Bachelors with Mathematics as Major

5th Semester

MMT522J3: Mathematics/Applied Mathematics:

FOURIER AND LAPLACE TRANSFORM

Credits: 4 THEORY + 2 TUTORIAL **Theory: 60 Hours & Tutorial: 30 Hours**

Course Objectives: To develop skill in students about

i) Fourier series, Fourier and Laplace transforms as a tool to solve various problems of Mathematics.

ii) Integral transforms to be used in the field of applied Mathematics and especially in the field of physics and electronics to express periodic functions that comprise communication signal in waveform.

Course Outcome: After the completion of this course, students shall be able to use Fourier and Laplace transforms to solve the differential equations and to understand signal processing in frequency and time domain.

Theory: 4 Credi

Unit- I

Fourier Series: Introduction, Periodic functions: Properties, Even & Odd functions. Special waveforms: Square wave, Sawtooth wave, and Triangular wave. Euler's Formulae for Fourier Series, Fourier Series for functions of period 2π, Fourier Series for functions of period 2L, Dirichlet's conditions, Sum of Fourier series. If $f(x)$ is bounded and integrable function on $(-\pi,\pi)$ and if a_n, b_n are its Fourier coefficients, then $\sum a_n^2 + b_n^2$ converges. Half Range Series for sine and cosine functions, examples. Riemann Lebesque theorem.

Unit – II

The Fourier Transform. Periodic functions, Definition and examples of Fourier series, Drichlet's conditions, determination of Fourier coefficients, even and odd functions and their Fourier expansion, change of interval, half range series. Fourier transform, inverse Fourier transform, Fourier sine and cosine transforms and their inversion, properties of Fourier transforms Fourier transform of the derivative, convolution theorem, discrete Fourier transform and fast Fourier transform and their properties.

Unit – III

Definition, Laplace transform of elementary functions, Properties of Laplace transforms viz Linearity, translation, Change of Scale property etc. Laplace transform as periodic functions, Dirac-Delta function, Inverse Laplace transform. Laplace transform for derivatives, Laplace transform for integrals, Convolution theorem. Solution of ordinary differential equations with constant coefficients. Applications of partial differential equations.

Unit – IV

Application of Laplace transform to differential equation and integral equation. Application of Laplace transform to boundary value problems. Electrical circuits, dynamics, Beams, Heat conduction equations and wave equations.

Tutorials: 2 Credits

Unit – V

Problems based on unit-I and unit-II.

Unit – VI

Problems based on unit-III and unit-IV.

Recommended Books:

1. Ruel V.Churchill, Fourier Series & Boundary Value Problems, 8th Edition McGraw Hill Education 2011.
2. Davies, Brian, Integral Transforms and Their Applications, Springer, 2002.
3. Erwin, Kreysgiz, Advanced Engineering Mathematics, John Willey & Sons. 10th Edition, 2011.
4. K.S. Rao, Introduction to Partial Differential Equations, K.S. Rao, PHI, India.
5. Murrey R. Spiegel, Laplace Transforms, Schaum's outline series.
6. I. N. Sneddon: The use of Integral Transforms, McGraw-Hill, Singapore 1972.
7. R. R. Goldberg, Fourier Transforms, Cambridge University Press, 1961.
8. D. Brain, Integral Transforms and their applications, Springer, 2002.