MATH335

Mathematical Methods

S1 Day 2015

Dept of Mathematics

Contents

General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
MATH235 and (MATH232 or MATH236)

Corequisites

Co-badged status

Unit description
This unit develops the ideas and techniques of analysis important in many branches of pure and applied mathematics. Topics include the theory of ordinary differential equations, including linear and nonlinear systems and their stability. Some special functions are also discussed, together with important applications in various branches of mathematics.

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:

Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations

Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)

Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields

Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of Ordinary Differential Equations

Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

Assessment Tasks

Name	Weighting	Due
Eight assignments	20%	to be advised
One Test	20%	to be advised
Final examination	60%	University Examination Period

Eight assignments

Due: **to be advised**
Weighting: **20%**

On successful completion you will be able to:

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of Ordinary Differential Equations
- Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

One Test

Due: **to be advised**

Weighting: **20%**

On successful completion you will be able to:

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

Final examination

Due: **University Examination Period**
Weighting: **60%**

On successful completion you will be able to:

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four hours.

Required and Recommended Texts and/or Materials

ORDINARY DIFFERENTIAL EQUATIONS

- *Ordinary Differential Equations and Stability Theory* David A. Sanchez, Dover
- *Ordinary Differential Equations and Stability Theory* V.I. Arnold
- *Ordinary Differential Equations* by BMN Clarke

SPECIAL FUNCTIONS

No single textbook is entirely satisfactory for this part of the course. Attendance of the lectures is strongly recommended.

- *Advanced Engineering Mathematics* Erwin Kreyszig, John Wiley&Sons, various editions. QA401.K7
- *Partial differential Equations. An Introduction* Walter A. Strauss, John Wiley&Sons, 1992. QA374.S86/1992
- *Equations of Mathematical Physics* A.N. Tikhonov & A.A. Samarskii, Oxford University Press (also reprinted by Dover). QA401.T512/1963
- *Advanced Calculus for Applications* F.B. Hildebrand, Prentice Hall, 1962. QA303.H55/1962

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and Adobe Reader software. Several areas of the university provide wireless access for portable computers. There are computers for student use in the Library and in the Numeracy Centre (C5A 255).

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

WEEK	ODES	SPECIAL FUNCTIONS
1	Introduction. First order equations.	Power series solutions to 2-nd order ODF with variable coefficients.
2	Existence & uniqueness, successive approximations.	
3	Second order linear equations, fundamental sets, reduction of order.	Legendre equation. Legendre functions.
4		Properties of Legendre functions.
5	Higher order linear equations.	Frobenius method to solve ODE with variable coefficients. Bessel equation.
6	Linear equations with constant coefficients.	Bessel functions. Gamma function.
	MID-SESSION BREAK	
7	First-order linear systems: fundamental set of solutions. Systems with constant coefficients	cntd. Bessel functions. Gamma function.

8	Critical points and stability. The phase plane and stability of linear systems.	Classical Orthogonal polynomials.
9		Sturm-Liouville problems.
10	Non-linear systems and stability.	Eigen-values problems. Properties.
11	Limit cycles and stability.	Series expansions in special functions.
12		Application to solving partial differential equations.
13	**Revision**	

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.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

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

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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://stu

dents.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://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use 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 use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of Ordinary Differential Equations

- Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

Assessment tasks

- Eight assignments
- One Test
- 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:

Assessment tasks

- Eight assignments
- One 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

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields
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Differential Equations

- Demonstrate efficient use of the techniques such as Picard approximation and variation of parameters in the theory of Ordinary Differential Equations

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

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
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- 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

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
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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 use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning especially in the context of the theory of Ordinary Differential Equations

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Assessment tasks

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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

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields
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Assessment tasks

- Eight assignments
- One Test
- 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

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations to model a broad range of phenomena in science and in engineering (in particular using the equation sets to characterise the dynamic systems)
- Understanding of the breadth of the theory of Ordinary Differential Equations and its role in other fields

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 outcome

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations

Extra requirements

Satisfactory performance on supervised assessment tasks, such as tests and the final exam, is necessary to pass this unit. If there is a significant difference between a student's marks on supervised assessment tasks and on unsupervised assessment tasks, the scaling of these tasks may be adjusted when determining the final grade, to reflect more appropriately that student's performance on supervised tasks.