ES3C2-15 Advanced Mechanical Engineering Design

22/23

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

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
- 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 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.

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

1. Plan and manage the design process, including cost drivers, evaluating outcomes, and working with technical uncertainty.
2. Ability to apply relevant practical and laboratory skills.

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimise solutions
2. Apply problem solving skills, information retrieval, and the effective use of general IT facilities
3. Communicate (written and oral; to technical and non-technical audiences) and work with others
4. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader

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Study

Study time

Type	Required
Lectures	15 sessions of 1 hour (30%)
Seminars	10 sessions of 2 hours (40%)
Practical classes	1 session of 3 hours (6%)
Private study	12 hours (24%)
Total	50 hours

Private study description

Guided Independent Learning. / Support of group portfolio submission.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group A4

	Weighting	Study time
Individual Design Study/Portfolio	50%	
Individual design study/portfolio – maximum 15 A4 pages (or A3 equivalent)		
Group Project - EV Gearbox	50%	
A final design portfolio submission for the group project comprising of a i) portfolio document and ii) a video assignment - Report of 20 pages, 5 minute video. Including Peer Assessment.		

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.

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
- UESA-H316 MEng Mechanical Engineering
  - Year 3 of H315 Mechanical Engineering BEng

    - Year 3 of H316 Mechanical Engineering MEng
- 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
- UESA-H11L Undergradaute Engineering (with Intercalated Year)
    - Year 3 of H11L Engineering (with Intercalated Year)
    - Year 4 of H11L 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