ES197-15 Systems Modelling, Simulation and Computation

23/24

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

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.

Study

Teaching split

Provider	Weighting
School of Engineering	95%
WMG	5%

Study time

Type	Required
Lectures	15 sessions of 1 hour (10%)
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

73 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.

Assessment

You must pass all assessment components to pass the module.

Assessment group DE

	Weighting	Study time
Group Project (including Peer Assessment)	30%	

In groups, students develop a MATLAB/Simulink model for an engineering problem. Assessed by four deliverables: project charter (15%, 3 pages), presentation/demo (70%, 15 mins, 5-10 mins questions), team reflection (15%, 2 pages) and peer assessment.

Assessment of Laboratory Skills (Matlab/Simulink)	30%

An in-class test to assess Matlab and Simulink skills.

Examination	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 in-class test
- Support through advice and feedback hours
- Cohort-level feedback on final exams

Past exam papers for ES197

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-HN15 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-HH35 BEng Systems Engineering
- Year 1 of UESA-HN11 BSc Engineering and Business Studies
- 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
- UESA-HH31 MEng Systems Engineering
    - Year 1 of HH31 Systems Engineering
    - Year 1 of HH35 Systems Engineering
- Year 1 of UCSA-G406 Undergraduate Computer Systems Engineering
- Year 1 of UCSA-G408 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