

### Suggestive Readings

- Frank Emmert-Streib, et al. (2022). Mathematical Foundations of Data Science Using R. (2nd ed.). De Gruyter Oldenbourg.
- Wes McKinney. (2022). Python for Data Analysis (3rd ed.). O'Reilly.
- Wickham, Hadley, et al. (2023). R for Data Science (2nd ed.). O'Reilly.

**Practical (30 hours)-** Practical work to be performed in Computer Lab using R/Python:

1. To explore different types data (nominal, ordinal, interval, ratio) and identify their properties.
2. To deal with dirty and missing data, such as imputation, deletion, and data normalization.
3. Use the real-world datasets (<https://data.gov.in/>) to demonstrate the following:
  - a) Data analysis and exploration, linear regression techniques such as simple, multiple explanatory variables, cross-validation, and regularization.
  - b) Dimensionality reduction techniques such as principal component analysis, singular value decomposition (SVD), and multidimensional scaling.
  - c) Clustering algorithms such as  $k$ -means, hierarchical, and density-based clustering and evaluate the quality of the clustering results.
  - d) Classification methods such as linear classifiers, support vector machines (SVM), and  $k$ -nearest neighbors ( $k$ -NN).

## DISCIPLINE SPECIFIC ELECTIVE COURSE-3(iv): INTEGRAL TRANSFORMS

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Integral Transforms</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>Class XII pass with Mathematics</b>	<b>Differential Equations, Elementary Mathematical Analysis</b>

**Learning Objectives:** Primary objective of this course is to introduce:

- The basic idea of integral transforms of functions and their applications through an introduction to Fourier series expansion of a periodic function.
- Fourier transform and Laplace transform of functions of a real variable with applications to solve ODE's and PDE's.

**Learning Outcomes:** The course will enable the students to:

- Understand the Fourier series associated with a periodic function, its convergence, and the Gibbs phenomenon.
- Compute Fourier and Laplace transforms of classes of functions.
- Apply techniques of Fourier and Laplace transforms to solve ordinary and partial differential equations and initial and boundary value problems.

**SYLLABUS OF DSE-3(iv)****UNIT-I: Fourier Series and Integrals (18 hours)**

Piecewise continuous functions and periodic functions, Systems of orthogonal functions, Fourier series: Convergence, examples and applications of Fourier series, Fourier cosine series and Fourier sine series, The Gibbs phenomenon, Complex Fourier series, Fourier series on an arbitrary interval, The Riemann-Lebesgue lemma, Pointwise convergence, uniform convergence, differentiation, and integration of Fourier series; Fourier integrals.

**UNIT-II: Integral Transform Methods (15 hours)**

Fourier transforms, Properties of Fourier transforms, Convolution theorem of the Fourier transform, Fourier transforms of step and impulse functions, Fourier sine and cosine transforms, Convolution properties of Fourier transform; Laplace transforms, Properties of Laplace transforms, Convolution theorem and properties of the Laplace transform, Laplace transforms of the heaviside and Dirac delta functions.

**UNIT-III: Applications of Integral Transforms (12 hours)**

Finite Fourier transforms and applications, Applications of Fourier transform to ordinary and partial differential equations; Applications of Laplace transform to ordinary differential equations, partial differential equations, initial and boundary value problems.

**Essential Readings**

1. Tyn Myint-U & Lokenath Debnath (2007). Linear Partial Differential Equations for Scientists and Engineers (4th ed.). Birkhauser. Indian Reprint.
2. Lokenath Debnath & Dambaru Bhatta (2015). Integral Transforms and Their Applications (3rd ed.). CRC Press Taylor & Francis Group.

**Suggestive Readings**

- Baidyanath Patra (2018). An Introduction to Integral Transforms. CRC Press.
- Joel L. Schiff (1999). The Laplace Transform-Theory and Applications. Springer.
- Rajendra Bhatia (2003). Fourier Series (2nd ed.). Texts and Readings in Mathematics, Hindustan Book Agency, Delhi.
- Yitzhak Katznelson (2004). An Introduction to Harmonic Analysis (3rd ed.). Cambridge University Press.

**DISCIPLINE SPECIFIC ELECTIVE COURSE-3(v): RESEARCH METHODOLOGY****CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research Methodology	4	3	0	1	Class XII pass with Mathematics	NIL