

## PH 401: MATHEMATICAL PHYSICS-I (3-1-0:4)

### Vector Spaces

Linear vector spaces, Schmidt orthogonalisation, linear operators, dual space, ket and bra notation, Hilbert space, metric space, function spaces, Riesz-Fisher theorem, basis, orthogonal expansion of separable Hilbert spaces, Bessel inequality, Parseval's formula.

### Vector Analysis

Vector differentiation; gradient, curl, divergence, vector integration; evaluation of line, surface, and volume integrals. The fundamental theorem for gradients, Gauss's divergence theorem, and Stoke's theorem. Green's theorem and its applications. Orthogonal curvilinear coordinates.

### Matrices

Matrices, special matrices (symmetric, hermitian, orthogonal, unitary), determinant, rank, inverse of a matrix, eigenvalue problem, orthogonalization theorem, matrix diagonalization, normal matrices, canonical forms, special matrices.

### Dirac Delta Function

Dirac delta function, definitions and different representations of delta functions, applications to electrodynamics.

### Differential Equations and Special Functions

Beta, Gamma and error functions, Frobenius method, Legendre, Hermite, Laguerre and Bessel functions, Recurrence relations, method of separation of variables for wave equations in Cartesian and curvilinear coordinates.

### Textbooks and References:

1. N. Kemmer, "Vector Analysis: A Physicist's Guide to the Mathematics of Fields in Three Dimensions", Cambridge University Press.
2. A. I. Borisenko and I. E. Tarapov, "Vector and Tensor Analysis with Applications", Dover Publications.
3. C. W. Wong, "Introduction to Mathematical Physics Methods and Concepts", Oxford University Press.
4. P. Dennery and A. Krzywicki, "Mathematics for Physicists", Dover Publications.
5. R. Beals and R. Wong, "Special Functions: A Graduate Text", Cambridge University Press.