Wrexham glyndŵr UNIVERSITY

MODULE SPECIFICATION

Module Title:	**Further Control Engineering**	**Level**:	6	**Credit Value**:	20

Module code:	ENG60J	**Is this a new module?** Yes	**Code of module being replaced**:	ENG696

Cost Centre(s):	GAEE	**JACS3 code**:	H660

Trimester(s) in which to be offered:	1, 2	**With effect from:**	September 18

School:	Faculty of Arts, Science and Technology	**Module Leader:**	Dr Z Chen

Scheduled learning and teaching hours	60 hrs
Guided independent study	140 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered	Core	Option
BEng (Hons) Electrical & Electronic Engineering	✓	
BEng (Hons) Industrial Engineering		✓

Pre-requisites
None

Office use only

Initial approval: June 16

Revised (to include UG suite) Sept 18 Version: 1

Have any derogations received Academic Board approval? Yes ✓ No ☐ N/A ☐

If new module, remove previous module spec from directory? Yes ☐ No ☐

Module Aims
1. To extend mathematical modelling to predict and modify control system behaviour. 2. To analyse modern control theories, approaches and applications. 3. To extend established analytical skills by applying computer-based tools to control system design, simulation, implementation and modification.

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Determine and apply appropriate methods for modelling and analysing problems in industrial control systems	KS3	KS5
2	Analyse and predict the performance of a computer controlled system	KS4	KS6
3	Design and/or modify, using computer aided techniques, a control system to a specified performance using the state space approach	KS3	KS7
4	Control system design and evaluation, engineering professional codes of conduct and ethical conduct in control engineering, control system reliability, operation risks, environmental and commercial risks, health and safety.	KS5	KS7

Transferable skills and other attributes

1. Apply mathematical analysis;
2. Solve problems;
3. Apply design

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%.

Assessment:

The assessment of this module consists of two parts:

1. Portfolio of activity evidence – Candidates will work on problems to apply computer-based tools for control system design, simulation and analysis. A written report will be submitted for the assessment.
2. Exam – At the end of semester, candidates will sit in an unseen written exam.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	3, 4	Portfolio	50%		2000
2	1, 2	Examination	50%	2 hours	

Learning and Teaching Strategies:

The module will be delivered through lectures and student-driven investigative work. A significant amount of the content is to be achieved through individual study. Approximately one third of the timetabled time will be devoted to formal lectures. The remainder of the time will be allocated to tutorials and to individual study but also with some programmed access to lab/computer facilities, for practical investigation and analysis activities.

Syllabus outline:

Modelling and simulation of dynamic processes: Different types of mathematical models for an industrial dynamic process; Mechanistical analysis-based modelling; Empirical databased modelling; Linear time invariant models; Model structure selection; Model parameter identification/estimation.

Discrete time control systems: Sampling and aliasing; Difference equations and Z transforms; The Z plane; System classification and frequency response; Digital filters; Digital implementation of analogue controllers.

Multivariable control systems: State space equations; State equations from transfer functions; Controllability and observability; Solution of state equation; Application of state feedback; State estimator; poles and zeros.

Adaptive control of industrial dynamic processes: Lyapunov stability; Lyapunov direct method; Lyapunov indirect method; Model reference adaptive control; Fuzzy logic; Self tuning control.

Multivariate Statistic Process Control: Statistic process control; Principal components; Partial least squares; Cross-validations; Principal Component Analysis; Projection to Latent Structures; Control chart.

Case studies: Industrial process control systems design, implementation, operation, maintenance; social, economic, commercial and ethical issues in control engineering; health and safety, system reliability and operation risk assessment, commercial and environmental risks.

Bibliography:

Essential reading

Nise, N.S. (2013) Control Systems Engineering, 7th edition, John Wiley & Sons.

Other indicative reading

Tewari A.; (2003) Modern Control Design with MATLAB and SIMULINK; UK; John Wiley & Sons.

Golten J., Verwer A.; (2003) Control System Design & Simulation; London; McGraw Hill.

Albertos P.; Sala A.; (2001) Multivariable Control Systems: An Engineering Approach (Advanced Textbooks in Control & Signal Processing); Springer-Verlag.

Ioannou P.; Fidan B.; (2006) Adaptive Control Tutorial; Society for Industrial and Applied Mathematics (SIAM). Roffel B.;

Betlem B.; (2003) Advanced Practical Process Control; Springer-Verlag.

Journals:

IEE Computing & Control Engineering Journal, monthly journal

IEEE Control Systems Magazine, monthly journal

International Journal of Control, monthly journal