

ES2C6-15 Electromechanical System Design

26/27

Department

School of Engineering

Level

Undergraduate Level 2

Module leader

Mark Dooner

Credit value

15

Module duration

10 weeks

Assessment

40% coursework, 60% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

ES2C6-15 Electromechanical System Design

[Module web page](#)

Module aims

The module aims to show applications of instrumentation and measurement in integrated electromechanical engineering systems, apply the principles of engineering control and feedback and design an electromechanical system with motors, actuators, sensors, control, mechanical and electrical power transmission. It also aims to deliver an understanding of the underpinning science behind energy conversion in electromechanical systems and instil the fundamental engineering principles and mathematical techniques of electromechanical power conversion.

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.

- Basic control system with gain, error, and feedback (open loop and closed loop)
- Block diagram and signal flow representation of control systems (system modelling and reduction techniques)
- System stability analysis
- PID control
- Electromechanical Actuators (PMDC Motors, Brushless Motors, Stepper motors, Servo motors etc,
- Sensors (speed sensors, current sensors, voltage sensors etc), signal conditioning, and Data acquisition
- Magnetic circuits and Systems
- AC power (real, reactive, complex and apparent power)
- Power factor correction and reactive power compensation in AC systems
- 3-Phase AC system (Star systems, delta systems, phase quantities, line quantities)
- Transformers (equivalent circuit, leakage reactance).

Learning outcomes

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

- Apply measurement and instrumentation in modern electro-mechanical systems. [C1, M1]
- Conceptualise, design and evaluate an electro-mechanical systems. [C5, M5, C12, M12, C13(D), M13(D), C16, M16, C17, M17]
- Apply the mathematical principles and formulations behind real, reactive, complex and apparent power. [C1, M1, C3, M3]
- Evaluate the design and efficiency of a power system with transformers and motors. [C6, M6, C1, M1]
- Appreciate and understand the operation of motors for energy conversion in modern electro-mechanical systems. [C2, M2]
- Use sensors, op-amps, actuators and feedback to implement control in modern electromechanical systems. [C4, C6, M4, M6]
- Produce an environmentally friendly design, within the constraints of the project, considering the life-cycle of the product and the benefit to society [C7, M7]

Indicative reading list

[Reading lists can be found in Talis](#)

Research element

Group design projects involve the use of research to develop solutions to electromechanical problems involving energy conversion, sensing, measurement, feedback and control. Students will consult datasheets, technical literature and manufacturer application notes when designing electromechanical systems.

Interdisciplinary

The module comprises of topics from electrical power, electronic sensing, mechanical design and mechanical structures.

Subject specific skills

1. Plan and manage the design process of electromechanical energy conversion and control systems including power sources, transformers, motors and controllers.
2. Designing and evaluating the performance of electromechanical systems and developing control strategies. Using control theory to ensure stable operation of electromechanical systems.
3. The use of technical literature, datasheets, other information sources including appropriate codes of practice and industry standards in the development of electromechanical energy conversion and control systems
4. Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk
5. Ability to apply relevant practical and laboratory skills in the design of systems that include electromechanical energy conversion, sensing, feedback and closed/open loop control.
6. Knowledge of professional codes of conduct, how ethical dilemmas can arise, relevant legal and contractual issues.

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize 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. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
5. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader
6. Awareness of the nature of business and enterprise in the creation of economic and social value
7. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner
8. Ability to formulate and operate within appropriate codes of conduct, when faced with an ethical issue
9. Appreciation of the global dimensions of engineering, commerce and communication
10. Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.

Study

Teaching split

| Provider | Weighting |
|-----------------------|------------------|
| School of Engineering | 90% |
| WMG | 10% |

Study time

| Type | Required |
|---------------------|-----------------------------|
| Lectures | 18 sessions of 1 hour (12%) |
| Project supervision | 20 sessions of 1 hour (13%) |
| Private study | 112 hours (75%) |
| Total | 150 hours |

Private study description

112 Guided Independent Learning consisting of pre-recorded lectures to support the live lectures, quizzes, problem sheets.

Around 40 hours of this will be spent of project work outside of supervised labs.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group D6

| Assessment component | Weighting | Study time | Eligible for self-certification |
|--|------------------|-------------------|--|
| Group Design Project | 40% | | No |
| Group Design project. It includes a group project report (2000 words), an oral presentation and a peer assessment. | | | |

Reassessment component

| | | | |
|---|--|--|----|
| Assignment | | | No |
| An assignment on the conceptualisation, design and evaluation of an electro-mechanical system | | | |

Weighting

Study time

Eligible for self-certification

which enables students to understand the operation of motors and includes the use sensors and feedback to implement control in an electro-mechanical system. 2000 words.

Assessment component

Centrally-timetabled
examination (On-campus)
Examination

60%

No

-
- Students may use a calculator
 - Answerbook Green (8 page)
 - Engineering Data Book 8th Edition

Reassessment component is the same

Feedback on assessment

- Support through advice and feedback hours.
- Written feedback on marked design report.
- Cohort-level feedback on final exam.

[Past exam papers for ES2C6](#)

Availability

Post-requisite modules

If you pass this module, you can take:

- ES3J8-15 Measurement and Instrumentation
- ES3E7-15 Power Systems and Electrical Machines
- ES3E8-15 Precision, Measurement and Control

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-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
- Year 2 of UESA-H336 MEng Automotive Engineering
- Year 2 of UESA-H163 MEng Biomedical Systems 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