# ES2C7-15 Engineering Mathematics and Data Analytics

## 25/26

**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:

- Recognise and apply advanced mathematical tools and techniques to solve engineering based problems [C1, C2, M1, M2]
- Develop complex mathematical models of engineering systems [C1, M1, C2, M2, C3, M3]
- Solve complex engineering problems using a computational approach [C3, M3, C12, M12]
- Apply data analytics techniques to datasets produced by engineering processes and systems [C2, M2]

## 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 D5

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|
| Laboratory Assesment | 30% | | No |
| Laboratory Assessment via moodle quizzes | | | |
| ES2C7 Written exam | 70% | | No |
| 2 hour exam | | | |

---

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|

- 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-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
- UESA-H316 MEng Mechanical Engineering
    - Year 2 of H315 Mechanical Engineering BEng
    - Year 2 of H316 Mechanical Engineering MEng
- UESA-HH31 MEng Systems Engineering

    - Year 2 of HH31 Systems Engineering
    - Year 2 of HH35 Systems Engineering
- Year 2 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 2 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng