1. PG: BOS-2021

*w.e.f. July, 2021*

**PH-8101** **Mathematical Methods of Physics-I**

| L | T | P | C |
|---|---|---|---|
| 4 | 1 | 0 | 5 |

**Course outcomes**

**After successful completion of the course, the students should be able to understand**

**CO1:** basic knowledge of complex variables and its application for physics problems

**CO2:** the partial differential equations and their use in basic sciences

**CO3:** the delta and gamma functions and their applications

**CO4:** the special functions such as Bessel, Legendre, Hermite and Laguerre functions.

**CO5:** the knowledge of Fourier series and Laplace transformation.

**CO/PO Mapping**

S-strong, M-medium and W-weak indicate the strength of correlation

| COs | Programme outcomes (POs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | W | W | W | | W | | M | S | S | S | S |
| CO2 | S | S | S | M | S | W | M | W | M | W | | M |
| CO3 | M | W | M | W | W | S | S | S | S | M | S | S |
| CO4 | S | S | W | | W | M | M | | M | S | W | W |
| CO5 | M | W | S | W | S | | S | M | | | M | W |

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**UNIT-I**

**Complex Variables:** Cauchy-Riemann conditions, Singularities and convergence, Analytic, Cauchy-Goursat theorem, Cauchy's Integral formula, Branch points and branch cuts, Multivalued functions, Taylor and Laurent expansion, , Residues, Dispersion relation, evaluation of definite integrals. **10 Hrs**

**Delta and Gamma Functions:** Dirac delta function, Delta sequences for one dimensional function, properties of delta function, Gamma function, factorial notation and its applications, Beta function. **10 Hrs**

**Differential Equations:** Partial differential equations of theoretical physics, Boundary value, Neumann & Dirichlet Boundary conditions, Separation of variables, Singular points, Series solutions, Second solution, Problems. **10 Hrs**

**UNIT-II**

**Special Functions:** Bessel's functions: Functions of first and second kind, Generating function, Integral representation and Recurrence relations for of first kind and Orthogonality. Legendre functions: Generating function, Recurrence relations and special properties, Orthogonality, Various definitions of Legendre polynomials. Associated Legendre functions: recurrence relations, Parity and Orthogonality, Hermite functions, Laguerre functions. **15 Hrs**

**Fourier Series and Integral Transforms:** Fourier series, Dirichlet conditions. General properties. Convolution and correlation, Advantages and applications, Gibbs phenomenon. Fourier transforms, Development of the Fourier integral, Inversion theorem, Fourier transforms of derivatives, Momentum representation.

Laplace transforms, Laplace transforms of derivatives, Properties of Laplace transform, Applications. Inverse Laplace transformation. **15 Hrs**

**Theory: 60hrs**

**BOOKS:**


1. Mathematical Methods for Physicists: G. Arfken and H.J. Weber (Academic Press, San Diego) 7th edition, 2012.
2. Mathematical Physics: P.K. Chattopadhyay (Wiley Eastern, New Delhi), 2004.
3. Mathematical Physics: A.K. Ghatak, I.C. Goyal and S.J. Chua (MacMillan, India, Delhi),1986.
4. Mathematical Methods in the Physical Sciences – M.L. Boas (Wiley, New York) 3rd edition, 2007.
5. Special Functions: E.D. Rainville (MacMillan, New York), 1960.
6. Mathematical Methods for Physics and Engineering: K.F.Riley, M.P.Hobson and S.J. Bence (Cambridge University Press, Cambridge) 3rd ed., 2006.
7. Mathematical methods for Physics and Engineering, K.F. Rilay, M.P. Hobson and S.J. Bence, Cambridge Uni. Press (1998).
8. Complex variables and applications, J.W. Brown, R.V. Churchill, 8th Ed., McGraw Hill (2009).
9. Introduction to Mathematical Physics, C. Harper, (PHI) 1978.


c/BOS


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