School of Engineering

ENGG2440: Modelling and Control

Callaghan
Semester 2 - 2023

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

COURSE OUTLINE

OVERVIEW

Course Description

This course introduces students to modelling and control of engineering systems. It presents tools that are fundamental for the analysis and design of such systems. The tools presented in the course use energy as a key element to develop modelling skills that can transcend physical domains and engineering specialisations. In addition, the course provides students with an understanding of the principle of feedback along with an introduction to classical control design techniques. Topics include fundamental limitations, stability of closed loop systems, control design for time domain and frequency domain specifications.

Assumed Knowledge

MATH1110 Mathematics for Engineering, Science and Technology 1,
MATH1120 Mathematics for Engineering, Science and Technology 2,
MATH2310 Calculus of Science and Engineering, and
PHYS1210 Advanced Physics I

Contact Hours

Lecture
Face to Face On Campus
2 hour(s) per Week for Full Term starting Week 1

Tutorial
Face to Face On Campus
2 hour(s) per Week for Full Term starting Week 2

Unit Weighting

10

Workload

Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator **Callaghan**
A/Pr Yuen Yong
Yuenkuan.Yong@newcastle.edu.au
(02) 4921 6438
Consultation: Please refer to Canvas course site

Teaching Staff Dr Alejandro Donaire

School Office **School of Engineering**
EAG03
EA Building
Callaghan
+61 2 4921 5798
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

This course will cover:

1. Introduction to engineering systems
2. Energy-based modelling of engineering systems in different physical domains
3. From energy-based to computational models for computer simulation
4. Analysis of linear systems using transforms including a review of Laplace transforms
5. Transfer functions and block diagrams
6. Role of feedback and fundamental limits on the response achievable with feedback, sensitivity and complementary sensitivity functions
7. Stability of closed loop systems, root locus
8. Time domain response specifications, P, PI, PID controller, Anti-integral windup
9. Frequency domain analysis, Bode, Stability Margins
10. Compensator design for frequency domain specifications

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Formulate mathematical models of basic engineering systems with components from different physical domains (mechanical, electrical, hydraulic)
2. Build computational models based on block diagrams and state-space equations
3. Perform numerical simulations of time-domain response of dynamic systems
4. Relate the time response of linear time-invariant systems to model structure and parameters
5. Relate the frequency response of linear systems to transfer functions and system time response to sinusoidal excitation
6. Analyse stability of equilibrium points of nonlinear systems via linearisation
7. Demonstrate how feedback can be used to control the response of a system in a desired manner, and recognize the limit of performance
8. Demonstrate how different controller attributes influence the performance of a feedback control system
9. Design feedback controllers for typical response specifications in time as well as frequency domain

Course Materials

Recommended Text:

- Dorf, Richard C. Modern Control Systems, Global Edition, 13th Edition. Pearson (Intl), 2017.
- Norman S. Nise, Control Systems Engineering

ASSESSMENTS

This course has 3 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Weekly Quizzes	To be announced via Canvas. Nominally weekly.	Individual	40%	1, 2, 3, 4, 5, 6, 7, 8, 9
2	Laboratory Assignments	To be announced on Canvas. Nominally fortnightly.	Individual	30%	1, 2, 3, 4, 5, 6, 7, 8, 9
3	Mid-term and Final Quizzes	To be announced on Canvas.	Individual	30%	1, 2, 3, 4, 5, 6, 7, 8, 9

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Weekly Quizzes

Assessment Type Quiz
Description The quizzes will consist of problems and questions related to system modelling and control. In order to do well in these quizzes, students must grasp key concepts from the lecture videos, notes, textbooks, slides, and complete problems and review questions sets for the assessed topics.
Weighting 40%
Length To be announced on Canvas.
Due Date To be announced via Canvas. Nominally weekly.
Submission Method To be announced via Canvas.
Assessment Criteria
Return Method
Feedback Provided

Assessment 2 - Laboratory Assignments

Assessment Type Tutorial / Laboratory Exercises
Description These are computer lab assignments. The lab assignments cover topics from modelling physical systems to design and simulation of control systems.
Weighting 30%
Due Date To be announced on Canvas. Nominally fortnightly.
Submission Method Online
Most submissions are via MATLAB Grader and Canvas.
Assessment Criteria
Return Method
Feedback Provided

Assessment 3 - Mid-term and Final Quizzes

Assessment Type Quiz
Description These two quizzes are designed for students to demonstrate a good understanding of the course from modelling to control. The mid-term quiz will be assessing students knowledge in modelling. The final quiz will be assessing students knowledge in modelling and control combined.
Weighting 30%
Due Date To be announced on Canvas.
Submission Method
Assessment Criteria
Return Method
Feedback Provided

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.
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Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.

Adverse Circumstances

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

Important Policy Information

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/no-room-for/policies-and-procedures that support a safe and respectful environment at the University.

This course outline was approved by the Head of School on 30.06.2023. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.

Graduate Profile Statements – ENGG2440 – Semester 2 2023

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers):

UON Att.	University of Newcastle Bachelor of Engineering Graduate Profile Statements/ Engineers Australia Stage 1 competency statements	Taught	Practised	Assessed	Skill Level (1-4)
	Professional Attributes				
11	3.1. Ethical conduct and professional accountability	Y	Y	Y	2
12	3.2. Effective oral and written communication in professional and lay domains.				
13	3.3. Creative, innovative and pro-active demeanour.	Y	Y	Y	2
14	3.4. Professional use and management of information.				
15	3.5. Orderly management of self, and professional conduct.		Y	Y	2
16	3.6. Effective team membership and team leadership.				
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.	Y	Y	Y	3
8	2.2. Fluent application of engineering techniques, tools and resources.	Y	Y	Y	1
9	2.3. Application of systematic engineering synthesis and design processes.				
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.				
	Knowledge Base				
1	1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	Y	Y	Y	2
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	Y	Y	Y	2
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	Y	Y	Y	2
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.				
5	1.5. Knowledge of contextual factors impacting the engineering discipline.				
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.				