

# ES197-15 Systems Modelling, Simulation and Computation

**24/25**

**Department**

School of Engineering

**Level**

Undergraduate Level 1

**Module leader**

James Atkinson

**Credit value**

15

**Module duration**

18 weeks

**Assessment**

60% coursework, 40% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

ES197-15 Systems Modelling, Simulation and Computation

[Module web page](#)

### Module aims

Systems modelling is an essential skill which underpins all Engineering disciplines allowing the Engineer to model a variety of problems. The use of models aims to provide information necessary to make decisions in the design and development of Engineering solutions or to investigate systems which are too costly, difficult or unethical to investigate physically. Vast numbers of bespoke software solutions are available to Engineers working in industry but this module will focus on designing and programming models from first principles showing the application of mathematical techniques and avoidance of modelling errors. There are design principles associated with models which ensure robust development and these will also be covered along with verification and validation techniques and applications to data modelling. These methods are inherited from software design processes and the synthesis will be exploited.

## 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.

### Lecture Topics

Context: What is modelling and how is it used?

- Model types, models as a tool, model design process akin to physical design process  
Systems Modelling: how are mathematical models developed, simulated and validated?  
Model in the loop
- First/second order, block diagrams, Simulink
- Modelling of translational, rotational, electrical, thermal systems
- First order systems, input-output and transfer function representation, step and frequency response
- Second order systems, input-output and transfer function representation, step and frequency response
- Fourier analysis
- Deriving relationships from data: linear, quadratic, polynomial  
Programming and implementation of models
- Key programming concepts (e.g. for-loops, functions, variables)

### Learning outcomes

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

- Apply computational thinking to create software for solving modelling and simulation problems [C1(D), M1(D), C3(D), M3(D)]
- Work in a team to create and demonstrate a model developed with a user and purpose in mind. [C5(D), M5(D), C12(D), M12(D), C13(D), M13(D), C16, M16]
- Simplify real engineering problems and approximate via a mathematical model. [C2(D), M2(D)]
- Derive simple models and relationships from data. [C2(D), M2(D)]
- Understand and predict the response of a system to test inputs (i.e. step, sine) using analytical and simulation-based approaches. [C1(D), M1(D), C6(D), M6(D)]

### Indicative reading list

Close, C.M., Newell, J.C. and Frederick, D.K., 2002. Modeling and analysis of dynamic systems. Wiley.

Karris, Steven T. Introduction to Simulink with engineering applications. Orchard Publications, 2006.

### Subject specific skills

Requirement writing and test plans.

## Transferable skills

Group work, project management, Group reflection.

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## Study

### Study time

Type	Required
Lectures	12 sessions of 1 hour (8%)
Seminars	3 sessions of 1 hour (2%)
Project supervision	12 sessions of 1 hour (8%)
Practical classes	8 sessions of 2 hours (11%)
Other activity	34 hours (23%)
Private study	73 hours (49%)
Total	150 hours

### Private study description

75 hours of guided independent learning

### Other activity description

1x 1 hr revision lecture

33 hours independent working on projects (33+12=45)

## 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 DD

	Weighting	Study time
Group Project (including Peer Assessment)	30%	
In groups, students develop a MATLAB/Simulink model for an engineering problem. Assessed by		

## Weighting

## Study time

four deliverables: project charter (15%, 3 pages), presentation/demo (70%, 15 mins, 5-10 mins questions), team reflection (15%, 2 pages) and peer assessment.

Continuous Assessment of Laboratory Exercises 30%

A series of laboratory exercises based on using MATLAB/Simulink to investigate various systems. Assessed via Moodle tests.

ES197 Written Exam 40%

- Answerbook Pink (12 page)
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

## Feedback on assessment

- Cohort level written feedback on group project
- Cohort-level written feedback on laboratory exercises
- Support through advice and feedback hours
- Cohort-level feedback on final exams

[Past exam papers for ES197](#)

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## Availability

## Courses

This module is Core for:

- Year 1 of UESA-H335 BEng Automotive Engineering
- Year 1 of UESA-H161 BEng Biomedical Systems Engineering
- Year 1 of UESA-H216 BEng Civil Engineering
- Year 1 of UESA-H63W BEng Electronic Engineering
- Year 1 of UESA-H113 BEng Engineering
- Year 1 of UESA-HN12 BEng Engineering Business Management
- Year 1 of UESA-HH75 BEng Manufacturing and Mechanical Engineering
- Year 1 of UESA-H315 BEng Mechanical Engineering
- Year 1 of UESA-HH36 BEng Systems Engineering
- UESA-H112 BSc Engineering
  - Year 1 of H112 Engineering
  - Year 1 of H112 Engineering
- Year 1 of UESA-H612 Computer Systems Engineering MEng

- Year 1 of UESA-H336 MEng Automotive Engineering
- Year 1 of UESA-H163 MEng Biomedical Systems Engineering
- Year 1 of UESA-H217 MEng Civil Engineering
- Year 1 of UESA-H63X MEng Electronic Engineering
- Year 1 of UESA-H114 MEng Engineering
- Year 1 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 1 of UESA-H316 MEng Mechanical Engineering
- Year 1 of UESA-HH3A MEng Systems Engineering with Exchange Year
- Year 1 of UCSA-G404 Undergraduate Computer Systems Engineering
- Year 1 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 1 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng