# ES3C2-15 Advanced Mechanical Engineering Design

## 21/22

**Department**
School of Engineering
**Level**
Undergraduate Level 3
**Module leader**
Richard Lillington
**Credit value**
15
**Module duration**
20 weeks
**Assessment**
100% coursework
**Study location**
University of Warwick main campus, Coventry

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## Description

### Introductory description

ES3C2-15 Advanced Mechanical Engineering Design

Module web page

### Module aims

The module examines the systematic approach to the complete design of optimal mechanical systems. Working at the convergence of fundamental mechanical engineering concepts and engineering design, the module approaches the design of mechanical systems by drawing on aspects such as theoretical calculations, computer-based simulation and design for manufacture to come up with a design that fulfils a design brief. The module will run across terms 1 and 2.

### 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.

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1. Design project process: requirements, specifications, assumptions and delivery.
2. Design analysis - FMEA.
3. Detailed component design – including fixings and fits and tolerances
4. Effective use of computer-based simulation for design optimisation
5. Design for manufacture - including material choice and manufacturing method selection
6. Machining processes
7. Prime movers
8. Mechanisms - including gearing and transmissions
9. Coupling mechanical and electronic/electrical systems
10. Justification of design decisions
11. Clear and concise technical communication
12. Evaluation of success and understanding basic types of risk associated with mechanical design and manufacturing.

## Learning outcomes

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

- Evaluate and apply suitable constraints to systematically manage and progress a complex design task, with due regard to technical uncertainty and the need to proceed with incomplete information.
- Choose appropriate components, assemblies, and configurations, and apply suitable design and analysis techniques to make judgements on key dimension and material choices and model solutions.
- Make judgements on the accuracy of analytical and numerical models, and use these to inform design choices
- Use modern CAD, analysis, and optimisation tools to demonstrate robust designs of machine elements and assemblies, selecting analytical models of suitable precision to progress the solution.
- Critique a design using methods such as Failure Modes and Effects Analysis, analysing the effects of uncertainty in design, and considering the effect of safety factors to identify workable improvements.
- Design mechanical components and assemblies with a full and achievable plan for how they can be manufactured with a focus on selecting appropriate manufacturing processes, ease ofmanufactureandefficiencyofassembly.
- Use practical laboratory and workshop skills to investigate broadly-defined problems.
- Design solutions for broadly-defined problems that meet a combination of user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal and environmental matters, codes of practice and industry standards.
- Balance the needs of all stakeholders whilst acknowledging the need for inclusivity and ethical design principles.
- Work efficiently within a small team to manage and plan a sequence of work both on an individual and team level.
- Communicate effectively with team members.
- Produce professional group-based documents and design documentation.

### Indicative reading list

- Shigley’s Mechanical Engineering Design 10th edition, Budynas and Nisbett, McGraw-Hill higher Education, 2014.
- Shigley, J.E. Uicker, J.J. Theory of machines and mechanisms, McGraw-Hill Education, 2016.
- Pahl, G., Beitz, W. Engineering Design, a systematic approach, 3rd Ed. Springer-Verlag, 2006.
- Design of Machinery: an Introduction to the Synthesis and Analysis of Mechanisms and Machines, Norton, RL, 5th edition (McGraw Hill 2012).
- French, M.J. Form, Structure and Mechanism, Palgrave Macmillan, 1992
- French, M.J. Conceptual Design for Engineers, Springer-Verlag UK, 1998

### Subject specific skills

TBC

### Transferable skills

TBC

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## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 15 sessions of 1 hour (5%) |
| Seminars | 10 sessions of 2 hours (7%) |
| Practical classes | 1 session of 3 hours (1%) |
| Private study | 112 hours (37%) |
| Assessment | 150 hours (50%) |
| Total | 300 hours |

### Private study description

Guided Independent Learning. / Support of group portfolio submission.

## 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 A3

| | Weighting | Study time |
|---|---|---|
| Group Design Project - Portfolio | 50% | 75 hours |
| A final design for the group project comprising of a portfolio document a and formal presentation to peers with Q&A | | |
| Individual Design Study | 25% | 37 hours 30 minutes |
| Individual design study/portfolio – 8 pages | | |
| Group Design Project -Initial Proposal | 25% | 37 hours 30 minutes |
| An initial proposal for the design for the group project comprising of a pitch desk/poster and short video submission. | | |

### Feedback on assessment

Individualised written comments on submitted work.
Written cohort feedback.
Cohort feedback
Team feedback in design seminars.
Support through advice and support hours.

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## Availability

### Pre-requisites

To take this module, you must have passed:

- All of
  - ES2D2-15 Mechanical Engineering Design

## Courses

This module is Core for:

- Year 3 of UESA-H310 BEng Mechanical Engineering
- Year 3 of UESA-H315 BEng Mechanical Engineering

- Year 4 of UESA-H314 BEng Mechanical Engineering with Intercalated Year
- Year 3 of UESA-H311 MEng Mechanical Engineering
- Year 3 of UESA-H316 MEng Mechanical Engineering
- Year 4 of UESA-H317 MEng Mechanical Engineering with Intercalated Year

This module is Core optional for:

- Year 3 of UESA-H115 MEng Engineering with Intercalated Year
- UESA-H317 MEng Mechanical Engineering with Intercalated Year
    - Year 3 of H317 Mechanical Engineering with Intercalated Year
    - Year 4 of H317 Mechanical 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

This module is Option list A for:

- Year 4 of UESA-H111 BEng Engineering with Intercalated Year
- UESA-H112 BSc Engineering
    - Year 3 of H112 Engineering
    - Year 3 of H112 Engineering