

# ES97H-15 Biomedical Signal Processing

**22/23**

**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 (13%)
Practical classes	3 sessions of 3 hours (6%)
Other activity	4 hours (3%)
Private study	117 hours (78%)
Total	150 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 A1

	Weighting	Study time	Eligible for self-certification
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<b>Assessment component</b>			
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Group presentation	40%		No
Group presentation of main results of the group project			

<b>Reassessment component</b>			
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individual presentation and oral exam			No
individual presentations to assess competencies, effort and understanding			

<b>Assessment component</b>			
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In-class test	60%		No
A combination of qualitative and quantitative short answers			

<b>Reassessment component is the same</b>			
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## Feedback on assessment

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

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## 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 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- 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 UESA-HH33 MEng Systems Engineering with Exchange Year
- Year 5 of UESA-HH32 MEng Systems Engineering with Intercalated Year
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 5 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)