

ES2C7-15 Engineering Mathematics and Data Analytics

23/24

Department

School of Engineering

Level

Undergraduate Level 2

Module leader

James Atkinson

Credit value

15

Module duration

10 weeks

Assessment

30% coursework, 70% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

ES2C7-15 Engineering Mathematics and Technical Computing

[Module web page](#)

Module aims

To build on the fundamental material introduced in ES193 Engineering Mathematics and ES197 Systems Modelling, Simulation and Computation thereby ensuring that students are equipped with the necessary analytical and computational tools to tackle advanced material in modules taught in later years. To present and provide skills in the application of more advanced mathematics and systems modelling concepts that underpin all areas of the Warwick Engineering Curriculum. To develop skills in the use of MATLAB for modelling and analysis of engineering systems. To apply computational methods to the analysis and modelling of data.

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.

Sequences, series, limits and Taylor series.

Fourier series.

Multi-variable vector calculus

Applied linear algebra: linear matrix/vector equations and their solution (applications such as linear regression analysis, electrical circuits and fluid networks); eigenvalue/eigenvector analysis (applications such as oscillation in circuits, structural dynamics, solution of state variable models and stability analysis); multidimensional Taylor series, linearization and extrema of functions.

Fourier transforms, z-transforms.

Partial differential equations and their solution (examples to include: wave equation, diffusion equation and Laplace equation).

Data manipulation in MATLAB

Data analysis techniques: Regression, classification, PCA and design of experiments.

MATLAB as a system modelling and analysis tool.

Learning outcomes

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

- 1. Recognise and apply advanced mathematical tools and techniques to solve engineering based problems
- 2. Develop complex mathematical models of engineering systems
- 3. Solve complex engineering problems using MATLAB
- 4. Apply data analytics techniques to datasets produced by engineering processes and systems

Indicative reading list

Croft, A. and Davison, R., "Mathematics for Engineers: and MyMathLab: A Modern Interactive Approach", 3rd Ed., Pearson, ISBN-10: 1408263238, 2010.

James, G., "Modern Engineering Mathematics : 4th edition with MyMathLab", Pearson, ISBN-10: 027373413X, 2010.

Magrab, E.B. et al., "An Engineer's Guide to MATLAB: International Edition", 3rd Ed. Pearson, ISBN-10: 0137039549, 2010.

Cho, MoonJung, and Wendy L. Martinez. "Statistics in Matlab: A Primer". Vol. 22. CRC Press, 2014.

Lei, B., Xu, G., Feng, M., van der Heijden, F., Zou, Y., de Ridder, D. and Tax, D.M., 2017. "Classification, parameter estimation and state estimation: an engineering approach using MATLAB". John Wiley & Sons.

Subject specific skills

Ability to integrate analytical, mathematical and programming skills for analysing, developing and critically evaluating mathematical engineering models. Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for complex concepts to become a reality. Ability to apply the knowledge of specific software package for engineering modelling.

Transferable skills

Ability to overcome difficulties by employing skills, knowledge and understanding in a flexible manner. Ability to apply mathematical and computational methods to communicate parameters, model and optimise solutions. Ability to apply problem-solving skills, information retrieval, and the effective use of specific software packages and general IT facilities. Ability to plan self-learning and improve performance as the foundation for lifelong learning and continuous professional development.

Study

Study time

Type	Required
Lectures	23 sessions of 1 hour (15%)
Practical classes	4 sessions of 3 hours (8%)
Private study	115 hours (77%)
Total	150 hours

Private study description

115 hours guided independent study

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group D4

	Weighting	Study time
Laboratory Assessment	30%	
Laboratory Assessment via moodle quizzes		
In-person Examination	70%	
2 hour exam		

Weighting

Study time

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

Feedback on assessment

- Model solutions to past papers.
- Support through advice and feedback hours.
- Online feedback on computer-based formative test.
- Cohort-level feedback on final exam.

[Past exam papers for ES2C7](#)

Availability

Courses

This module is Core for:

- Year 2 of UESA-H335 BEng Automotive Engineering
- Year 2 of UESA-H161 BEng Biomedical Systems Engineering
- Year 2 of UESA-H216 BEng Civil Engineering
- Year 2 of UESA-H63W BEng Electronic Engineering
- Year 2 of UESA-H113 BEng Engineering
- Year 2 of UESA-HN15 BEng Engineering Business Management
- Year 2 of UESA-HH75 BEng Manufacturing and Mechanical Engineering
- Year 2 of UESA-H315 BEng Mechanical Engineering
- Year 2 of UESA-HH35 BEng Systems Engineering
- UESA-H112 BSc Engineering
 - Year 2 of H112 Engineering
 - Year 2 of H112 Engineering
- Year 2 of UESA-HN11 BSc Engineering and Business Studies
- Year 2 of UESA-H336 MEng Automotive Engineering
- Year 2 of UESA-H163 MEng Biomedical Systems Engineering
- Year 2 of UESA-H217 MEng Civil Engineering
- Year 2 of UESA-H63X MEng Electronic Engineering
- Year 2 of UESA-H114 MEng Engineering
- Year 2 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 2 of UESA-H316 MEng Mechanical Engineering
- UESA-HH31 MEng Systems Engineering
 - Year 2 of HH31 Systems Engineering

- Year 2 of HH35 Systems Engineering
- Year 2 of UCSA-G406 Undergraduate Computer Systems Engineering
- Year 2 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 2 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 2 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng