MECH304

Applied Numerical Engineering

S2 Day 2017

Dept of Engineering

Contents

General Information

Unit convenor and teaching staff
Lecturer
Ann Lee
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Contact via 98509069
Room 142, Level 1, E6B Building
Thursday 2pm-4pm

Credit points
3

Prerequisites
COMP115 and MECH202 and MECH204

Corequisites

Co-badged status

Unit description
The unit is designed to teach the students applications of mathematical equations commonly used in engineering practice, specifically in computational fluid dynamics (CFD) and finite element analysis (FEA). The students will have prior knowledge of the required mathematical concepts and will learn how to apply those in real-world engineering. It covers a broad range of topics, such as numerical differentiation and integration of differential equations and partial differential equations, central differencing schemes, Runge-Kutta methods, stiffness and multistep methods and boundary value and eigenvalue problems that have specific applications to real world engineering problems. The unit will also emphasize error analysis, optimization techniques and curve fitting methods that are applied in practical engineering fields.

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:

Understand how engineering problems can be solved using basic mathematical models and numerical methods

Ability to identify risk associated with floating point computations and perform error

analysis

Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations

Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

General Assessment Information

Student must achieve at least a 50% aggregate grade and meet the hurdle requirement in order to obtain a passing grade (P/CR/D/HD).

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. Assignment solutions will be demonstrated by the tutor within a week after the submission date in the tutorial class. Submissions will not be accepted once the solution is given.

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.

In the event that an assessment task is submitted late, the following penalties will apply; 0 to 24 hours -25%, 24 hours to 48 hours -50%, greater than 48 hours will result in no mark being awarded.

Hurdle Requirement

The final examination is a hurdle requirement because it is the only reliable assessment of individual performance for this unit. A passing grade of 50% or more in the final examination is a condition of passing this unit. Students who make a serious attempt but fail to meet the hurdle requirement will be given one further opportunity to pass. A serious attempt is defined as achievement of a mark of 40% or greater.

Assessment Tasks

Name	Weighting	Hurdle	Due
1st Assignment	6%	No	Week 3

Name	Weighting	Hurdle	Due
2nd Assignment	8%	No	Week 6
3rd Assignment	8%	No	Week 8
4th Assignment	8%	No	Week 11
Participation and Management	5%	No	Continual
Mid term test	15%	No	Week 7
Final Examination	50%	Yes	Exam Period

1st Assignment

Due: **Week 3**
Weighting: **6%**

A five-page solutions to assignment problems based on the learning outcome is to be submitted on the specified due date. Grading will take into consideration the level of discovery and understanding demonstrated as evidenced by the approach taken to present each solution. The assignment problems will be set to develop learning outcomes during the lecture block associated with the tutorial.

On successful completion you will be able to:

- Understand how engineering problems can be solved using basic mathematical models and numerical methods
- Ability to identify risk associated with floating point computations and perform error analysis

2nd Assignment

Due: **Week 6**
Weighting: **8%**

A five-page solutions to assignment problems

On successful completion you will be able to:

- Understand how engineering problems can be solved using basic mathematical models and numerical methods
- Ability to identify risk associated with floating point computations and perform error analysis

3rd Assignment

Due: **Week 8**
Weighting: **8%**

A five-page solutions to assignment problems

On successful completion you will be able to:

- Understand how engineering problems can be solved using basic mathematical models and numerical methods
- Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

4th Assignment

Due: **Week 11**
Weighting: **8%**

A five-page solutions to assignment problems

On successful completion you will be able to:

- Understand how engineering problems can be solved using basic mathematical models and numerical methods
- Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

Participation and Management

Due: **Continual**
Weighting: **5%**

Participation in tutorial sessions counts toward this mark. The mark will be assessed during scheduled tutorials. Grading will take into consideration 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. Students are expected to participate in the learning activities with a developing level of independence as well as team work.

On successful completion you will be able to:

- Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

Mid term test

Due: **Week 7**

Weighting: **15%**

A closed-book examination of 1 hour will be conducted in the tutorial class.

On successful completion you will be able to:

- Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations

Final Examination

Due: **Exam Period**
Weighting: **50%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

A final closed-book examination of three hours will be conducted during the formal examination period.

This task is a hurdle requirement. A passing grade of 50% or more in the final examination is a condition of passing this unit.

On successful completion you will be able to:

- Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations

Delivery and Resources

Required and Recommended Texts and/or Materials

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

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

Technology Used and Required

Computer software (Matlab) for numerical coding and analysis.

Unit Web Page

Access from the online iLearn Learning System at http://ilearn.mq.edu.au

Unit Schedule

Week	Topic	Lecturer	Laboratory/Tutorial	Assessments
1	Introduction to numerical methods	Dr. Lee	No tutorial	

2	Applied Matlab programming	Dr. Lee	Matlab programming	
3	Nonlinear equation	Dr. Lee	Linear and nonlinear problems	Assignment 1 due
4	System of linear equation, Elimination methods, LU factorization	Dr. Lee	Linear and nonlinear problems	
5	Interpolation and polynomial approximation, curve fitting	Dr. Lee	Problem sets on interpolation	
6	Numerical differentiation & Numerical integration	Dr. Lee	Problem sets on polynomial and curve fitting	Assignment 2 due
7	Midterm examination	Dr. Lee	Numerical differentiation problems	
8	Euler method, Runge-Kutta method	Dr. Lee	Numerical integration problems	Assignment 3 due
9	Boundary value ordinary differential equations	Dr. Lee	Thermofluid problems	
10	Partial differential equations	Dr. Lee	ODE and PDE problem sets	
11	Method of solutions	Dr. Lee	CFD pre processing	Assignment 4 due
12	Computational Fluid Dynamics	Dr. Lee	CFD analysis	
13	Revision	Dr. Lee	CFD post processing	

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/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

- Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations
- Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

Assessment tasks

- 3rd Assignment
- 4th Assignment
- Participation and Management
- Mid term test
- 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

- Understand how engineering problems can be solved using basic mathematical models and numerical methods
- Demonstrate skill in Matlab as the tool to implement numerical analysis for practical engineering problems

Assessment tasks

- 1st Assignment
- 2nd Assignment
- 3rd Assignment
- 4th Assignment
- Participation and Management

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

- Ability to identify risk associated with floating point computations and perform error analysis
- Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations
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- 2nd Assignment
- 3rd Assignment
- 4th Assignment
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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

- Ability to identify risk associated with floating point computations and perform error analysis
- Ability to develop techniques for accurate and efficient solution of models based on linear and nonlinear equations, ordinary equations and partial differential equations
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Changes from Previous Offering