School of Engineering

MENG4210: Medical and Industrial Electronic Product Design

Callaghan

Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

The construction of medical and industrial electronic products requires the ability to sense physical quantities, communicate signals, and generate stimuli for organisms and transducers, which are the main topics of this course. This course will introduce the principles required to build high resolution instrumentation systems for biomedical, industrial, and commercial applications. This includes electrochemical sensors, gas detection, pressure and flow rate sensors, and optical sensors. The principles for designing and analysing these circuits will be combined with practical skills for fabricating and testing these devices. Commonly used analogue circuit building blocks will be discussed, including high-order active filters, passive filters, biopotential amplifiers, and signal conditioning for data acquisition. To communicate between devices and measurement systems, the course will cover topics on isolation, serial data transmission, and RF circuit design. Drive and controller circuits will also be investigated for medical and industrial actuators such as valves, pumps, and small motors. A basic introduction to feedback control is provided to demonstrate the regulation of variables such as pressure, flow, and temperature. By the end of the course, students will be able to design and build industrial and medical electronic products that optimize a given set of design objectives, such as size, power requirements, accuracy, resolution, and cost.

Academic Progress Requirements

Nil

Requisites

This course replaces ELEC4210. Students who have successfully completed ELEC4210 are not eligible to enrol in MENG4210.

Assumed Knowledge

ELEC2430, ELEC3240

Contact Hours

Callaghan
Laboratory
Face to Face On Campus
3 hour(s) per week(s) for 2 week(s) starting Week 11
Weeks 1-8, 11,12
Laboratory
Face to Face On Campus
3 hour(s) per week(s) for 8 week(s) starting Week 1
Weeks 1-8, 11,12
Lecture 1
Face to Face On Campus
2 hour(s) per week(s) for 10 week(s) starting Week 1
2x 2hour lectures per week
Lecture 2
Face to Face On Campus
2 hour(s) per week(s) for 10 week(s) starting Week 1
2x 2hour lectures per week

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
Prof Andrew Fleming
Andrew.Fleming@newcastle.edu.au
(02) 4921 6493
Consultation: Wednesday 1pm to 2pm in EAG29

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

School of Engineering
EAG02
EA Building
Callaghan
+61 2 4921 5798
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

- Noise in electronic circuits, interference, and shielding
- Analogue amplifier and filter design, signal conditioning, data conversion
- RF electronics design principles, transmission lines, impedance matching
- Isolation, electrical and medical device safety
- Drive circuits, power management, battery management

Course Learning Outcomes

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

1. Design optimal analog interface circuits for physical sensors and devices.
2. Construct electronic systems that meet electrical and medical safety requirements.
3. Design power management circuits for low-power electronics.
4. Design safety critical communications links between devices and other systems.

Course Materials

Lecture Materials:

- Lecture content will be posted on Canvas

Recommended Reading:

- These texts are useful as a second source for the RF topics. They are less detailed so maybe useful if you need a simpler explanation.
  C Coleman, "An Introduction to Radio Frequency Engineering", Cambridge University Press.
  TH Lee, "The Design of CMOS Radio-Frequency Integrated Circuits".

Required Text:

- For RF topics such as transmission lines and impedance matching I recommend: Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design: Theory and Application", 2nd Edition, Prentice-Hall 2009.
  For electronics design, I recommend:
  Horrowitz and Hill, "Art of Electronics".
  It is useful to have the third and second editions of this text, since the third edition contains the most up to date information but some of the content from the second edition was dropped to reduce the size of this text. This is an invaluable reference that will help you understand, modify, and design electronic circuits modules.

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	Laboratory Reports	See weekly schedule on Canvas	Individual	20%	1, 2
2	Written Assignment	See weekly schedule on Canvas	Individual	50%	1, 3
3	Project	Week 13	Individual	30%	1, 2, 3, 4

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 - Laboratory Reports

Assessment Type Report
Purpose To develop a working knowledge of methods for analog and RF circuit debugging and performance testing.
Description There are four assessed laboratory sessions, each with a weighting of 2.5%. Each laboratory exercise covers practical application of concepts covered in lecture and tutorial content on the same or previous week.
Weighting 20%
Length 3 hour lab session
Due Date See weekly schedule on Canvas
Submission Method Online
Students should complete the lab and submit a completed report for marking in the same week of the laboratory.
Assessment Criteria Successful understanding and demonstration of circuit analysis and testing.
Return Method Online
Feedback Provided Online - One week after the lab sessions.
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Written Assignment

Assessment Type Written Assignment
Purpose To develop skills in circuit design, analysis, simulation, and practical implementation.
Description The assignments use course material learned in the preceding weeks to develop solutions for a number of specific electronics design problems. There are three, equally weighted assignments.
Weighting 50%
Due Date See weekly schedule on Canvas
Submission Method Online
Submit via Canvas
Assessment Criteria Correct application of electronics design methodology and correct solution.
Return Method Online
Feedback Provided Online - One week after due date.
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Project

Assessment Type	Project
Purpose	To develop a solution for a loosely defined, complex electronics design problem. This requires analysis and understanding of the problem specifications, design and comparison of possible solutions, practical implementation, and performance testing against the project specifications.
Description	The project is undertaken during the second half of the course and involves the design of an electronic system which solves a complex engineering problem. The solution will require practical application of knowledge gained in Weeks 1 to 10. The project is undertaken individually and requires the demonstration of a working circuit prototype and the submission of a report.
Weighting	30%
Due Date	Week 13
Submission Method	Online Submit via Canvas
Assessment Criteria	The assessment includes a submitted report and practical demonstration. Refer to the project specifications for a detailed list of the assessment criteria.
Return Method	Online
Feedback Provided	Online - One week after due date.
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

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).

WH&S Requirements	Students must complete the EE lab induction and general access quiz to receive unsupervised laboratory access.
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.
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/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

This course outline was approved by the Head of School on 12.02.2024. 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 – MENG4210 – S1 2024

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				
12	3.2. Effective oral and written communication in professional and lay domains.		X	X	4
13	3.3. Creative, innovative and pro-active demeanour.		X		4
14	3.4. Professional use and management of information.				
15	3.5. Orderly management of self, and professional conduct.		X		4
16	3.6. Effective team membership and team leadership.				
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.	X	X	X	4
8	2.2. Fluent application of engineering techniques, tools and resources.	X	X	X	4
9	2.3. Application of systematic engineering synthesis and design processes.	X	X	X	4
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.		X		4
	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.		X		4
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.		X		4
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	X	X	X	4
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.	X	X		4
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.				