Birla Institute of Technology & Science, Pilani
Hyderabad Campus

**SECOND SEMESTER 2021 - 2022**
**Course Handout Part II**

**Date: 15.01.2022**

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 : **Jagan Mohan Jonnalagadda**
Instructors : **Jagan Mohan Jonnalagadda, Kshama Trivedi, Sushil Pathak**

## 1. 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.

## 2. 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.

## 3. 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 | Chapter in the Text Book |
|---|---|---|---|
| **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 | Classification of integral equations, Fredholm equations, Hilbert - Schmidt theory, Iterative methods for solving equations of the second kind, the | **T1 (3.6 - 3.11)** |

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| | exact solution of certain linear integral equations | Neumann series and Fredholm theory. | |
| **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), 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 | Variable end points. | **T1 (2.8)** |

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| | together with the 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)** |

**4. Evaluation Scheme:**

| S. No. | Evaluation Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|---|---|---|---|---|---|
| 1 | Quiz - 1 | | 10 | TBA | Open book |
| 2 | Assignment - 1 | | 10 | TBA | Open book |
| 3 | Mid Semester Examination | 90 Minutes | 30 | 16/03 9.00am to10.30am | Closed book |
| 4 | Quiz - 2 | | 10 | TBA | Open book |
| 5 | Comprehensive Examination | 120 Minutes | 40 | 19/05 FN | Closed book |

**5. Chamber Consultation Hour:** To be announced by the individual instructor.
**6. Notices:** All notices regarding this course will be displayed on CMS.
**7. Make-up Policy:** Make-up for any component will be given only for very genuine cases and it also depends upon the feasibility. Prior permission has to be obtained from Instructor-in-charge.
**8. 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**
**MATH F241**