

# ES3C5-15 Signal Processing

20/21

**Department**

School of Engineering

**Level**

Undergraduate Level 3

**Module leader**

Adam Noel

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

40% coursework, 60% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

[Module web page](#)

### Module aims

The module aims to introduce signal processing to 3rd year students. It aims to develop the student's ability to: Select and apply appropriate mathematical methods for modelling and analysing signals; Understand the scientific principles underlying the generation of signals; Use practical skills in a laboratory session in which the relevant test and measurement equipment is available; Select and apply appropriate computer based methods for modelling signals and communication systems; Design signal processing systems.

### 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.

Signals: Time domain and frequency domain representation of continuous and discrete signals; Laplace transform and transfer functions; Z-transform and transfer functions; Relation between time domain and frequency domain; Fourier Transform; Discrete Time Fourier Transform; Practical

use of Fast Fourier Transform; Convolution.

Filter Design: Specification in terms of frequency response; time domain and frequency responses; filter design filter design - FIR and IIR; Linear phase filters; Non-recursive designs using windowing; Quantisation and rounding in both recursive and non-recursive designs; Filter applications

Random Signal Analysis: Revision of some fundamental concepts of probability:- probability density, expected values, correlation; Time domain analysis:- correlation functions for continuous and discrete signals, analogue and digital measurement of correlation; Frequency domain analysis:- spectral densities and their relation to correlation functions, analogue and digital measurement; Estimation of noisy signals.

## 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
- 2. Apply signal processing systems to classify signals and extract information.
- 3. Critique practical issues behind signal processing and information retrieval
- 4. Design signal processing systems
- 5. Model signals, filters and processes using computer packages
- 6. Evaluate signals and systems using laboratory test and measurement equipment

## 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 Schaffer, 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

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## Study

## Study time

Type	Required
Lectures	24 sessions of 1 hour (16%)
Practical classes	3 sessions of 2 hours (4%)
Other activity	4 hours (3%)
Private study	46 hours (31%)
Assessment	70 hours (47%)
Total	150 hours

## Private study description

46 hours Guided independent learning

## Other activity description

2 x 1hr examples class

2 x 1hr revision class

## 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.

Students can register for this module without taking any assessment.

## Assessment group DA

	Weighting	Study time	Eligible for self-certification
<b>Assessment component</b>			
Lab Assignment	40%	40 hours	No
Assignment submissions supported by laboratory activities and using both hardware and software			

Reassessment component is the same

Assessment component	Weighting	Study time	Eligible for self-certification
Online Examination ~Platforms - QMP	60%	30 hours	No

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

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 ES3C5](#)

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## Availability

### Post-requisite modules

If you pass this module, you can take:

- ES96T-15 Advanced Wireless Systems and Networks

## Courses

This module is Core for:

- Year 3 of UESA-H161 BEng Biomedical Systems Engineering
- Year 3 of UESA-H63W BEng Electronic Engineering
- Year 4 of UESA-H63V BEng Electronic Engineering with Intercalated Year
- Year 3 of UESA-HH35 BEng Systems Engineering
- Year 3 of UESA-HH36 BEng Systems Engineering
- Year 4 of UESA-HH34 BEng Systems Engineering with Intercalated Year

- Year 3 of UESA-H163 MEng Biomedical Systems Engineering
- Year 3 of UESA-H63X MEng Electronic Engineering
- UESA-H636 MEng Electronic Engineering with Intercalated Year
  - Year 3 of H636 Electronic Engineering with Intercalated Year
  - Year 4 of H636 Electronic Engineering with Intercalated Year
- UESA-HH31 MEng Systems Engineering
  - Year 3 of HH31 Systems Engineering
  - Year 3 of HH35 Systems Engineering
- Year 3 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 3 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng
- Year 4 of UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year

This module is Core optional for:

- UESA-H636 MEng Electronic Engineering with Intercalated Year
  - Year 3 of H636 Electronic Engineering with Intercalated Year
  - Year 4 of H636 Electronic Engineering with Intercalated Year
- Year 4 of UESA-H63Y MEng Electronic Engineering with Intercalated Year
- Year 3 of UESA-H115 MEng Engineering with Intercalated Year
- Year 4 of UESA-HH32 MEng Systems Engineering with Intercalated Year
- UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year
  - Year 3 of H607 Electrical and Electronic Engineering with Intercalated year
  - Year 4 of H607 Electrical and Electronic Engineering with Intercalated year

This module is Optional for:

- Year 3 of UESA-H113 BEng Engineering
- Year 3 of UESA-H114 MEng Engineering
- Year 4 of UESA-H115 MEng Engineering with Intercalated Year
- 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 4 of UESA-H111 BEng Engineering with Intercalated Year
- Year 3 of UESA-H112 BSc Engineering

This module is Option list B for:

- Year 3 of UCSA-G406 Undergraduate Computer Systems Engineering
- Year 3 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 4 of UCSA-G407 Undergraduate Computer Systems Engineering (with Intercalated Year)
- Year 4 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)