

PHY 631 - Mathematical Methods in Physics

Course Code & Number	Course Name	C.H.	Lec.	Lab.	Tut.
PHY 631	Mathematical Methods in Physics	4	4	0	0

Syllabus

Vector Analysis in Curved Coordinates and Tensors: *Orthogonal coordinates, Differential vector operator, Special coordinate systems, Circular cylinder coordinates, Spherical polar coordinates, Tensor analysis, Contraction, Direct product, Quotient rule, Pseudotensors, Dual tensors, General tensors, Tensor derivative, Operators.*

Group Theory: *Introduction to group theory, Generators of continuous groups, Orbital angular momentum, Angular momentum coupling, Homogeneous Lorentz group, Lorentz covariance of Maxwell's equations, Discrete groups, Differential forms.*

Infinite Series: *Fundamental concepts, Convergence tests, Alternating series, Algebra of series, Series of functions, Taylor's expansion, Power series, Elliptic integrals, Bernoulli numbers, Euler-Maclaurin formula, Asymptotic series, Infinite products.*

Functions of a Complex Variable: *Complex algebra, Cauchy-Riemann conditions, Cauchy's integral theorem, Calculus of residues.*

The Gamma Function (Factorial Function): *Definitions, Simple properties, Digamma and polygamma functions, Stirling's series, The beta function.*

Differential Equations: *Partial differential equations, First-order differential equations, Separation of variables, Frobenius method.*

Sturm-Liouville Theory-Orthogonal Functions: *Self-adjoint ODEs, Hermitian, Gram-Schmidt orthogonalization, Green's function.*

Integral Transforms: *Integral transforms, Development of the Fourier integral, Fourier transform-inversion theorem, Fourier transform of derivatives, Laplace transforms, Laplace transform of derivatives.*

Integral Equations: *Integral transforms, Generating functions, Neumann series, Separable Kernels, Hilbert-Schmidt theory.*

References

- G.B. Arfken, *Mathematical Methods for Physicists*, 2005.
- H.W. Wyld, *Mathematical Methods for Physics*, Perseus Books Publishing, 1999.
- R. Courant, D. Hilbert, *Methods of Mathematical Physics*, John Wiley and Sons, 1st Edition, 1965.

