

Department of Physics

Indian Institute of Technology Kanpur

PHY605 : Review of Mathematical Methods in Physics

Course content:

| S. No. | Topics | No. of Lecture and Tutorial Hours |
|--------|--|-----------------------------------|
| 1 | Problem oriented review of Mathematical Methods in Physics. Vector spaces - Discrete and continuous: orthogonality, operator algebra. Hermitian and unitary operators, projection operators, matrices and applications in Physics. Calculus of variations, function spaces and Hilbert spaces, Orthogonal polynomials, expansions in orthogonal polynomials, generating functions. Integral transforms (e.g Fourier, Laplace, etc.) and applications to physics. | 12 |
| 2 | Differential equations: General introduction to ordinary differential equations, linear first and second order ordinary differential equations, singular points, series solutions-Frobenius method, second solution, inhomogeneous equations-Green's function, Sturm-Liouville theory, partial differential equations, characteristics, Boundary conditions. Special functions and applications in Physics. | 16 |
| 3 | Complex analysis: Cauchy-Riemann conditions, Cauchy-Goursat theorem, Cauchy integral formula, Contour integrals, Taylor and Laurent Series, The residue theorem. Applications of complex analysis to physics problems. | 12 |

Reference books:

1. Sadri Hassani, Mathematical Physics: a modern introduction to its foundations (Springer)
2. Arfken, Weber- Mathematical Methods for Physicists (Academic Press)
3. Tulsı Dass and S. K. Sharma, Mathematical methods in Classical and Quantum Physics (University Press)
4. A. K. Kapoor, Complex variables (World Scientific)
5. Mathews, Walker - Mathematical Methods of Physics (Addison-Wesley)
6. Schaum Series - Vector Analysis
7. A. W. Joshi, Matrices and Tensors in Physics (New age international)