

Under-Graduate Programme with MATHEMATICS; 5th Semester

MATHEMATICS

MMT526J3: Fourier and Laplace Transforms

Theory: 4 Credits (60 Hours)

MAJOR COURSE

Credits: 6(4-TH + 2-TUT)

Tutorial: 2 Credits (30 Hours)

Course Objectives: The objective of this course is:

1. Fourier series are 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 completion of the 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 Credits

Unit- I

Fourier Series: Introduction, Periodic functions: Properties, Even & Odd functions. Special waveforms: Square wave, Sawtoothed 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, Dirichlet'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.

Unit – IV

Laplace transform for derivatives, Laplace transform for integrals, Convolution theorem. Solution of ordinary differential equations with constant coefficients using Laplace Transform. Solution of initial value problems. Applications to partial differential equations (simple cases such as heat or wave equations).

Tutorials: 2 Credits

Unit – V

Problems based on unit-I and unit-II.

Unit – VI

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.

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
3. Erwin, Kreysigz, Advanced Engineering Mathematics, Willey Eastern Pub.,
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.