MTRN4062

Micro Electro Mechanical Systems (MEMS)

Session 2, In person-scheduled-weekday, North Ryde 2024

School of Engineering

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General Information

Unit convenor and teaching staff
Unit Convenor and Lecturer
David Inglis
david.inglis@mq.edu.au
Contact via email or office phone (02 9850 9150)
3MD-160
Tuesday 4-5pm during teaching weeks 0 to 14

Credit points
10

Prerequisites
MTRN3026 OR MECH3005

Corequisites

Co-badged status

Unit description
This unit introduces Microelectromechanical Systems (MEMS) and their application in a wide range of systems including sensors, actuators, biology and microfluidics. MEMS has been identified as one of the most promising technologies and has found vast applications in all aspects of our daily life. Industrial, healthcare, automobile and aerospace designs are increasingly deploying MEMS devices by combining microelectronics with micromachining technology for highly precise control, automation, and positioning applications.

The unit includes hands-on experience in the field of MEMS and aims to familiarise students with the steps of the microfabrication process. Students will spend time within the School of Engineering clean room to perform foundational microfabrication processes. They will learn about the physics and underlying principles behind MEMS devices and will develop understanding of the diversity and significance of the field.

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:

ULO1: Describe the working principles of a range of MEMS devices including sensors,

actuators, gyroscopes and microfluidics.

ULO2: Execute a successful analysis of a MEMS problem and provide insights into the practical applications of the methods.

ULO3: Perform a simple modelling or computational model for a MEMS problem with sufficient complexity

ULO4: Design and fabricate a MEMS system or component by utilising appropriate facilities and applying the theory learned.

General Assessment Information

Grading and passing requirement for unit

In order to pass this unit a student must obtain a mark of 50 or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD).

Supplementary Exam: If you receive special consideration for the final exam, a supplementary exam will be scheduled by the faculty during a supplementary exam period. This is typically 3 to 4 weeks after the normal exam period. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Late submissions and Resubmissions

Online quizzes, in-class activities, or scheduled tests and exam must be undertaken at the time indicated in the unit guide. All other assessments must be submitted by 5:00 pm on their due date. Should either of these assessments be missed due to illness or misadventure, students should apply for Special Consideration.

Assessments not submitted by the due date will receive a mark in accordance with the late submission policy as follows: A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark: 12 to 24 hours late = 10% deduction; for each day thereafter, an additional 10% per day or part thereof will be applied until five days beyond the due date. After this time, a mark of zero (0) will be given. For example, an assessment worth 20% is due 5 pm on 1 January. Student A submits the assessment at 1 pm, 3 January. The assessment received a mark of 15/20. A 20% deduction is then applied to the mark of 15, resulting in the loss of four (4) marks. Student A is then awarded a final mark of 11/20.

Resubmissions of work are not allowed.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the

convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Mid-Session Exam	24%	No	during lecture of week 7
Literature Review Presentation	14%	No	Weeks 12 and 13 during SGTA
Assignments	12%	No	Week 5 and Week 11
Online quizzes to prepare for lab visits	10%	No	Typically every 2 teaching weeks, see ilearn for due dates
Final Exam	28%	Yes	during University Exam period
Skills and knowledge demonstrated during research lab visits	12%	No	assessed during lab visits

Mid-Session Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 18 hours
Due: **during lecture of week 7**
Weighting: **24%**

The mid-Session Exam will cover lecture and problem-set content up to the mid-session break

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Execute a successful analysis of a MEMS problem and provide insights into the practical applications of the methods.
- Perform a simple modelling or computational model for a MEMS problem with sufficient complexity

Literature Review Presentation

Assessment Type [1]: Presentation
Indicative Time on Task [2]: 18 hours
Due: **Weeks 12 and 13 during SGTA**

Weighting: **14%**

Students will engage with relevant literature and prepare for a presentation, oral defence, or debate.

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Execute a successful analysis of a MEMS problem and provide insights into the practical applications of the methods.

Assignments

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 25 hours
Due: **Week 5 and Week 11**
Weighting: **12%**

Assignments will be used to assess MEMS component modelling, and knowledge of lecture content. They will also provide practice for examinations.

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Execute a successful analysis of a MEMS problem and provide insights into the practical applications of the methods.
- Perform a simple modelling or computational model for a MEMS problem with sufficient complexity
- Design and fabricate a MEMS system or component by utilising appropriate facilities and applying the theory learned.

Online quizzes to prepare for lab visits

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 8 hours
Due: **Typically every 2 teaching weeks, see ilearn for due dates**
Weighting: **10%**

Prior to laboratory visits, students must complete training and induction modules. These will include online quizzes. In addition to a grade, students may be required to achieve a mastery threshold before being admitted to the laboratory.

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Design and fabricate a MEMS system or component by utilising appropriate facilities and applying the theory learned.

Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 22 hours
Due: **during University Exam period**
Weighting: **28%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The final exam will cover content from after the mid-session break until the end of session.

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Execute a successful analysis of a MEMS problem and provide insights into the practical applications of the methods.
- Perform a simple modelling or computational model for a MEMS problem with sufficient complexity

Skills and knowledge demonstrated during research lab visits

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 0 hours
Due: **assessed during lab visits**
Weighting: **12%**

Students' behavior and knowledge during visits to research laboratories will be assessed by teaching staff. This may include replicating a task after having it demonstrated, answering questions about the equipment and facilities, and behavior in a professional manner.

On successful completion you will be able to:

- Describe the working principles of a range of MEMS devices including sensors, actuators, gyroscopes and microfluidics.
- Design and fabricate a MEMS system or component by utilising appropriate facilities and applying the theory learned.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Students are encourage to obtain a copy of "Foundations of MEMS" by Chang Liu. Any edition will be suitable.

"Fundamentals of Microfabrication, The Science of Miniaturization" by Marc J. Madou is also a useful text.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

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

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) 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 or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

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

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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.

Changes from Previous Offering

In response to student feedback:

-the unit will provide some background in chemistry.

-the weighting and structure of the presentation will be adjusted.

Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	1.2
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	
	1.3 In-depth understanding of specialist bodies of knowledge	1,2,3,4
	1.4 Discernment of knowledge development and research directions	2

	1.5 Knowledge of engineering design practice	4
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	2,3
	2.2 Fluent application of engineering techniques, tools and resources.	2,3,4
	2.3 Application of systematic engineering synthesis and design processes.	
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	4
	3.2 Effective oral and written communication in professional and lay domains.	1,2
	3.3 Creative, innovative and pro-active demeanour.	
	3.4 Professional use and management of information.	
	3.5 Orderly management of self, and professional conduct.	4
	3.6 Effective team membership and team leadership	

Unit information based on version 2024.04 of the Handbook