Aims

This course seeks to introduce students of science in their first year in the university to calculus, vectors and complex numbers, and to show how these areas of mathematics are used in the natural sciences.

Syllabus

**Differentiation:** Derivatives of elementary functions, the product, quotient and chain rules, increasing and decreasing functions, higher derivatives, maxima and minima, rates of various processes (11 lectures).

**Integration:** Indefinite and definite integrals, integrals of elementary functions, area under a curve, integration by substitution and by parts, the average and expectation value, introduction to differential equations (12 lectures).

**Vectors:** Concept of a vector, addition and multiplication by scalar, inner product of vectors, length, unit vectors, angle between vectors (5 lectures).

**Complex numbers:** Real and imaginary parts, arithmetic of complex numbers, complex conjugate, modulus and argument (5 lectures).

Teaching and Assessment

**Contact Hours:** 3 lectures and 1 tutorial per week
**Assessment:** 20% by class tests or other continuous assessment
                  80% by end of course 2-hour exam
**Resit Type:** exam
By the end of the course, students should be able to:

- differentiate elementary and composite functions
- understand the geometric interpretation of the derivative of a function as the slope of its graph
- compute higher derivatives of a function and interpret them geometrically
- use techniques of differentiation in curve sketching and in solving problems arising in the natural sciences
- check if a given function satisfies an ordinary differential equation
- calculate indefinite and definite integrals of elementary function
- understand the geometrical meaning of a definite integral
- apply the technique of integration by substitution and parts to simple examples
- apply techniques of integration to compute expectation values and averages
- understand the concept of a vector
- add vectors and multiply them by scalars
- compute inner products and lengths of vectors, as well as angles between two vectors
- use vectors and inner products to compute geometric properties of three-dimensional objects
- add, subtract, multiply and divide complex numbers
- draw complex numbers in the Argand diagram
- compute the complex conjugate and modulus of a complex number
- represent and manipulate complex numbers in modulus-argument form