Approval:10th senate meeting

Course Name : Mathematical Physics
Course Number : PH 511
Credits : 4-0-0-4
Prerequisites : Undergraduate physics courses and faculty consent.
Intended for : I-Ph.D, M.Sc., B.Tech 3rd and 4th Year.
Distribution : Core course for I-PhD and elective for others
Semester : Odd

Preamble **:** Mathematical physics provides firm foundation in various mathematical methods developed and used for understanding different physical phenomena. This course provides mathematical tools to address formalisms used in the core course of masters level physics program.

Course Outline **:** The course starts with the vector calculus followed by the introduction to tensor analysis, and the concept of linear vectors space. The course continues to introduce differential equations and special function that are used to understand physical phenomena in different geometries. This followed by complex analysis and finally Fourier analysis and integral transforms are discussed.

Modules

1- Coordinate system, Vector calculus in Cartesian and Curvilinear coordinates, Introduction to Tensor analysis. (9 lectures)

2- Linear vector spaces, Gram-Schmidt orthogonalization, Self -adjoint, Unitary, Hermitian Operators, transformation of operators , eigenvalue equation, Hermitian matrix diagonalization. (8 lectures)

3- Ordinary differential equation (ODE) with constant coefficients, Second order Linear ODE, Series Solution- Frobenius Method, Inhomogeneous linear ODE. Sturm Liouville equation Hermition operators - eigenvalue problem. (9 Lectures)

4- Special functions: Bessel, Neumann, Henkel, Hermite, Legendre, Spherical Harmonics, Laguerre, Gamma, Beta, Delta functions. (10 lectures)

5- Complex analysis, Cauchy- Riemann conditions, Cauchy's Integral theorem, Laurent expansion, Singularities, Calculus of residues, evaluation of definite integrals, Method of steepest descent, saddle point. (12 lectures)

6- Fourier Series general properties and application, Integral transform, Properties of Fourier transform, Discrete Fourier transform, Laplace transform, Convolution theorem (6 lectures)

Text books

1. Mathematical methods for physicists by Arfken and Weber (Elsevier Academic Press, 6th edition, 2005)
2. Mathematical Methods in Physical Sciences by Mary L Boas (Willey 3rd edition, 2005)

References

1. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley , M. P. Hobson (Cambridge India South Asian Edition, 2009)

2. Mathematical Methods for Physicists by Mathews, J., and Walker, R.L.,(Imprint, New edition 1973)

3. Mathematics of Classical and Quantum Physics by F W Byron and R W Fuller (Dover Publication, New edition, 1992)

4. Methods of theoretical Physics Vol. I and II by P M Morse , H. Freshbach (Mc-GrawHill, 1953)

5. Advanced Engineering Mathematics by E Kreyszing (Wiley India Private Limited, 10th edition, 2003)

6. Mathematics for Physcists by Philippe Dennery and Andre Krzywicki (Dover Publications Inc. 1996)