# **ES98G-15 Signal Processing**

### 24/25

Department School of Engineering Level Taught Postgraduate Level Module leader Viji Ahanathapillai Credit value 15 Module duration 10 weeks Assessment 30% coursework, 70% exam Study location University of Warwick main campus, Coventry

# Description

# Introductory description

# Module aims

The module aims to introduce signal processing to MSc students. It aims to develop the student's ability to: Select and apply appropriate mathematical methods for modelling and analysing signals and systems; Understand the scientific principles underlying the generation and classification of signals; Use practical skills to measure and analyse real-world signals; Select and apply appropriate computer based methods for modelling signals and systems; Design signal processing systems to meet a target specification.

# **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.

Analogue Signals and Systems: Time domain and s-domain representation of continuous-time signals; Linear time-invariant systems; Laplace transform; Analogue system transfer functions; Analogue system stability; Fourier transform and analogue frequency response; Analogue filter design and specification; Fourier series for periodic analogue signals; Computational modelling of analogue signals and systems

Digital Signals and Systems: Time-domain and z-domain representation of discrete-time signals; Signal conversion between analogue and digital representations; Sampling and aliasing; Linear shift-invariant systems; Z-transform; Digital system transfer functions; Digital system stability; Discrete-time Fourier transform and digital frequency response; Finite impulse response and infinite impulse response filters; Digital filter design and specification; Discrete Fourier Transform and evaluation with the Fast Fourier Transform; Computational modelling of digital signals and systems

Random Signal Processing: Random variable properties and variable distributions; Random signals; Signal estimation; Correlation; Power spectral density

Image Processing: Multi-dimensional signals; Representing images as signals; Multi-dimensional convolution; Image filtering

# Learning outcomes

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

- 1. Apply mathematics to analyse deterministic and random signals and to analyse processing systems [M1]
- 2. Apply signal processing systems to classify signals and extract information [M1]
- 3. Critique practical issues behind signal processing and information retrieval [M12]
- 4. Design signal processing systems to meet a specification [M1]
- 5. Model signals, filters and processes using computer packages [M3]
- 6. Measure and analyse real-world signals [M12]

# Indicative reading list

"Essentials of Digital Signal Processing", B.P. Lathi and R.A. Green, Cambridge University Press, 2014

"Essential MATLAB", B. Hahn and D. Valentine, Academic Press, 6th Edition, 2017 "Discrete-Time Signal Processing", Oppenheim and Schafer, Pearson, 3rd Edition, 2013

# Subject specific skills

- · Ability to conceive, make and realise a component, product, system or process
- Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality

# Transferable skills

- Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
- Apply problem solving skills, information retrieval, and the effective use of general IT facilities
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

# Study

# Study time

#### Туре

Lectures Practical classes Other activity Private study Total

#### Required

24 sessions of 1 hour (16%) 3 sessions of 2 hours (4%) 4 hours (3%) 116 hours (77%) 150 hours

# Private study description

46 hours Guided independent learning30 hours coursework submission40 hours final exam study

### Other activity description

2 x 1hr examples class 2 x 1hr revision class

# Costs

No further costs have been identified for this module.

# Assessment

You must pass all assessment components to pass the module.

### Assessment group D

Weighting Study time Eligible for self-certification

Assessment component

Lab Assignment30%Yes (extension)Assignment submission supported by timetabled laboratories. Submission consists of a writtenreport (maximum length of 5 pages) in addition to written code files and code output.

Weighting

No

Reassessment component is the same

Assessment component

Online Examination 70% QMP Online Examination 2hr

~Platforms - QMP

- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

Reassessment component is the same

#### Feedback on assessment

- Model solutions to past papers.
- Individual and cohort-level feedback on assignments.
- Support through advice and feedback hours.
- Cohort-level feedback on final exam.

Past exam papers for ES98G

### Availability

#### Anti-requisite modules

If you take this module, you cannot also take:

• ES3C5-15 Signal Processing

### Courses

This module is Optional for:

• Year 1 of TESA-H800 Postgraduate Taught Biomedical Engineering

• Year 1 of TESA-H641 Postgraduate Taught Communications and Information Engineering

This module is Option list A for:

• Year 1 of TESA-H643 Postgraduate Taught Electrical Power Engineering