ES3E8-15 Precision, Measurement and Control

26/27

Department
School of Engineering
Level
Undergraduate Level 3
Module leader
Hungyen Lin
Credit value
15
Module duration
10 weeks
Assessment
30% coursework, 70% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES3E8-15 Precision, Measurements and Control

Module web page

Module aims

The module will provide engineers with an opportunity to develop their understanding of the important cross-disciplinary factors in measurement, instrumentation, and control that underpin modern machine functionality.

Both instrumentation and control are perceived as important topics for engineers to have some theoretical foundation in, along with an ability to translate that theory into practical applications.

The module provides mechanically biased engineers with an opportunity to develop their measurement knowledge, and couple this to deliver control in practical engineering systems.

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.

- Further Instrumentation principles. Operation and performance of selected sensors and transducers, and their conditioners, and the limits imposed by measurement systems and the conditions of use. Examples of sensing force, torque, temperature, pressure, flow, displacement, voltage, and current. Parameter – measuring device interactions in precision measurement.
- Measurement. Understand the need for rigorous metrology concepts in design and use of measurement systems. Understand the importance and use of gauging and mastering, and traceability to national standards.
- Precision. Precision and accuracy constraints. Sources of uncertainty. Random and systematic effects. The combinational effects of errors in the measurement chain. Methods of uncertainty categorization, and reduction.
- Complex Control. Consolidate understanding of commonly applied control techniques, and develop understanding by considering alternative and enhanced control using methods other than PID. Methods for system identification. Breakdown of control.

Learning outcomes

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

- Appraise measurement limitations imposed by instruments and physical conditions, and interactions between the test system and the thing being measured.
- Discriminate between different sensor types and strategies for taking effective measurements in demanding conditions.
- Communicate the need for rigorous metrology concepts in design and use of measurement systems. Evaluate the importance and use of gauging and mastering, and traceability to national standards.
- Analyse and communicate uncertainty. Analysis of uncertainty reduction methods.
- Numerically evaluate complex control systems to interpret their stability or otherwise.
- Evaluate practical alternatives and enhanced methods of system identification and control above simple methods such as PID. Understand ‘the Control Frontier’.

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

- Ability to apply relevant practical and laboratory skills
- Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality

Transferable skills

- Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions
- Overcome difficulties by employing skills, knowledge and understanding in a flexible manner

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Study

Study time

Type	Required
Lectures	26 sessions of 1 hour (17%)
Seminars	4 sessions of 2 hours (5%)
Practical classes	1 session of 3 hours (2%)
Other activity	2 hours (1%)
Private study	111 hours (74%)
Total	150 hours

Private study description

Guided independent learning - 111 hrs

Other activity description

2 x 1hr revision class.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group D7

Assessment component	Weighting	Study time	Eligible for self-certification
Assignment	30%		Yes (extension)

	Weighting	Study time	Eligible for self-certification
A 1,500-word assignment (6 pages max.)			

Reassessment component is the same

Assessment component

Centrally-timetabled examination (On-campus) Written examination 2 hours	70%		No

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- Students may use a calculator
- Engineering Data Book 8th Edition
- Answerbook Pink (12 page)

Reassessment component is the same

Feedback on assessment

- Worked examples in revision class.
- Written feedback on laboratory report.
- Model solutions to past papers.
- Worked examples in examples class(es).
- Support through advice and feedback hours.
- Cohort level feedback on examinations

Past exam papers for ES3E8

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - ES2C6-15 Electromechanical System Design

Courses

This module is Core for:

- Year 3 of UESA-H315 BEng Mechanical Engineering
- Year 4 of UESA-H314 BEng Mechanical Engineering with Intercalated Year
- UESA-H316 MEng Mechanical Engineering
    - Year 3 of H315 Mechanical Engineering BEng
    - Year 3 of H315 Mechanical Engineering BEng
    - Year 3 of H316 Mechanical Engineering MEng
- 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