

# ES97H-15 Biomedical Signal Processing

**20/21**

**Department**

School of Engineering

**Level**

Taught Postgraduate Level

**Module leader**

Nigel Stocks

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

100% coursework

**Study location**

University of Warwick main campus, Coventry

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## 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.

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## 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.

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# Assessment

You must pass all assessment components to pass the module.

## Assessment group A

### 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

Signal processing test 50% 60 hours No

A combination of qualitative short answers and qualitative multiple choice questions to

#### Reassessment component is the same

#### Assessment component

Worksheet based on Laboratory Classes 20% 30 hours No

Coursework

#### 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.

## **Availability**

### **Pre-requisites**

ES3C5

### **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