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**Course Objectives:** This course aims at providing the student

- With the concepts and several methods of integral transforms and its applications.
- The concepts of fractional calculus and its applications.

**UNIT – 1: Basic concepts of integral transforms:: Fourier transforms:**

9 Hrs

Introduction, basic properties, applications to solutions of Ordinary Differential Equations (ODE), Partial Differential Equations (PDE) and Integral Equations.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Solve ordinary differential equations and partial differential equations.
- Solve Integral equations.

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**UNIT – II: Laplace transforms:**

Introduction, existence criteria, Convolution, differentiation, integration, inverse transform, Tauberian Theorems, Watson's Lemma, solutions to ODE, PDE including Initial Value Problems (IVP) and Boundary Value Problems (BVP).

Applications of joint Fourier-Laplace transform, definite integrals, summation of infinite series, transfer functions, impulse response function of linear systems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Solve initial and boundary value problems using Laplace transform technique.
- Apply the techniques of joint Fourier-Laplace transform techniques.

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L4

**UNIT – III: Hankel Transforms & Hilbert Transforms**

**Hankel Transforms:** Introduction, properties and applications to PDE Mellin transforms: Introduction, properties, applications; Generalized Mellin transforms.

**Hilbert Transforms:** Introduction, definition, basic properties, Hilbert transforms in complex plane, applications; asymptotic expansions of 1-sided Hilbert transforms.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Solve PDE by using the concepts of Hankel transforms.
- Learn the concepts of Hilbert transforms.

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**UNIT – IV: Stieltjes Transform, Legendre transforms and Radon transforms**

**Stieltjes Transform:**

Definition, properties, applications, inversion theorems, properties of generalized Stieltjes transform.

**Legendre transforms:**

Introduction, definition, properties, applications.

**Radon transforms:**

Introduction, properties, derivatives, convolution theorem, applications, inverse radon transform.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Analyzes the Stieltje's and Legendre's transforms.
- Analyzes random transforms and focuses on their applications.

L4

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**UNIT – V: Fractional Calculus and its applications & Integral transforms in fractional equations**

**Fractional Calculus and its applications:** Introduction, fractional derivatives, integrals, Laplace transform of fractional integrals and derivatives.

**Integral transforms in fractional equations:** fractional ODE, integral equations, IVP for fractional Differential Equations (DE), fractional PDE, green's function for fractional DE.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Learn the basic concepts of fractional calculus. L2
- Applies the concepts of integral transforms in fractional calculus. L4

**Text Books:**

1. Advanced Topics in Applied Mathematics for Engg. & physical Science: Sudhakar Nair
2. Introduction to Applied Mathematics, Gilbert Strang

**Reference Books:**

1. Fractional Calculus Theory and Applications of Differentiation and Integration to Arbitrary Order: J. Spanier and K. B. Oldham
2. Handbook of Mathematical Functions: M. Abramowitz & I. Stegun

**Course Outcomes:**

At the end of this Course the student will be able to

- Use the basic concepts of integral transforms, Stieltjes Transform, Legendre transforms and Radon transforms etc., in real life problems. L1
- Use the concepts of Laplace transforms in solving the initial value and boundary value problems. L2
- Applies the concepts of Hankel Transforms & Hilbert Transforms while addressing the various problems related to engineering sciences. L3
- Analyze the problems in engineering and technology using various techniques of integral transforms and applications. L4
- Uses the ideas of fractional calculus and its applications in solve the real world problems. L5

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