Aims

The objective of the module is to introduce and develop the methods of vector analysis. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics.

Syllabus

Vector Algebra and Geometry: Vector addition and scalar multiplication. Scalar and vector products. Equations of lines and planes. Curves and surfaces; parametric and non-parametric equations of curves and surfaces. (5 lectures)


Vector Integration: Curvilinear line integrals. Surface integrals. The divergence theorem, Green's theorem and Stoke's theorem. (10 lectures)

Curvilinear Coordinate Systems: Coordinate free vector derivatives. Vector derivatives in curvilinear coordinates. Spherical, polar and cylindrical coordinates (4 lectures)

Potential Theory: Gradient fields. Rotation fields. Harmonic functions. Helmholtz's fundamental theorem of vector calculus. (6 lectures)

Teaching and Assessment

Contact Hours: 3 lectures and 1 tutorial per week
Assessment: up to 15% by class tests or other continuous assessment
At least 85% by end of course 2-hour exam
Resit Type: examination
By the end of the course, students should be able to:

- Calculate scalar and vector products.
- Find the vector equations of lines and planes.
- Understand the parametric equations of curves and surfaces.
- Differentiate vector functions of a single variable.
- Calculate velocity and acceleration vectors for moving particles.
- Understand and be able to find the unit tangent vector, the unit principal normal and the curvature of a space curve.
- Find the gradient of a function.
- Find the divergence and curl of a vector field and prove identities involving these.
- Use the gradient operator to calculate the directional derivative of a function.
- Calculate the unit normal at a point on a surface.
- Recognise irrotational and solenoidal vector fields.
- Evaluate line and surface integrals.
- Understand the various integral theorems relating line, surface and volume integrals.