Course No	Course Name	L-T-P-Credits
MA 501	**Integral Transforms and Integral Equations**	**3-1-0: 4**

Prerequisite: NIL

Course Objectives: The objective of this course is to introduce the fundamental concepts of Fourier series, Fourier transforms and Laplace transforms and their applications to ODEs and PDEs. The course also introduces the classification of integral equations, fundamental mathematical ideas and techniquesthat lie at the core of integral equation approach of problem solving.

Course Outcomes: After successful completion of the course, students will be able to:

1. Obtain the Fourier coefficients and Fourier series for a given periodic function.
2. Evaluate the Fourier transform of standard functions, properties and derive the rules for differentiation and integration.
3. Apply the Fourier transform in solving ODEs with constant coefficients and PDEs with initial and boundary conditions.
4. Know the Laplace transform of standard functions, properties and differentiation in time and frequency domains.
5. Apply the Laplace transform in solving ODEs with constant coefficients and arbitrary initial conditions and PDEs with initial and boundary conditions.
6. Classify and convert the IVPs and BVPs into integral equations and vice-versa.
7. Solve Volterra type and Fredholm type integral equations.
8. Construct the Green's function for non-homogeneous BVPs.

SYLLABUS

Module	Contents	Hours
I	**Fourier transforms:** Fourier series, Fourier integral formula, definition of Fourier transforms, properties, convolution theorem, Fourier transform as a limit of Fourier series, applications to differential equations.	08
II	**Laplace transforms:** Definitions, properties, convolution theorem, inverse Laplace transformation, applications to differential equations.	08
III	**Integral equations:** Basic concepts, Volterra integral equations, relationship between linear differential equations and Volterra equations, resolvent kernel, method of successive approximations, convolution type equations, Volterra equation of the first kind. Abel's integral equation.	10

IV	**Fredholm integral equations:** Fredholm integral equations, Fredholm equations of the second kind, the method of Fredholm determinants, iterated kernels, integral equations with degenerate kernels, eigenvalues and eigenfunctions of a Fredholm alternative, construction of Green's function for BVP, singular integral equations.	10

Essential Readings:

1. P. Dyke, "An Introduction to Laplace Transforms and Fourier Series", Springer Undergraduate Mathematics Series, 2nd edition, 2014.
2. F. G. Tricomi, "Integral Equations", Dover Publications Inc, 1985.G. P. Tolstov and R. A. Silverman, "Fourier Series", Dover Publications Inc, 1976.

Supplementary Readings:

1. G. P. Tolstov and R. A. Silverman, "Fourier Series", Dover Publications Inc, 1976.
2. D. Porter and D. S. G. Stirling, "Integral Equations: A Practical Treatment, from Spectral Theory to applications", Cambridge University Press, 1990.
3. Ram P. Kanwal, "Linear Integral Equations: Theory & Technique", Birkhäuser, 2nd edition, 2012.