

Vector Calculus (Part 1A)

Curves in \mathbb{R}^3

Parameterised curves and arc length, tangents and normals to the curve in \mathbb{R}^3 , curvature and torsion

Integration \mathbb{R}^2 and \mathbb{R}^3

Line integrals, surface and volume integrals, definitions; ~~interpretation as normal~~ examples using cartesian, cylindrical and spherical coordinates, change of variables

Vector Operators

Directional derivatives, The gradient of a real-valued function; definition; interpretation as normal to level surfaces, examples including the use of cylindrical, spherical and general orthogonal curvilinear coordinates

Divergence, curl and ∇^2 in Cartesian coordinates, examples, formulae for these operators (statement only) in cylindrical, spherical and general orthogonal curvilinear coordinates. Solenoidal fields, ~~irrational~~ irrotational fields and conservative fields, scalar potentials. Vector derivative identities

Integration theorems

Divergence theorem, Green's theorem, Stokes theorem, Green's second theorem; statements; informal proofs, examples, applications to fluid dynamics, and to electromagnetics including statement of Maxwell equations.

Laplace's equation

Laplace's equation in \mathbb{R}^2 and \mathbb{R}^3 , uniqueness theorem, maximum principle. Solution of Poisson's equation by Gauss method (for spherical and cylindrical symmetry) and as an integral.

Cartesian tensors in \mathbb{R}^3

Tensor transformation laws, addition, multiplication, contraction, with emphasis on tensors of second rank. Isotropic second and third rank tensors. Symmetric and antisymmetric tensors. Revisions of principal axes and diagonalisation. Quotient theorem. Examples including inertia and conductivity.

Appropriate books

B. Anton Calculus Wiley Student Edition (2000)

T. M. Apostol Calculus Wiley Student Edition (1975)

M. L. Boas Mathematical Methods in the Physical Sciences Wiley 1983

+ P. E. Bourke and P. C. Kendall Vector Analysis and Cartesian tensors 3rd Edition, Nelson Thornes 1999

E. Kreyszig Advanced Engineering Mathematics. Wiley International Edition, 1995

J. E. Marsden and A. J. Tromba Vector Calculus Freeman 1996

P. C. Matthews Vector Calculus SUMS Springer Undergraduate Math

+ K. F. Riley and M. P. Hobson Mathematical Methods for Physics and series) Engineering CUP 2002

H. M. Schey Div, grad, curl and all that, an informal text to Vector calculus Norton 1996

M. R. Spiegel Schaum Outline for Vector Calculus (Analysis) McGraw Hill 1974