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SECOND SEMESTER 2024 - 2025

Course Handout Part II

Date: 06-01-2025

In addition to Part - I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. *: MATH F241*
Course Title *: Mathematical Methods*
Instructor-in-charge *: Dr. K. Bhargav Kumar*
Instructors *: K. Bhargav Kumar **&** Debismita Nayak*

Scope and Objective of the Course:

This course introduces different mathematical methods and their applications to many real life problems of science, engineering and technology.

Text Books:

T1: F. B. Hildebrand, Methods of Applied Mathematics, Dover Publications, Second Edition, 1992.
T2: Sudhakar Nair**,** Advanced Topics in Applied Mathematics: For Engineering and the Physical Sciences, Cambridge University Press, 2011.

Reference Books:

R1: G. B. Arfken and H. J. Weber, Mathematical Methods for Physicist, Academic Press 2002.
R2. Anadi S. Gupta, Calculus of Variations with Applications, Prentice - Hall of India Pvt. Limited, 2004.
R3. Lokenath Debnath and D. Bhatta, Integral Transform and their Applications, Taylor & Francis, 2002.
R4. Ivar Stakgold, Michael J. Holst, Green's Functions and Boundary Value Problems, Wiley, 3rd Edition, 2011.
R5. R P. Kanwal, Linear Integral Equations, Birkhauser Boston, 1996.

Lecture Plan:

Lecture No.	Learning Objectives	Topics to be covered	Text Book/Sec.
1 - 2	To deal with the formulation and theory of linear integral equations	**Integral Equations:** Introduction and relation between integral and differential equations.	**T1 (3.1 - 3.2)**
3 - 5	To introduce and interpret Green's function	Green's operator and Green's function, adjoint operator, Sturm - Liouville operator.	**T1 (3.3)**
6 - 12	To study different analytical procedures available for the exact solution of certain	Classification of integral equations, Fredholm equations, Hilbert - Schmidt theory, Iterative methods for solving equations of the second kind, the Neumann series and Fredholm theory.	**T1 (3.6 - 3.11)**

	linear integral equations		
13 - 16	To describe various numerical methods for obtaining approximate solutions of certain linear integral equations	Approximation of Fredholm equations by set of algebraic equations, approximate methods by undetermined coefficients, method of collocation, method of weighing function, method of least squares.	**T1 (3.15 - 3.19)**
17 - 18	To introduce a powerful technique for solving linear and partial differential equations arising in engineering and physics when the domain is infinite or semi-infinite	Dirac - Delta function and its properties. Fourier series, Riemann - Lebesgue lemma, localization lemma, Fourier integral theorem, Fourier cosine and sine transforms.	**T2 Chapter I (Articles 1 - 10) – Self Study,** **T2 (3.1 - 3.4)**
19 – 21	To discuss important properties of Fourier transforms	Properties of Fourier transforms, properties of trigonometric transforms, transforms of elementary functions.	**T2 (3.5 - 3.7)**
22 - 26	To illustrate some examples of solutions of differential and integral equations obtained using the Fourier transform	Convolution integral, mixed trigonometric transform, Applications of Fourier transforms, discrete Fourier transform.	**T2 (3.8 - 3.9, 3.11, 3.18)**
27 - 31	To introduce the variational notation and derive the Euler equations relevant to a large class of problems	**Calculus of Variations:** Maxima and minima, The simplest case, illustrative examples**,** natural boundary conditions, transition conditions, the variational notation, general case of two independent variables.	**T1 (2.1 - 2.6)**
32 - 33	To determine one or more functions by a variational procedure in which variations are governed by one or more auxiliary conditions.	Constraints and Lagrange's multipliers.	**T1 (2.7)**
34-35	To solve variational problems in which the boundary of the region of integration is not completely specified but is to be determined together with the	Variable end points.	**T1 (2.8)**

	unknown function or functions.		
36 - 38	To illustrate one of the important class of variational problems	Sturm - Liouville problems, Hamilton's principle, Lagrange's equations.	**T1 (2.9 – 2.11)**
39 - 40	To obtain approximate solutions of problems expressed in variational form	The Rayleigh - Ritz method.	**T1 (2.19)**

Evaluation Scheme:

Sl. No.	**Evaluation Component**	**Duration**	**Weightage** (%)	**Date & Time**	**Nature of Component**
1	Quiz		15	Will be announced later	Closed book
2	Assignment + Classroom evaluation		10 + 10	Will be announced later	Open book
3	Mid Sem Exam	1.5 Hours	25	07/03 4.00 - 05.30PM	Closed book
4	Comprehensive Exam	3 Hours	40	13/05AN	Closed book

Make-up Policy: Make-up for Mid-Sem Exam will be given only for very genuine cases and prior permission has to be obtained from Instructor In-charge. NO MAKE-UP for quiz, assignment and classroom participation.

Chamber consultation hour: To be announced by the respective Instructor.

Total Marks: 100

Notices: The notices concerning this course will be displayed in LMS only.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE