MATH335
Mathematical Methods
S1 Day 2016
Dept of Mathematics

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General Information

Unit convenor and teaching staff
Unit Convenor
Li Ji
ji.li@mq.edu.au
Contact via ji.li@mq.edu.au
ANN 2.639
Friday or by appointment

Lecturer
Elena Vynogradova
elena.vynogradova@mq.edu.au
Contact via elena.vynogradova@mq.edu.au
ANN L2
Wednesday or by appointment

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 http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/

Learning Outcomes

1. Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations and the theory of Special Functions.
2. Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.

3. Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

4. Expressing yourself clearly and logically in writing.

**Assessment Tasks**

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight assignments</td>
<td>20%</td>
<td>See the iLearn for details</td>
</tr>
<tr>
<td>One Test</td>
<td>20%</td>
<td>week 8</td>
</tr>
<tr>
<td>Exam</td>
<td>60%</td>
<td>University Examination Period</td>
</tr>
</tbody>
</table>

**Eight assignments**

Due: See the iLearn for details

Weighting: 20%

Assignments on Ordinary differential equations and Special functions

This Assessment Task relates to the following Learning Outcomes:

- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
- Expressing yourself clearly and logically in writing.

**One Test**

Due: week 8

Weighting: 20%

Supervised in class test.

This Assessment Task relates to the following Learning Outcomes:
- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Expressing yourself clearly and logically in writing.

Exam

Due: University Examination Period
Weighting: 60%

Final exam

This Assessment Task relates to the following Learning Outcomes:
- Knowledge of the principles and concepts of a basic theory of Ordinary Differential Equations and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Expressing yourself clearly and logically in writing.

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.

• *Equations of Mathematical Physics* A.N. Tikhonov & A.A. Samarskii, Oxford University Press (also reprinted by Dover). QA401.T512/1963

**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**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>ODES</th>
<th>SPECIAL FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction. First order equations.</td>
<td>Power series solutions to 2-nd order ODF with variable coefficients.</td>
</tr>
<tr>
<td>2</td>
<td>Existence &amp; uniqueness, successive approximations.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Second order linear equations, fundamental sets, reduction of order.</td>
<td>Legendre equation. Legendre functions.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Properties of Legendre functions.</td>
</tr>
<tr>
<td>5</td>
<td>Higher order linear equations.</td>
<td>Frobenius method to solve ODE with variable coefficients. Bessel equation.</td>
</tr>
</tbody>
</table>

**MID-SESSION BREAK**
| 7 | First-order linear systems: fundamental set of solutions. Systems with constant coefficients |
| 9 | Sturm-Liouville problems. |
| 11 | Series expansions in special functions. Application to solving partial differential equations. |
| 12 | Limit cycles and stability. |
| 13 | Revision |

### Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](http://mq.edu.au/policy/docs/). Students should be aware of the following policies in particular with regard to Learning and Teaching:


In addition, a number of other policies can be found in the [Learning and Teaching Category](http://mq.edu.au/policy/docs/) 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 Enquiry Service

For all student enquiries, visit Student Connect at ask.mq.edu.au

Equity 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.

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

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 and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

**Assessment tasks**

- Eight assignments
- One Test
- Exam

**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 and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

**Assessment tasks**

- Eight assignments
- One Test
- Exam
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 and the theory of Special Functions.
• Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
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Assessment tasks

• Eight assignments
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• Exam

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
• Exam

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 and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

**Assessment tasks**

- Eight assignments
- One Test
- Exam

**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 and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.

**Assessment tasks**

- Eight assignments
- One Test
- Exam

**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 and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.

**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 and the theory of Special Functions.

**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 and the theory of Special Functions.
- Ability to use the ideas and techniques of the theory of Ordinary Differential Equations and the theory of the Special Functions to model a broad range of phenomena in science and in engineering.
- Ability to construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning.
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.