Course Syllabus: Core VI, Semester III

Course Title: Mathematical Physics-III

Course Outcomes

- Understanding and application of Complex function variables.
- Understanding the concept of Fourier Integral transform.
- To Understand the properties and application of Fourier integral transformation.
- To Understand the properties and application of Laplace integral transformation.
- To Apply the acquired knowledge to solve problems.

Unit-wise Syllabus

Unit I: Complex Analysis

- Brief Revision of Complex Numbers and their Graphical Representation.
- Euler’s formula, De Moivre's theorem, Roots of complex Numbers.
- Functions of Complex Variables.
- Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions.
- Singular functions: poles and branch points, order of singularity, branch cuts.
- Integration of a function of a complex variable.
- Cauchy's Inequality, Cauchy's Integral formula.
- Simply and multiply connected region.
- Laurent and Taylor's expansion.
- Residues and Residue Theorem.
- Application in solving Definite Integrals.

Unit II: Integral Transforms-I: Fourier Transforms

- Fourier Integral theorem.
- Fourier Transform, Examples.
- Fourier Transform of trigonometric, Gaussian, finite wave train and other functions.
- Representation of Dirac delta function as a Fourier Integral.
- Fourier transform of derivatives.
- Inverse Fourier Transform.

Unit III: Integral Transforms-II: Properties and Applications

- Convolution theorem.
- Properties of Fourier Transforms (translation, change of scale, complex conjugation).

- Three dimensional Fourier transforms with examples.
- Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat flow Equations.

Unit IV: Laplace Transforms

- Laplace Transforms (LT) of Elementary functions.
- Properties of Laplace Transforms: Change of Scale Theorem, Shifting Theorem.
- LTs of Derivatives and Integrals of Functions.
- Derivatives and Integrals of LTs.
- LT of Unit Step function, Dirac Delta function, Periodic Functions.
- Inverse LT.
- Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.