DISCIPLINE SPECIFIC ELECTIVE COURSE – PHYSICS DSE 13b: MATHEMATICAL PHYSICS I

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
MATHEMATICAL PHYSICS I PHYSICS DSE – 13b	**4**	**3**	**1**	**0**	Passed 12th Class	NIL

LEARNING OBJECTIVES

The emphasis of course is to equip students with the mathematical tools required in solving problem of interest to physicists. The mathematical tools might be building blocks to understand the fundamental computational physics skills and hence enable them to solve a wide range of physics problems. Overall, to help students develop critical skills and knowledge that will prepare them not only for doing fundamental and applied research but also prepare them for a wide variety of careers

LEARNING OUTCOMES

After completing this course, student will be able to,

- Learn the functions more than one variable using the concepts of calculus.
- Solve first order differential equations and apply it to physical problems.
- Represent a periodic function by a sum of harmonics using Fourier series.
- Obtain power series solution of differential equation of 2nd order with variable coefficients using Frobenius mehod.
- Learn beta and gamma functions

SYLLABUS OF PHYSICS DSE 13b

THEORY COMPONENT

Unit – I **(18 Hours)**

Calculus of functions of more than one variable: Partial derivatives, chain rule for partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions. Application to Summing of Infinite Series.

Unit – II **(12 Hours)**

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre Differential Equations and its solution. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations.

Unit – III **(15 Hours)**

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular geometry. Solution of 1D wave equation.

References:

Essential Readings:

1) An introduction to ordinary differential equations, E.A. Coddington, PHI learning, 2009
2) Differential Equations, George F. Simmons, McGraw Hill, 2007
3) Mathematical methods for Scientists and Engineers, D. A. McQuarrie, Viva Book, 2003
4) Advanced Engineering Mathematics, D. G. Zill and W. S. Wright, 5th Edition, Jones and Bartlett Learning, 2012
5) Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India, 2008
6) Fourier Analysis: With Applications to Boundary Value Problems, Murray Spiegel, McGraw Hill Education, 2017
7) Mathematical Methods for Physicists, G. B. Arfken, H. J. Weber, F. E. Harris, 7th Edition, Elsevier, 2013
8) Essential Mathematical Methods, K. F. Riley and M. P. Hobson, Cambridge Univ. Press, 2011

Additional Readings:

1) Introduction to Electrodynamics, Chapter 1, David J. Griffiths, 4th Edition, Cambridge University Press, 2017
2) The Feynman Lectures on Physics, Volume II, Feynman, Leighton and Sands, Narosa Publishing House, 2008
3) Advanced Engineering Mathematics, D. G. Zill and W. S. Wright, 5th Edition, Jones and Bartlett Learning, 2012
4) Mathematical Tools for Physics, James Nearing, Dover Publications, 2010
5) Mathematical Physics, A. K. Ghatak, I. C. Goyal and S. J. Chua, Laxmi Publications Private Limited, 2017