WM273-15 Instrumentation & Control

22/23

Department
WMG
Level
Undergraduate Level 2
Module leader
Siavash Amin-Nejad
Credit value
15
Module duration
13 weeks
Assessment
50% coursework, 50% exam
Study locations
University of Warwick main campus, Coventry Primary
Distance or Online Delivery

Description

Introductory description

Instrumentation and control is the nervous system of industrial complexes, power generation, and basically all the processes that require some intelligence to accomplish the task of producing a product or process.

Module web page

Module aims

This module aims to provide the students with an understanding of concepts, components, analogue systems and digital systems for industrial measurements and for process control. It will equip students with knowledge on how different sensors, controllers and actuators, with their limits, can form different open-loop and closed-loop control systems. Examples, simulations and analytical work underpin the learning of simple and moderately complex control systems: discrete (ON/OFF, PWM, multi-level) and continuous (proportional, integral, PID).

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.

Instrumentation for control purposes:

- Industrial data representation, analog and digital signal processing, passive circuits,
- Analog-to-digital and digital-to-analog converters,
- Operational amplifier circuits in instrumentation, comparators, amplifiers, instrumentation amplifiers,
- Thermal, mechanical and optical sensors; associated op-amp circuits,
- Switching devices and PWM switching control circuits,
- Actuators: heaters, relays, electric motors, pressure modulators,
  Process-control systems
- Introduction to process-control systems,
- Block diagrams and transfer functions of continuous systems,
- Open-loop and closed-loop systems: basics & modelling,
- Proportional, integral and derivative mode controllers,
- Steady-state performance - comparison with simulation studies.
  Analysis of feedback systems
- Basic concepts of feedback control,
- Transfer functions, Bode diagrams, polar plots,
- Stability of linear systems, Routh-Hurwitz criterion, Nyquist criterion,
- Response of linear systems to impulse, step and sinusoidal excitation.

Learning outcomes

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

- describe, classify and analyse the performance of various sensors and associated electronics found in both analogue and digital instrumentation systems,
- compare the main characteristics (structure, functionality and performance) of simple and moderately complex control systems
- apply mathematical techniques to design and analyse analogue measurement and control systems
- undertake the simulation and practical work related to control systems

Indicative reading list

1. N. Storey: “Electronics: A Systems Approach” (Pearson), ISBN: 9780273773276, (2013).
2. J.A.Svoboda, R.C.Dorf: “Introduction to Electric Circuits” (Wiley E-book), ISBN: 9781118560587, (2013).
3. S.J.Dods: "Feedback control: linear, nonlinear and robust techniques and design with industrial applications", (Springer e-book), ISBN: 9781447166757 (2015).
4. R.C.Dorf, R.H.Bishop: “Modern control systems” (Pearson, 2011) ISBN: 9780131383104.
5. E. Lipiansky: "Electrical, Electronics, and Digital Hardware Essentials for Scientists and Engineers", (Wiley E-book) ISBN: 9781118414521, (2012).
6. P.C.Krause: "Electromechanical motion devices", (Wiley e-book), ISBN: 9781118316887, (2012).

7. A.S.Morris, R. Langari: "Measurement and instrumentation: theory and application", (Waltham e-book) ISBN: 9780123819628 (2012).

View reading list on Talis Aspire

Subject specific skills

Design analogue electronic instruments.
Analyse the stability of a system.
Design controllers.

Transferable skills

Technology literacy.
Teamwork.
Critical thinking.
Problem-solving.

Study

Study time

Type	Required
Lectures	9 sessions of 1 hour (6%)
Seminars	8 sessions of 1 hour (5%)
Practical classes	4 sessions of 1 hour (3%)
Online learning (scheduled sessions)	9 sessions of 1 hour (6%)
Online learning (independent)	15 sessions of 1 hour (10%)
Private study	45 hours (30%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

On-line forum discussions and support: 5 hours
Self-study (to include additional seminar-type questions, exam revision, software exercises): 65 hours

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group C

	Weighting	Study time	Eligible for self-certification
Assignment	50%	30 hours	Yes (extension)
Numerical and simulation study.			
Exam	50%	30 hours	No
Formula sheets available during the exam.			

Feedback on assessment

Feedback given as appropriate to the assessment type:

- verbal formative feedback given during seminar/tutorial sessions,
- written individual formative feedback on the assignment reports,
- written cohort-level summative feedback on the exam.

Past exam papers for WM273

Availability

Courses

This module is Core for:

- Year 2 of UWMS-H7C3 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer)
- Year 2 of DWMS-H7C7 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer) (Degree Apprenticeship)
- Year 2 of UWMS-H7C2 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer)
- Year 2 of DWMS-H7C6 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)
- Year 2 of UWMS-H7C1 Undergraduate Applied Professional Engineering (Manufacturing Engineer)
- Year 2 of DWMS-H7C5 Undergraduate Applied Professional Engineering (Manufacturing Engineer) (Degree Apprenticeship)
- Year 2 of UWMS-H7C4 Undergraduate Applied Professional Engineering (Product Design and Development Engineer)

- Year 2 of DWMS-H7C8 Undergraduate Applied Professional Engineering (Product Design and Development Engineer) (Degree Apprenticeship)