## School of Information and Physical Sciences

# MATH2310: Calculus of Science and Engineering

Callaghan

Semester 2 - 2023

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

COURSE OUTLINE

# OVERVIEW

**Course Description**

Provides the essential mathematical techniques of Physical Science and Engineering. These are the methods of Multivariable Calculus and Differential Equations. Multivariable Calculus involves a study of the differential and integral calculus of functions of two or more variables. In particular it covers introductory material on the differential calculus of scalar and vector fields, and the integral calculus of scalar and vector functions. Differential Equations arise from mathematical models of physical processes. Also includes the study of the main analytical and numerical methods for obtaining solutions to first and second order differential equations.

**Requisites**

Students must have successfully completed MATH1120 or MATH1220 before they can enrol in this course.

**Contact Hours**

**Lecture**
Face to Face On Campus
4 hour(s) per Week for Full Term

**Workshop**
Face to Face On Campus
2 hour(s) per Week for 11 Weeks starting Week 2

**Unit Weighting**
10

**Workload**
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

# CONTACTS

**Course Coordinator**

**Callaghan**
Dr Elena Levchenko
Elena.Levchenko@newcastle.edu.au
(02) 4921 6121
Consultation: open door policy SR 215 or email for appointment

**Teaching Staff**

Other teaching staff will be advised on the course Canvas site.

**School Office**

**School of Information and Physical Sciences**
SR233, Social Sciences Building
Callaghan
CESE-SIPS-Admin@newcastle.edu.au
+61 2 4921 5513
9am-5pm (Mon-Fri)

# SYLLABUS

**Course Content**

- Real valued functions of several variables.
- The differential operator "del".
- Cylindrical and spherical coordinates.
- General curves and surfaces.
- Normals, tangents and tangent planes.
- Double integrals.
- Iterated integrals.
- Triple integrals.
- Line integrals.
- Surface integrals.
- Vector valued functions.
- Divergence and Curl.
- Line integrals of vector fields.
- Green's theorem.
- Stokes' theorem.
- Divergence theorem.
- Formulation of differential equations for simple physical processes
- Interpreting solutions for first order differential equations using appropriate software.
- Further studies of ordinary differential equations
- Finding numerical solutions using Runge-Kutta methods via computer software.
- Laplace transform methods for initial value problems.
- Solving second order initial value problems with step function forcing terms.
- Power series solutions to second order differential equations.
- Boundary-value problems for partial differential equations.

**Course Learning Outcomes**

**On successful completion of this course, students will be able to:**

1. Identify and apply mathematical methods applicable to the differentiation and integration of functions of several variables and to ordinary differential equations.

2. Apply appropriate mathematical fundamentals to solve a specific mathematical problems involving functions of many variables

3. Apply mathematical models involving multivariable calculus and ordinary differential equations to solve mathematical problems

4. Effectively communicate and interpret solutions to mathematical modelling problems.

**Course Materials**

**Recommended Text:**

- Zill/Wright: Differential Equations with Boundary-Value Problems, 8th edition, 2013, ISBN 9781111827069

**Required Reading:**

- Stewart: Multivariable Calculus, 8th edition, 2016, ISBN 9781305266643

# SCHEDULE

| Week | Week Begins | Topic | Learning Activity | Assessment Due |
|---|---|---|---|---|
| **1** | 17 Jul | MVC: Partial derivatives and coordinate systems<br><br>DE: Introduction to DEs | Lectures | - |
| **2** | 24 Jul | MVC: General curves and surfaces<br><br>DE: Modelling with DEs | Lectures + Workshop 1 on week 1 Lecture material | Workshop Quiz 1 |
| **3** | 31 Jul | MVC: Double integrals<br><br>DE: Linear equations with constant coefficients | Lectures + Workshop 2 on week 2 Lecture material | Workshop Quiz 2 |
| **4** | 7 Aug | MVC: Change of variables in integration<br><br>DE: Existence & uniqueness | Lectures + Workshop 3 on on week 3 Lecture material | Workshop Quiz 3 |
| **5** | 14 Aug | MVC: Triple Integrals<br><br>DE: Numerical methods | Lectures + Workshop 4 on week 4 Lecture material | Workshop Quiz 4 |
| **6** | 21 Aug | MVC: Vector Fields<br><br>DE: Series revision | Lectures + Workshop 5 on week 5 Lecture material | Workshop Quiz 5 |
| **7** | 28 Aug | No lectures due to mid-semester test preparation preparation | Mid-term test preparation | Mid-semester test (during workshop time in face to face mode planned).<br>The test covers the first 5 weeks of lectures. |
| **8** | 4 Sep | Lecture MVC: Line integrals<br>Lecture DE: Series solutions | Lectures + Workshop 6 on week 6 Lecture material | Workshop Quiz 6 |
| **9** | 11 Sep | MVC: Fundamental theorem of line integrals and Green's theorem<br><br>DE: Laplace 1 | Lectures + Workshop 7 on week 8 Lecture material | Workshop Quiz 7 |
| **10** | 18 Sep | MVC: Curl and divergence<br><br>DE: Laplace 2 | Lectures + Workshop 8 on week 9 Lecture material | Workshop Quiz 8 |
| **Mid Term Break** | | | | |
| **Mid Term Break** | | | | |
| **11** | 9 Oct | MVC: Surface integrals<br><br>DE: Laplace 3 | Lectures + Workshop 9 on week 10 Lecture material | Workshop Quiz 9 |
| **12** | 16 Oct | MVC: Stokes' and Divergence theorem<br><br>DE: PDE / BVP | Lectures + Workshop 10 on week 11 Lecture material | Workshop Quiz 10 |
| **13** | 23 Oct | | | |
| **Examination Period** | | | | |
| **Examination Period** | | | | |

# ASSESSMENTS

This course has 3 assessments. Each assessment is described in more detail in the sections below.

| | Assessment Name | Due Date | Involvement | Weighting | Learning Outcomes |
|---|---|---|---|---|---|
| **1** | Workshop Quiz | at the end of workshop, week 2-6, 8-12 | Individual | 25% | 1, 2, 3 |
| **2** | Examination | Formal examination period. | Individual | 50% | 1, 2, 3 |
| **3** | Mid Semester Test | Week 7 in the workshops. | Individual | 25% | 1, 2, 3, 4 |

**Late Submissions** The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

## Assessment 1 - Workshop Quiz

**Assessment Type** Quiz
**Purpose** To provide regular work and ongoing feedback for student learning.
**Description** Each quiz covers the material covered in the lectures of the preceding week(s). See course schedule for the details.
**Weighting** 25%
**Length** 25 minutes
**Due Date** at the end of workshop, week 2-6, 8-12
**Submission Method** In Class
submit at the end of the workshop
**Assessment Criteria** Mathematical correctness.
**Return Method** In Class
**Feedback Provided** In Class - . demonstrators will return the marked quizzes in class

## Assessment 2 - Examination

**Assessment Type** Formal Examination
**Purpose** To test individual student's knowledge of the course material and their analytical and problem-solving ability
**Description** Formal Examination covers content from Week 1 to Week 12
**Weighting** 50%
**Length** 120 minutes + 10 minutes reading time
**Due Date** Formal examination period.
**Submission Method** Formal Exam
**Assessment Criteria** Mathematical correctness.
**Return Method** Not Returned
**Feedback Provided** No Feedback - .

## Assessment 3 - Mid Semester Test

**Assessment Type** In Term Test
**Purpose** To test individual student's progress, knowledge of the 5 weeks of the course material and their analytical and
problem-solving ability
**Description** Mid semester test covers the first 5 weeks of the semester.
**Weighting** 25%
**Length** 60 minutes
**Due Date** Week 7 in the workshops.
**Submission Method** In Class
**Assessment Criteria** Mathematical correctness
**Return Method** In Class
**Feedback Provided** In Class - week 9. demonstrators will return the marked quizzes in class

# ADDITIONAL INFORMATION

**Grading Scheme**

This course is graded as follows:

| Range of Marks | Grade | Description |
|---|---|---|
| 85-100 | High Distinction (HD) | Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives. |
| 75-84 | Distinction (D) | Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives. |
| 65-74 | Credit (C) | Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes. |
| 50-64 | Pass (P) | Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes. |
| 0-49 | Fail (FF) | Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action. |

*Skills are those identified for the purposes of assessment task(s).

**Communication Methods**

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.

**Course Evaluation**

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

**Oral Interviews (Vivas)**

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

**Academic Misconduct**

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.

**Adverse Circumstances**

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;

3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

**Important Policy Information**

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/no-room-for/policies-and-procedures that support a safe and respectful environment at the University.

*This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.*