

## 2E1 ENGINEERING MATHEMATICS III [5 credits]

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### Module organisation

The module runs for the first half (12 weeks) of the academic year and comprises of three lectures and one tutorial per week (total of 43 hours contact time).

### Module description, aims and contribution to programme

This module is a natural continuation of the Junior Freshman courses 1E1 Engineering Mathematics I and 1E2 Engineering Mathematics II and introduces students to further fundamental ideas and methods of mathematics for engineering, covering the areas of multivariate calculus, integration and Laplace transforms. The aim of the module is to provide the necessary background and to teach the students to use it efficiently.

### Learning outcomes

Upon completion of this module, students will be able to:

- analyse the behaviour of functions of several variables, present the result graphically and efficiently calculate partial derivatives of functions of several variables (also for functions given implicitly);
- obtain equations for tangent lines to plane curves and tangent planes to space surfaces;
- apply derivative tests and the method of Lagrange multipliers to find maxima and minima of functions of several variables, local and global;
- effectively calculate multiple integrals, in Cartesian and polar coordinates, in particular, to find areas, volumes and centres of mass;
- solve differential equations by applying Laplace transforms.

### Course content

#### *Vector-valued functions*

- Calculus
- Change of parameter

#### *Partial derivatives*

- Chain rule
- Gradients
- Maxima and minima

#### *Multiple Integrals*

- Double and triple integrals
- Surface area

### ***Topics in vector calculus***

- Vector fields
- Line integrals
- Green's theorem
- Surface integrals
- Stokes' theorem

### ***Laplace Transforms***

- Differential equations
- Unit and delta functions
- Convolution

### **Teaching strategies**

The module is taught using a combination of lectures and tutorials. Answers to tutorial problems are available on the lecturer's webpage.

### **Assessment**

Tutorial assignments contribute 10% towards the final grade with the end-of-year final written two-hour examination contributing 90%.

### **Required textbook**

Calculus: Late Transcendentals Combined, 9th Edition; Howard Anton, Irl Bivens, Stephen Davis; ISBN: 978-0-470-39874-6; 1168 pages  
Advanced Engineering Mathematics, Chapter 5, 8<sup>th</sup> edition, Erwin Kreyszig

### **Further information**

<http://www.maths.tcd.ie/~frolovs/Calculus/Calculus2E1.html>

<http://www.tcd.ie/Engineering/undergraduate/baiyear2/2E1>