31 MEng Systems Engineering
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering