ELEC326

Mechatronic Systems

S2 Day 2018

Dept of Engineering

Contents

General Information

Unit convenor and teaching staff
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E6B 111 (7 WW)
Monday 1pm to 3pm E6B 111 (7 WW)

Lecturer
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Credit points
3

Prerequisites
ELEC324 and ELEC260

Corequisites

Co-badged status

Unit description
This unit builds on the instrumentation foundation of ELEC260 and the system control concepts of ELEC324. It introduces a number of mechatronic specific topics including AC electric motors and drives, pneumatics, application specific integrated circuits, and advanced control. It requires the application of design and modelling procedures developed in prerequisites, and through medium-scale projects, prepares students to undertake advanced projects.

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 understanding of mechatronic systems and building blocks of them

Able to analyse the performance of AC motor drives and controller

Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

General Assessment Information

The students are expected to complete assessment tasks and submit their report by the due date They should discuss with the lecturer as well as tutor if they are not able to maintain the deadline due to some problem.

In order to pass this unit a student must obtain a minimum of 40% in the Final examination and a total mark of 50 or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD).

Assessment Tasks

Name	Weighting	Hurdle	Due
Home Task Exercises#1	2%	No	Week#2
Test#1	5%	No	Week#3
Home Task Exercises#2	2%	No	Week#5
Practical Assessment#1	10%	No	Week#5
Home Task Exercises#3	2%	No	Week#7
Test#2	5%	No	Week#9
Practical Assessment#2	10%	No	Week#9
Home Task Exercises#4	2%	No	Week#10
Home Task Exercises#5	2%	No	Week#12
Test#3	5%	No	Week#13
Self-Topic Presentation	5%	Yes	Week#12
Practical Assessment#3	10%	No	Week#13
Final Examination	40%	Yes	TBA

Home Task Exercises#1

Due: **Week#2**
Weighting: **2%**

The students will be given some numerical problems to do by themselves at home. They need to submit the answers in the following week which will be marked. The marked answers will be returned with feedback.

On successful completion you will be able to:

- Demonstrate understanding of mechatronic systems and building blocks of them

Test#1

Due: **Week#3**
Weighting: **5%**

The Test#1 is a Mini Test and will be on the content of Week 1 and 2.

On successful completion you will be able to:

- Demonstrate understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller

Home Task Exercises#2

Due: **Week#5**
Weighting: **2%**

The students will be given some numerical problems to do by themselves at home. They need to submit the answers in the following week which will be marked and returned with feedback.

On successful completion you will be able to:

- Able to analyse the performance of AC motor drives and controller

Practical Assessment#1

Due: **Week#5**
Weighting: **10%**

AC Motor drive: The students will need to come to laboratory on the first week. On that day, detailed briefing will be provided to them.

The students will learn on Schneider motor drive on the week 2 to 4. They will be asked to implement some drive activities on the 5th week. This activity is worth of 10%. Grading will take into consideration the level of discovery as evidenced by insight presented in the report in terms of critical evaluation of the laboratory activity and technical justification of procedure and design. The assignments problems will be set to develop learning outcomes during the lecture block associated with the laboratory. Grading will take into consideration the level of understanding demonstrated as evidenced by the approach taken to present each solution. Grading will also take into consideration of the level of participation as evidenced by attendance and demeanour in the classes. High marks will be awarded for initiative, approach to self-learning and self-management.

On successful completion you will be able to:

- Demonstrate understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller

Home Task Exercises#3

Due: **Week#7**
Weighting: **2%**

The students will be given some numerical problems to do by themselves at home. They need to submit the answers in the following week which will be marked and returned with feedback.

On successful completion you will be able to:

- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

Test#2

Due: **Week#9**
Weighting: **5%**

The Test#2 is a Mini Test and will be on the content of Week 6, 7 and 8.

On successful completion you will be able to:

- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

Practical Assessment#2

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

Pneumatic Circuit design and PLC (the students will do experiments on weeks 6 to 8 on making different pneumatic circuits for pneumatic control. They will learn PLC on the 6th week and use them in the laboratory. The students will be asked for making a circuit to implement a specific job using pneumatic components and PLC on the 9th week which will be assessed against 10% of full grade.

On successful completion you will be able to:

- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

Home Task Exercises#4

Due: **Week#10**
Weighting: **2%**

The students will be given some numerical problems to do by themselves at home. They need to submit the answers in the following week which will be marked and returned with feedback.

On successful completion you will be able to:

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Home Task Exercises#5

Due: **Week#12**
Weighting: **2%**

The students will be given some numerical problems to do by themselves at home. They need to submit the answers in the following week which will be marked and returned with feedback.

On successful completion you will be able to:

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Test#3

Due: **Week#13**
Weighting: **5%**

The Test#3 is a Mini Test and will be on the content of Week 10, 11 and 12.

On successful completion you will be able to:

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Self-Topic Presentation

Due: **Week#12**
Weighting: **5%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The students will be asked to choose a Mechatronic topic of their own interest and do self-study on it. They need to decide the topic and infor the Unit convenor by the end of Week#2. They will work on the topic throughout the semester. They will need to present on it within 5 minutes on Week 12. The time of presentation will be decided later.

On successful completion you will be able to:

- Able to analyse the performance of AC motor drives and controller
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Practical Assessment#3

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

Robotic Arm: The students will learn on robotic arm on the week 10, 11 and 12. They will be asked to implement some activities using the robotic arm on the 13th week. This activity is worth of 10%. Grading will take into consideration the level of discovery as evidenced by insight presented in the report in terms of critical evaluation of the laboratory activity and technical justification of procedure and design. The assignments problems will be set to develop learning outcomes during the lecture block associated with the laboratory. Grading will take into consideration the level of understanding of each and every student.

On successful completion you will be able to:

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Final Examination

Due: **TBA**
Weighting: **40%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

A 3-hours Final examination at the end of the semester. The students will be allowed to bring a A4 sheet hand-written notes. The student must obtain a minimum of 40% in the Final exam to pass the unit.

On successful completion you will be able to:

- Demonstrate understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller
- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Delivery and Resources

The lecture materials will be uploaded in iLearn.

The students may consult the books as listed below:

1. Electrical Machines, Drives and Power Systems by T. Wildi,

2. Mechatronics by Sabri Cetinkunt, John Wiley and Sons Inc.

3. Mechatronics by W. Bolton, Prentice Hall

4. Introduction to Robotics by Saeed B. Niku, Prectice Hall

5. Robotics, Vision and Control by Peter Corke, Springer

Unit Schedule

Contents

Week	Title	Details
1	Introduction	Introduction of the lecturer, unit, assessment Fundamentals of Mechatronic Systems, Components details and a few examples; Fundamental of rotating motors, operating principles, drive systems
2	Actuators for Mechatronics systems: Rotating Motors and Drives	Motor selection criterions, different types of load, thermal consideration and deratings.
3	Induction Motor	Induction motor; Rotating Magnetic Field; Operating principle of Induction motor; Synchronous speed; slip; Single-Phase and Three-phase Induction Motor
4	Induction Motor and Drives	Induction motor; Equivalent circuit for performance analysis of Induction motor; Brief overview of different inverters and design/control fundamentals; performance analysis
5	Vector Drives of Induction motors	Fundamental of Vector control of induction motors; operation principles, derivation, performance analysis
6	PLC System	Introduction to PLCs, operating principle, architecture and programming; Ladder diagrams, PLCs in industry
7	Pneumatic Systems	Introduction, Pneumatic components, Gas Laws, Air compressors, Air Filters, Pipes and symbols of Pneumatic components. Types of Pneumatic valves.
8	Hydraulic Actuators	Operating principles of Hydraulic and Electromagnetic actuators in Mechatronic systems. Types of hydraulic actuators. A review of Hydraulic/Pneumatic Simulation Software
9	PLC controlled Pneumatic circuit design	Pneumatic control in mechatronic systems; Pneumatic logic elements; signal flow and circuit design; Logic functions AND, OR, NOR; Pneumatic Actuators: linear, rotary; Pneumatic circuit design; DCVs.

10	Introduction to robots as advanced mechatronic systems	Modelling of mechatronic systems (a review); A brief review of forward and inverse kinematics.
11	Motion planning in robotic systems	Denavit-Hartenberg (DH) transformation. Path planning and trajectory planning.
12	Inverse Kinematics of Robots	Inverse Kinematics of Robots
13	Industrial Robots	A review of industrial robots. Overview of industrial robot software.

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 understanding of mechatronic systems and building blocks of them
- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

Assessment tasks

- Practical Assessment#2
- Home Task Exercises#4
- Practical Assessment#3
- 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 outcome

- Demonstrate understanding of mechatronic systems and building blocks of them

Assessment tasks

- Practical Assessment#1
- Home Task Exercises#3
- Practical Assessment#2
- Home Task Exercises#4
- Home Task Exercises#5
- Self-Topic Presentation
- Practical Assessment#3
- 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

- Demonstrate understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller
- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment tasks

- Home Task Exercises#1
- Home Task Exercises#2
- Practical Assessment#1
- Home Task Exercises#3
- Test#2
- Practical Assessment#2
- Home Task Exercises#4
- Home Task Exercises#5
- Test#3
- Self-Topic Presentation
- Practical Assessment#3
- 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.

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Learning outcomes

- Demonstrate understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller
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Assessment tasks

- Home Task Exercises#1
- Test#1
- Home Task Exercises#2

- Practical Assessment#1
- Home Task Exercises#3
- Test#2
- Practical Assessment#2
- Home Task Exercises#4
- Home Task Exercises#5
- Test#3
- Self-Topic Presentation
- Practical Assessment#3
- 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 understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment tasks

- Home Task Exercises#1
- Test#1
- Practical Assessment#1
- Home Task Exercises#3
- Test#2
- Practical Assessment#2
- Home Task Exercises#4
- Home Task Exercises#5
- Test#3
- Practical Assessment#3
- 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 understanding of mechatronic systems and building blocks of them
- Able to analyse the performance of AC motor drives and controller
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment tasks

- Home Task Exercises#1
- Test#1
- Home Task Exercises#2
- Practical Assessment#1
- Home Task Exercises#3
- Practical Assessment#2
- Test#3
- Practical Assessment#3
- 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 outcome

- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment tasks

- Practical Assessment#1

- Practical Assessment#2
- Self-Topic Presentation
- Practical Assessment#3
- 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

- Demonstrate understanding of mechatronic systems and building blocks of them
- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment tasks

- Test#1
- Test#2
- Test#3

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

- Apply pneumatics, and PLCs integrated with pneumatics, to control mechatronic systems
- Demonstrate understanding of modelling of mechatronic systems and kinematics of robotic system

Assessment task

- Self-Topic Presentation

Changes from Previous Offering

The sequence has been changed from last year. Induction motors will be covered first as they learn similar things in MECH362, expected to help their learning.

The tutorial questions and assessments on tutorials have been added, it is expected that the tutorials will help to learn the unit in a much better way.

The weightings on the assessment has been changed.

To help their learning some home tasks have been added.

The weight of the Mid Term Test has been reduced from 10% to 5%. In fact the Mid Term test has been replaced by 3 Mini Tests with the expectation that it will make the students more engaged through out the semester.

The weight of the self-topic presentation has been reduced from 10% to 5%.

Changed from last offering

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