MECH6004

Numerical Modelling and Simulation Techniques

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

School of Engineering

Contents

General Information

Unit convenor and teaching staff
Unit convener
Ann Lee
ann.lee@mq.edu.au
Contact via email
Room 132, 44 Waterloo Rd
By appointment

Credit points
10

Prerequisites

Corequisites

Co-badged status
MECH3004

Unit description
This unit focuses on exploring the practical applications of mathematical equations frequently employed in engineering practices, including computational fluid dynamics (CFD) and finite element analysis (FEA). The curriculum encompasses various topics, ranging from numerical differentiation and integration of differential equations to partial differential equations. Upon completion of this unit, students should have attained proficiency in the methodologies and comprehensive understanding necessary to address challenges using CFD techniques.

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: Apply advanced mathematical and numerical theories within the domain of numerical simulations to effectively resolve complex real-world engineering challenges.

ULO2: Evaluate and generate inventive design solutions, showcasing adept critical thinking skills through the application of computational techniques.

ULO3: Exhibit proficiency in utilizing CFD tools, essential within the realm of computational modeling in engineering.

ULO4: Demonstrate domain-specific knowledge to address problems that emulate real-world situations.

ULO5: Apply effective communication skills through the creation of well-structured written reports.

ULO6: Proficiently apply problem-solving techniques aligned with industry requirements.

General Assessment Information

Notifications

Formal notification of assessment tasks, grading rubrics and due dates will be posted on iLearn. Although all reasonable measures to ensure the information is accurate, the University reserves the right to make changes without notice. Each student is responsible for checking iLearn for changes and updates.

Assignment Tasks

Assignment Problems will be posted on iLearn at least two weeks before their submission date. Submissions will not be accepted once the solution is demonstrated by the teaching staff.

All assignments must be submitted electronically through iLearn (in pdf format). Submissions are expected to be typed set in a logical layout and sequence. Markers WILL NOT grade poorly organised or illegible scans or drafts. The expected workload includes preparation of final copies and clear diagrams.

Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following university standard late penalty applied. Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions will accepted as follows: ·

Assessment I and II – YES, Standard Late Penalty applies

Special Consideration

If you experience events or conditions that adversely affect your academic performance and you require an extension to complete the assessment tasks, you should apply for "Special

Consideration". More information can be found here

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. For further details about grading, please refer below in the policies and procedures section.

Supplementary Final Exam

If you receive special consideration for the final exam, a supplementary exam will be scheduled by the faculty during a supplementary exam period, typically about 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.

Final Exams

More information if there will be open- or closed-book exams will be provided on iLearn.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment II	25%	No	Week 12
Final exam	50%	No	Exam Period
Assignment I	25%	No	Week 6

Assignment II

Assessment Type [1]: Project
Indicative Time on Task [2]: 25 hours
Due: **Week 12**
Weighting: **25%**

The assignment requires the student to perform CFD simulations for a complex fluid mechanics engineering problem with relevant software, analyse the results and submit a technical report on the results.

On successful completion you will be able to:
- Apply advanced mathematical and numerical theories within the domain of numerical simulations to effectively resolve complex real-world engineering challenges.

- Evaluate and generate inventive design solutions, showcasing adept critical thinking skills through the application of computational techniques.
- Exhibit proficiency in utilizing CFD tools, essential within the realm of computational modeling in engineering.
- Apply effective communication skills through the creation of well-structured written reports.
- Proficiently apply problem-solving techniques aligned with industry requirements.

Final exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 30 hours
Due: **Exam Period**
Weighting: **50%**

Final examination assessing all material delivered throughout the course

On successful completion you will be able to:

- Apply advanced mathematical and numerical theories within the domain of numerical simulations to effectively resolve complex real-world engineering challenges.
- Evaluate and generate inventive design solutions, showcasing adept critical thinking skills through the application of computational techniques.
- Exhibit proficiency in utilizing CFD tools, essential within the realm of computational modeling in engineering.
- Demonstrate domain-specific knowledge to address problems that emulate real-world situations.
- Proficiently apply problem-solving techniques aligned with industry requirements.

Assignment I

Assessment Type [1]: Project
Indicative Time on Task [2]: 15 hours
Due: **Week 6**
Weighting: **25%**

The assignment requires the student to perform numerical simulations for an engineering problem using MATLAB, analyse the results and submit a technical report on the results.

On successful completion you will be able to:

- Apply advanced mathematical and numerical theories within the domain of numerical simulations to effectively resolve complex real-world engineering challenges.
- Evaluate and generate inventive design solutions, showcasing adept critical thinking skills through the application of computational techniques.
- Apply effective communication skills through the creation of well-structured written reports.
- Proficiently apply problem-solving techniques aligned with industry requirements.

[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

There is no single core text for this course. However, the following texts are recommended:

1- "Applied Numerical Methods for Engineers and Scientists" by Singiresu S. Rao

2- "Computational Fluid Dynamics- A Practical Approach by Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu

3- "Computational Methods for Fluid Dynamics" by Joel H. Ferziger, Milovan Perić, Robert L. Street

Unit Schedule

Lectures : Week 1-13

Practicals : Week 2-13

For full unit schedule please refer to iLearn.

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.

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.	ULO1:50%
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	ULO1:50%
	1.3 In-depth understanding of specialist bodies of knowledge	
	1.4 Discernment of knowledge development and research directions	

	1.5 Knowledge of engineering design practice	ULO2:50%
	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	ULO2:50% ULO3:50%
	2.2 Fluent application of engineering techniques, tools and resources.	ULO3:50%
	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.	
	3.2 Effective oral and written communication in professional and lay domains.	ULO4:100%
	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.	
	3.6 Effective team membership and team leadership	

Unit information based on version 2024.02 of the Handbook