Prifysgol Wrecsam
Wrexham University

Module specification

When printed this becomes an uncontrolled document. Please access the Module Directory for the most up to date version by clicking on the following link: Module directory

Module Code	ENG5D1
Module Title	Control Systems Diagnostics
Level	5
Credit value	20
Faculty	FACE
HECoS Code	100188
Cost Code	GAME
Pre-requisite module	N/A

Programmes in which module to be offered

Programme title	Core/Optional/Standalone
FdEng Industrial Engineering (Electrical) BEng (Hons) Electrical Engineering with Manufacture BEng (Hons) Electrical Engineering	Core

Breakdown of module hours

Learning and teaching hours	18 hrs
Placement tutor support hours	0 hrs
Supervised learning hours e.g. practical classes, workshops	18 hrs
Project supervision hours	0 hrs
Active learning and teaching hours total	**36 hrs**
Placement hours	0 hrs
Guided independent study hours	164 hrs
Module duration (Total hours)	**200 hrs**

Module aims

This module develops applied understanding through a balance of theory and practice. Learners undertake both classroom study and supervised practical activity to explore design, implementation, and evaluation processes. Collaborative work and enquiry-based learning foster communication, teamwork, and the confidence to apply problem-solving techniques in varied contexts.

This module, *Control System Diagnostics*, aims to develop students' understanding of the principles and methodologies underpinning control system design and diagnostics. It covers both time domain and frequency-domain analysis, classical proportional–integral–derivative (PID) control, and advanced control strategies, including model predictive control with Kalman filtering and reinforcement-learning-based autonomous systems.

Module Learning Outcomes

At the end of this module, students will be able to:

1	Apply fundamental principles of control system theory to analyse time-domain and frequency-domain responses of broadly defined control systems, including the use of PID controllers (AHEP-4 F1).
2	Use appropriate analytical and computational tools to model and diagnose the performance of control systems, recognising the limitations of classical and modern control techniques (AHEP-4 F3).
3	Analyse the behaviour of contemporary control systems employing intelligent control approaches, including model predictive control with Kalman filtering and reinforcement learning, to evaluate their effectiveness in autonomous applications (AHEP-4 F6).

Assessment

Indicative Assessment Tasks:

This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment 1: Portfolio (100%)

Students will undertake an individual coursework portfolio focused on the modelling, simulation, behavioural analysis, and optimisation of a broadly defined dynamic control system representative of a practical engineering application.

Assessment number	Learning Outcomes to be met	Type of assessment	Duration/Word Count	Weighting (%)	Alternative assessment, if applicable
1	1-3	Portfolio	3000	100	N/A

Derogations

Credits shall be awarded by an Assessment Board for those modules in which a pass mark 40% has been achieved, with a minimum mark of 30% in each assessment element.

Learning and Teaching Strategies

Learning integrates conceptual study with practical investigation to deepen understanding and enhance problem-solving ability. Students participate in lectures, laboratory work, and team-based projects that encourage collaboration and communication. Online materials, recordings, and discussion forums support blended engagement. Tutorials promote reflective learning and increasing autonomy in preparation for advanced study.

Welsh Elements

This module will be delivered through the medium of English; however, students have the option to submit their assessments in the medium of Welsh. While this module is not currently offered fully through Welsh, Welsh language support and guidance are available, and some learning materials or tutorial discussions may incorporate Welsh elements where appropriate. To further promote bilingual learning, all students have the opportunity to take the 20-credit *Welsh for STEM* short course, designed to develop confidence and subject-specific language skills in both English and Welsh.

Indicative Syllabus Outline

Time-Domain Modelling and Analysis:
Development of mathematical models of control systems, with analysis of transient and steady-state responses, stability, and key performance indices.

Frequency-Domain Techniques and PID Control:
Application of frequency-domain methods, including Laplace transforms, transfer functions, Bode plots, and Nyquist criteria, alongside the design and tuning of PID controllers.

Simulation and Computational Analysis:
Use of industry-standard computational tools to simulate control system behaviour and validate models against expected performance characteristics.

Diagnostic and Performance Evaluation Techniques:
Application of diagnostic methods, including sensitivity analysis, robustness evaluation, and assessment of modelling assumptions and limitations.

State Estimation and Optimal Control:
Application of advanced control principles, including Kalman filtering and model predictive control, to analyse constrained dynamic systems.

Autonomous and Adaptive Control Systems:
Introduction to reinforcement learning-based control and comparison with classical control approaches through evaluation of their effectiveness in autonomous engineering applications.

Indicative Bibliography

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads:

N. S. Nise, *Control Systems Engineering*, 8th ed., Hoboken, NJ, USA: John Wiley & Sons, 2020.

Other indicative reading:

R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 14th ed., Harlow, UK: Pearson Education, 2021.

Administrative Information

For office use only	
Initial approval date	June 2026
With effect from date	September 2026
Date and details of revision	
Version number	1