PGP/PSP 4433 **MATHEMATICAL PHYSICS - I** **4 hrs / 4 Cr**

This course helps to understand the complex variables and acquire knowledge about special functions and series solutions of differential equations in physics. Students get basic concept about Fourier series and integral transforms also familiarizing withnumerical methods and to impart mathematical knowledge for the description of physics phenomena

At the end of the course, students will be able to

i. explain the characteristics of complex functions, evaluate residues and definite integrals.
ii. describe the properties and usage of special functions in physics
iii. elucidate the characteristics of orthogonal polynomials

iv. expand the periodic functions using Fourier series and apply integral transforms

v. solve polynomials, integral and differential equations using numerical methods.

Unit I: Complex Variable

Functions of a complex variable – analytic function – Cauchy-Riemann conditions - Cauchy's integral theorem and integral formula - Taylor's and Laurent's expansions - Cauchy residue theorem – Evaluation of residues - Evaluation of definite integrals

Unit II: Special Functions in Physics

Gamma functions – Beta functions – Dirac-Delta functions – Green's functions- One dimension – Two and three dimension - Applications of Green's functions.

Unit III: Series Solutions of Differential Equations in Physics

Differential equations, Generating function, Rodrigues' formula Recurrence relations and Orthogonality of Bessel, Legendre, Hermite and Laguerre polynomials

Unit IV: Fourier series and Integral Transforms

Fourier series - Application of Fourier series - Fourier Integral theorem - Fourier Transform – Convolution theorem – Parseval's relation – Transforms of derivatives - Application of Fourier transform - Laplace transform - Application of Laplace transform.

Unit V: Numerical Methods

Roots of polynomial and transcendental equations - Newton-Raphson method - Lagrange's interpolation - Numerical integration - Trapezoidal, Simpson's method - Euler's method, Runge-Kutta method

Text Books:

1. Charlie Harper, *Introduction to Mathematical Physics*, Prentice-Hall, Inc, (2008)
2. George B. Arfken and Hans J. Weber, *Mathematical Methods for Physicists*, Elsevier Academic Press Seventh Edition, (2012)
3. M.K. Venkataraman, *Numerical Methods in Science and Engineering*, National Publishing Co, Fifth Edition, (1999)