Aims

The course aims to provide the necessary mathematical tools for second-year science and engineering courses. It builds on the first-year mathematics courses for engineers and scientists.

Syllabus

**First-Order Differential Equations:** Terminology; First-Order DEs; Separation of Variables; Solution of DEs using Transformations; First-Order Linear DEs, Applications. (5 lectures)

**Second-Order Differential Equations:** Second-Order Homogeneous DEs with Constant Coefficients; Applications. (4 lectures)

**Further Second-Order Differential Equations:** Second-Order Inhomogeneous DEs with Constant Coefficients; Applications. (4 lectures)

**Partial Differentiation:** Review of Differentiation; Partial Differentiation; Higher-Order Partial Derivatives; Directional Derivatives; Chain Rule; Partial Differential Equations. (5 lectures)

**Maxima and Minima:** Stationary Points; Maxima, Minima and Saddle Points; Applications. (3 lectures)

**Taylor Series:** Taylor series in 1D; Maclaurin Series; Taylor Series in 2D; Error Analysis. (4 lectures)

**Multiple Integrals:** Double Integrals over Rectangular Domains and over More General Regions. (4 lectures)

**Further Multiple Integrals:** Double Integrals using Polar Coordinates; Length of Curves; Surface Area; Mass; Centre of Mass; Applications. (4 lectures)

Teaching and Assessment

**Contact Hours:** 4 lectures and 1 tutorial per week

**Assessment:** 15% by class tests or other continuous assessment

85% by end of course 2-hour exam

**Resit Type:** exam only
By the end of the course, students should be able to:

- find general solutions of first-order DEs.
- solve initial value problems for first-order DEs.
- apply methods for solving first-order DEs to applications.
- find general solutions of second-order homogeneous ODEs.
- understand that general solution of inhomogeneous equation is given by complementary function + particular integral.
- find particular integral of inhomogeneous second-order equations with rhs a constant, a polynomial, $e^{ax}, \sin ax, \cos as, e^{ax}g(x)$.
- solve initial value problems for second-order DEs.
- apply methods for solving second order DEs to applications.
- work out partial derivatives of any order.
- apply the chain rule.
- find stationary points of functions of two variables and determine whether they are maxima or minima.
- show that a given function is a solution to a given partial differential equation.
- know the definition of Taylor series of a function.
- write down the linear approximation of a function of two or more variables.
- evaluate double integrals over various planar regions.
- interchange the order of integration of repeated integrals.
- use multiple integrals to find volumes, averages, masses and centres of gravity.
- evaluate integrals by using polar coordinates.

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