MECH362

Embedded Mechatronic Engineering

S1 Day 2018

Dept of Engineering

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General Information

Unit convenor and teaching staff
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Monday 1.0pm to 3.0pm

Tutor
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Credit points
3

Prerequisites
ELEC260 and MATH136

Corequisites

Co-badged status

Unit description
Most of the technical processes and engineering products in the area of mechanical and electrical engineering integrate mechanics with digital electronics and smart embedded processing. The integration of hardware and software resulting in integrated mechatronic systems involves an optimal balance between the basic mechanical structure, sensor and actuator, embedded controller based information processing and overall control. The unit builds on the mechatronic foundations and deals with various embedded control functions, mechatronic system design approaches, and recent developments in mechatronic systems.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems

Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective

Ability to implement analog and digital filters

Design and implementation of a complete model of the embedded controller based solenoid system.

Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

General Assessment Information

The students will need to obtain an overall 50 or more to pass the unit.

More details will be provided during lecture and laboratory time.

Assessment Tasks

Name	Weighting	Hurdle	Due
Mini Test#1	7%	No	Week #3
Practical Assessment #1	10%	No	Week #4
Practical Assessment #2	6%	No	Week #6
Mid Term Test	10%	No	Week #8
Practical Assessment #3	10%	No	Week #9
Mini Test#2	7%	No	Week #11
Practical Assessment #4	10%	No	Week #13
Final Examination	40%	No	TBA

Mini Test#1

Due: **Week #3**
Weighting: **7%**

Test will be for a duration of 45 minutes and is worth of 7.0%.

On successful completion you will be able to:

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems

Practical Assessment #1

Due: **Week #4**
Weighting: **10%**

#1: Transformer load test and efficiency calculation (the students will do experiments on 2nd and 3rd week on transformer. They will learn theory during lecture on the 2nd week and use them in the laboratory. The students will be asked for making necessary circuit to implement loading of transformer on the 4th week and calculate efficiency and regulation. This will be assessed against 10% of full grade. The report is based on experimental results. The details of the assessment such as duration, study materials and type will be briefed during the practical classes.

On successful completion you will be able to:

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems

Practical Assessment #2

Due: **Week #6**
Weighting: **6%**

Boost Converter.

Model and simulation.

Hardware: Power Circuit development.

The students will model the Boost converter using a simulation software such as Cadence. Then they will fabruicate the power circuit and control circuit.

The details of the assessment such as duration, study materials and type will be briefed during the practical classes.

On successful completion you will be able to:

- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective

Mid Term Test

Due: **Week #8**
Weighting: **10%**

Test will be for a duration of 60 minutes and is worth of 10%.

On successful completion you will be able to:

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters

Practical Assessment #3

Due: **Week #9**
Weighting: **10%**

Embedded Controller Interfacing with alternating (high frequency) input signals.

Analog and Digital Filter.

Delay.

The details of the assessment such as duration, study materials and type will be briefed during the practical classes.

On successful completion you will be able to:

- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Mini Test#2

Due: **Week #11**
Weighting: **7%**

Test will be for a duration of 45 minutes and is worth of 7.0%.

On successful completion you will be able to:

- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Practical Assessment #4

Due: **Week #13**
Weighting: **10%**

Model with Solenoid and motor.

The details of the assessment such as duration, study materials and type will be briefed during the practical classes.

On successful completion you will be able to:

- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Final Examination

Due: **TBA**
Weighting: **40%**

3 hour Final examination.

On successful completion you will be able to:

- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Delivery and Resources

Lecture materials will be available at iLearn.

Unit Schedule

Week #1: AC Power Fundamentals: Power Generation; Power Equation; Single Phase and Three Phase. Star and Delta Systems. Power Factor and harmonics.

Week #2: Transformer: Operating principle, analysis, construction, OC and SC tests, Load Test, Efficiency and Regulation.

Week #3: Dc Power Fundamentals; Rectified Configuration; Linear Power Supplies, Battery and Inductive Power Supplies.

Week #4: DC to DC Power Converters. Swicthed Mode Power Supplies. Buck, Boost, Buck-Boost, Foward, Flyback and Push-Pull converter configuration.

Week #5: Embedded Microcontroller. Interfacing with Sensors and Actuators.

Week #6: ADC; DAC, Sampling, Resolution, Delay.

Week #7: Filter circuits; Analog and Digital.

Week #8: Modeling Fundamental; Transfer Functions.

Week #9: Embedded Controller Based DC Motor Control; Disturbance Analysis.

Week #10: Embedded Controller Based Solenoid; Model and Analysis.

Week #11: Embedded Controller Based PMDC Motor Control; Model and Analysis.

Week #12: Buffer time and Review

Week #13: Review of the unit

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Practical Assessment #1
- Mid Term Test
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Ability to implement analog and digital filters
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Mid Term Test
- Final Examination

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Mid Term Test
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective

- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Mini Test#1
- Practical Assessment #1
- Practical Assessment #2
- Mid Term Test
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Mini Test#1
- Practical Assessment #1

- Practical Assessment #2
- Mid Term Test
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Mini Test#1
- Practical Assessment #1
- Practical Assessment #2
- Mid Term Test
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms

effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Ability to implement analog and digital filters
- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Practical Assessment #1
- Practical Assessment #2
- Practical Assessment #3
- Mini Test#2
- Practical Assessment #4
- Final Examination

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Design and implementation of a complete model of the embedded controller based solenoid system.
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment tasks

- Practical Assessment #2
- Final Examination

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Demonstrate fundamental understanding of power supplies (AC, DC, Linear and Switching) to implement embedded mechatronics systems
- Re-visit of embedded controllers. Issues of interfacing with sensors and actuators with reference to Embedded Mechatronic Perspective
- Demonstrate an understanding of complete Implementation of an embedded controller based PMDC motor

Assessment task

- Practical Assessment #4