ES3C2-15 Advanced Mechanical Engineering Design

20/21

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

Description

Introductory description

ES3C2-15 Advanced Mechanical Engineering Design

Module web page

Module aims

This module builds upon the fundamentals of Mechanical Design as taught in ES2D2. The module provides a systematic approach to the design of mechanical systems such as engine transmissions, and explores theoretical models of common machine elements for use in making strategic decisions about their arrangement. 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.

1. Design project control : requirements and specifications. Design analysis – FMEA.
2. Prime movers – sources of rotational power.

3. Power matching: torque and speed characteristics of prime movers and mated loads; corner power.
4. Kinematics of toothed gearing: conjugate action, fundamental law of gearing, involute tooth profiles, interference and addendum modification.
5. Gearing performance: mean tooth sliding velocity and estimating power losses, root and surface failure.
6. Epicyclic gearing: relative velocity method for velocity, acceleration and displacement, applications.
7. Belt transmissions: slip limitation for flat and vee belts, initial tension, applications.
8. Shaft transmission of power, and bearing selection.
9. Hydraulic systems, pumps, transmission, actuators.
10. Disc clutches and brakes : friction, uniform pressure and uniform wear relationships.

Learning outcomes

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

- Evaluate and apply suitable constraints to 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.

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

Study

Study time

Type	Required
Lectures	13 sessions of 1 hour (9%)
Seminars	7 sessions of 2 hours (9%)
Practical classes	6 sessions of 1 hour (4%)
Private study	117 hours (78%)
Total	150 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 A2

	Weighting	Study time
Group Design Project	60%	
Portfolio (60%) Nominal portfolio weightings: Ideation (10 pages max) 15%; Main portfolio submission - communication of design choices / design intent (30 pages max) 30%; Video presentation - 10 minute max / 10 slides max video presentation 15%.		
Individual Design Study	30%	

	Weighting	Study time
Individual design study – 8 pages		
Group Design Project	10%	
Poster A2 (10%) - Submitted at the Module Poster Show		

Feedback on assessment

Individualized written comments on submitted work.
Written cohort feedback.
Cohort feedback / design challenge lecture in T2.
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
- 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