CHEN90032 Process Dynamics And Control

Credit Points:	12.50
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	This subject is not offered in 2014.
Time Commitment:	Contact Hours: 3 x one hour lectures per week + 1 x one hour tutorial per week + 1 x three hours of laboratory work per semester Total Time Commitment: Estimated 200 hours
Prerequisites:	Students must have completed the following subjects (or equivalent) prior to enrolling in this subject:

Subject	Study Period Commencement:	Credit Points:
MAST20029 Engineering Mathematics	Summer Term, Semester 1, Semester 2	12.50
CHEN20008 Chemical Process Analysis 2	Semester 2	12.50

CHEN20008 Chemical Process Analysis 2 may be taken concurrently by students admitted to the Master of Engineering.

Corequisites:	None
Recommended Background Knowledge:	Students undertaking this subject will be expected to be competent in the use of Matlab.
Non Allowed Subjects:	CHEN30009 Process Dynamics and Control
Core Participation Requirements:	For the purposes of considering applications for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005) and Students Experiencing Academic Disadvantage Policy, this subject requires all students to actively and safely participate in laboratory activities. Students who feel their disability may impact upon their participation are encouraged to discuss this with the Subject Co-ordinator and the Disability Liaison Unit http://www.services.unimelb.edu.au/disability/Contact
Contact:	Email: **gdasilva@unimelb.edu.au (mailto:gdasilva@unimelb.edu.au)**

Subject Overview:

AIMS

Continuous chemical processes are inherently dynamic systems – process inputs and outputs change in time. To accommodate this, modern plants require some form of automatic control. This subject equips students with the skills to understand how and why key process variables change in time, and to then design and implement effective control strategies to accommodate this.

Students are introduced to the concept of feedback control, with examples of control schemes for common unit operations. Time domain analysis of process dynamics is performed using linear ordinary differential equations, Laplace transforms, and transfer functions. The response of complex process plants to common dynamic inputs is investigated. Students are introduced to frequency response analysis and Bode plots. The development of empirical dynamic models, and numerical simulation using MATLAB, is also covered.

The process control component of the subject introduces the concept of closed loop transfer functions and the PID controller. Dynamic process simulation is performed using analytical techniques and with the numerical simulation capabilities of the MATLAB Simulink software package. The stability of closed loop systems is analysed using techniques such as Routh stability analysis, the Bode stability criterion, and gain and phase margins. The effect of controller tuning constants on control system response is investigated, along with various controller tuning methods. Advanced control strategies including cascade control, time-delay compensation, and feedforward control are developed, as well as techniques to simultaneously control multiple process variables in multiloop systems.

	INDICATIVE CONTENT Feedback control schemes for common unit operations. Developing and solving dynamic process models, including the application of Laplace transforms and transfer functions as well as the use of numerical simulation tools. Frequency response analysis and Bode plots. Modelling of closed-loop control systems and PID controllers. Closed-loop stability analysis and controller tuning. Advanced single-loop control strategies and multiloop control systems.
Learning Outcomes:	**INTENDED LEARNING OUTCOMES (ILO)** On completion of this subject the student is expected to: 1 Understand how key process variables change in time for common chemical processes responding to typical dynamic inputs. 2 Be able to model the dynamics of common unit operations, using analytical methods and computer simulations. 3 Analyse and implement effective and efficient control strategies for chemical processes. 4 Understand how feedback controllers operate and be able to tune them. 5 Demonstrate mastery of the mathematical modelling of feedback and other control loops. 6 Appreciate how and when to implement advanced forms of process control and understand complications arising from multiloop control.
Assessment:	Three assignments spread throughout the semester (30 %), totalling about 2500 words. One assignment is associated with a laboratory experiment and report. One assignment is associated with designing and simulating a controller. One three-hour written examination at the end of semester (70%). Hurdle requirement: A mark of 40 % or more in this examination is required to pass the subject. Intended Learning Outcomes (ILOs) 1 to 6 are addressed in the examination and two of the assignments. ILOs 1 and 2 are addressed in the laboratory experiment.
Prescribed Texts:	None
Recommended Texts:	Seborg, Edgar, Mellichamp, Doyle, *Process Dynamics and Control*, Third Edition 2011, Wiley.
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	# Ability to apply knowledge of basic science and engineering fundamentals. # In-depth technical competence in at least one engineering discipline. # Ability to undertake problem identification, formulation and solution. # Ability to use a systems approach to design and operational performance. # Ability to optimise control systems for maximum efficiency. # Ability to apply engineering methods to solve complex problems.
Notes:	**LEARNING AND TEACHING METHODS** The subject is delivered through a combination of lectures and tutorials. Students also complete an experiment and a simulation-based controller design project, applying material covered in the lectures. **INDICATIVE KEY LEARNING RESOURCES** Lecture notes and slides. Worked solutions to tutorial problems. Online quizzes. All content is made available via the LMS. **CAREERS / INDUSTRY LINKS** Case studies on practical control and process safety systems, delivered by a practicing control engineer.
Related Majors/Minors/ Specialisations:	B-ENG Chemical Engineering stream B-ENG Chemical and Biomolecular Engineering stream

	Master of Engineering (Biochemical) Master of Engineering (Chemical with Business) Master of Engineering (Chemical)