ES3C2-15 Advanced Mechanical Engineering Design

24/25

Department
School of Engineering
Level
Undergraduate Level 3
Module leader
Javier Munguia
Credit value
15
Module duration
10 weeks
Assessment
60% coursework, 40% exam
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 2 and 3.

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.

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.

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. Fundamental machinery and mechanical components
8. Mechanisms - including brakes, bearings, joints and shafts
9. Coupling theoretical mechanical design calculations with digital design.
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. [C1, C3, C4, M1, M3, M4]
- 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. [C3, C12, C13, M3, M12, M13]
- Make judgements on the accuracy of analytical and numerical models, and use these to inform design choices. [C3, C6, M3, M6]
- 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. [C5, C9, M5, M9]
- 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, mitigating security risk, diversity, inclusion, cultural, societal and environmental matters, codes of practice and industry standards. [C5, C10, C11, M5, M10, M11]
- Balance the needs of all stakeholders whilst acknowledging the need for inclusivity and ethical design principles. [C8, M8]
- Work efficiently within a small team to manage and plan a sequence of work both on an individual and team level. [C16, C17, M16, M17]

Indicative reading list

- RACE CAR DESIGN, Book by DEREK. SEWARD 2014
- 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.

- Design of Machinery: an Introduction to the Synthesis and Analysis of Mechanisms and Machines, Norton, RL, 5th edition (McGraw Hill 2012).
- Manual of engineering drawing: technical product specification and documentation to British and international standards Book by C. H. Simmons; Neil Phelps; D. E. Maguire ©2012

View reading list on Talis Aspire

Research element

-Students are required to investigate different mechanical device options to these presented in-class. E.g., for torque joints, the preferred torque transfer method will be pins and shaft, but students are encouraged to research on convolute splines design, manufacture and specification.
-A moderate element of research is also introduced for a variety of other components:
-->brakes (research on friction coefficients)
-->bearings (research on bearing types, options and functionality)
-->Wishbone materials (research on alternative materials to tubular steel sections, e.g. carbon fibre, composites)

Subject specific skills

1. Plan and manage the design process, including component selection, complex assemblies, evaluating outcomes, and working with technical uncertainty.
2. Ability to apply the theory acquired in previous modules from years 1 and 2 into real mechanical systems.
3. Understanding of industrial information, datasheets, catalogues and standards governing diverse mechanical components.

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

---

Study

Study time

Type	Required
Lectures	8 sessions of 1 hour (5%)
Total	150 hours

Type	Required
Tutorials	1 session of 2 hours (1%)
Practical classes	8 sessions of 2 hours (11%)
Supervised practical classes	3 sessions of 2 hours (4%)
Online learning (independent)	16 sessions of 1 hour 30 minutes (16%)
Private study	94 hours (63%)
Total	150 hours

Private study description

Every week we introduce a new topic with the main briefing taking place during the in-person Lecture, and followed by a series of pre-recorded videos and activities (learning paths and Quizzes) to be completed by students via Moodle at their own time.

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 D1

	Weighting	Study time
Group Project and Design Portfolio Group design assignment 15 pages.	60%	
QMP Examination QMP examination. Answer book required. On campus. ~Platforms - Moodle	40%	

- Online examination: No Answerbook required
- Engineering Data Book 8th Edition

Feedback on assessment

Individualised written comments on submitted work.
Team feedback in design seminars.

Support through advice and support hours.

Past exam papers for ES3C2

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
- Year 3 of UESA-H11L Undergradaute 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