UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Process Dynamics and Control
Module Code	CPE6009-B
Academic Year	2022/3
Credits	20
School	Department of Chemical Engineering
FHEQ Level	FHEQ Level 6

Contact Hours	
Type	Hours
Lectures	24
Laboratories	6
Tutorials	10
Directed Study	160

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Semester 1

Module Aims

This module aims to provide students with solid theoretical fundamentals for understanding production plants automatic control. This is to ensure operational safety, enhance product quality and increase in profitability of chemical process plants. The module covers aspects of dynamic modelling, control stability and analysis of various control systems, and basic instrumentation concepts.

Outline Syllabus

- Terminology: basic elements in a simple control loop, process variables, closed-loop vs. open-loop system, impulse, step, ramp inputs.
- Control Loop Hardware: sensors, transmitters, control valves.
- Instrumentation for measurement of process variables.
- Mathematical models for dynamic processes, the response of first-order plus dead time (FOPDT) and secondorder dynamics.
- Block diagram representation and simplification.
- Laplace/inverse transforms and partial fractions.
- Transfer functions, poles and zeros and system response versus pole location.
- Rise time, settling time, overshoot, damping ratio, and bandwidth.
- Stability: Routh-Hurwitz Criterion.
- System type, steady-state error, error constants, Final Value Theorem.
- Frequency response: Bode/Nyquist plots. Gain/phase margin.
- Root Locus Techniques: Root Locus design.
- Control Strategies: feed-forward, ratio, cascade, phase lead/lag.
- PID controller and tuning methods, Anti-windup.
- Process and Instrumentation Diagram (P&ID), standards and symbols.
- Process control system simulation using MATLAB and Simulink.

Learning Outcomes

Outcome Number	Description
LO 1	Use process control terminology and describe the instrumentation needed to implement process control.
LO 2	Determine process dynamics from step response data and convert differential equations into transfer function and state space representation.
LO 3	Analyse stability and performance of feedback loops using Laplace and frequency domain techniques.
LO 4	Formulate design specifications for a control system and select appropriate compensator design strategies to achieve desired performance.
LO 5	Identify and use material from a variety of references, such as books and web-based sources.
LO 6	Solve problems and communicate effectively through writing reports.

Learning, Teaching and Assessment Strategy

The course material is delivered through a combination of interactive lectures supported by videos/animations, tutorials, and computer simulation. Lectures will explore principles of process control analysis and design (LOs 1, 2, 3, 4, 5). Case studies are presented to illustrate real-world applications of control and promote class discussion.

Formative assessment is through tutorial exercises and computer simulations which provide the opportunity for students to test their understanding and implement the techniques learned in the lectures (LOs 2, 3, 4, 6). Directed reading will help deepen understanding of the lecture topics (LO 5).

The coursework (LOs 1, 2, 3, 4, 5, 6) and examination (LOs 1, 2, 3, 4) are used to assess understanding of the theory, use of the software tools, and analytical problem solving skills, developed during the course. Formative verbal feedback is given in the weekly tutorials. Written feedback on the coursework is provided after marking of the submitted reports (LO 6).

Mode of Assessment			
Type	Method	Description	Weighting
Summative	Coursework - Written	1. Coursework (1500 words)	25%
Summative	Coursework - Written	2. Coursework (1500 words)	25%
Summative	Examination - Closed Book	3. Closed-book examination (2hrs)	50%

Reading List
To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html

Please note:
This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.

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