Module specification

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Module Code	ENG5B4
Module Title	Intelligent Control System Design
Level	5
Credit value	20
Faculty	FAST
HECoS Code	100166
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BEng / MEng Electrical and Electronic Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	30 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	0 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**30** hrs
Placement / work based learning	0 hrs
Guided independent study	170 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	22/08/2022
With effect from date	September 2022
Date and details of revision	
Version number	1

Module aims

- To cover the key concepts and frameworks of control system design with a focus on time-domain and frequency-domain analysis of the responses of control systems, and proportional, integral and derivative controllers.
- To study on contemporary systems with intelligent control schemes will also be covered by examining model predictive control assisted by Kalman filtering and autonomous control implemented by reinforcement learning.
- To introduce algorithmic frameworks and relevant artificial intelligence-driven paradigms (particularly, machine learning methods) for the design of present-day control systems.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Model analytically and mathematically, conventional and contemporary control schemes.
2	Characterise any given control system to ascertain steady-state behaviour and stability.
3	Identify and validate real-world use cases for proportional, integral and derivative controllers.
4	Implement intelligent frameworks and models for the augmentation of traditional control schemes to enhance their robustness and efficiency.

In addition to the module learning outcomes, students will also cover the following accreditation of higher education programme (AHEP) fourth edition learning outcomes: C2.

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.

Using MATLAB and Simulink (and other applicable MATLAB toolboxes) to address real-world intelligent control system design problems. For example, (1) autonomous flight of a drone; (2) autonomous navigation of a mobile robot.

Behavioural study of real-world intelligent control schemes. For example, (1) implementation of model predictive control and Kalman filtering for heading control; (2) implementation of reinforcement learning for robotic path planning.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1,2,3,4	Portfolio	100%

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Learning and Teaching Strategies

The module is taught through a combination of lectures and workshops. An active and inclusive approach is used to engage learners in the topics and will involve individual, group work and flipped learning experiences aligned to the university's Active Learning Framework (ALF). The approach offers students a flexible and adaptive learning experience that can accommodate a range of options that includes both on campus learning and remote learning where appropriate.

The Moodle VLE and other on-line materials and resources will be available to support learning. ALF offers a balance between the classroom elements and digitally enabled activity incorporating flexible and accessible resources and flexible and accessible feedback to support learning.

The module will be delivered mainly via lectures, in-class demonstrations, and self-guided use of model-based design computational platforms (MATLAB, Simulink and relevant MATLAB toolboxes) for the design, analysis, characterisation, testing and simulation of real-world control systems for some applications. Onramp Courses and Tech. Talks from MathWorks will also be incorporated into the module to enhance the proficiency of the students in working independently, as well as in a team, using MATLAB, Simulink and relevant MATLAB toolboxes environment.

Indicative Syllabus Outline

Introduction to Control Systems

Transient or Time Response Analysis of Control Systems

Frequency Response Analysis of Control Systems

Proportional, Integral and Derivative Controllers

Model Predictive Control and Kalman Filtering

Autonomous Control and Reinforcement Learning

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*. New Jersey: John Wiley and Sons, 2020.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas.

Core Attributes
Engaged
Enterprising
Creative
Ethical

Key Attitudes
Commitment
Curiosity
Resilience
Confidence
Adaptability

Practical Skillsets
Digital Fluency
Organisation
Leadership and Team working
Critical Thinking
Emotional Intelligence
Communication