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| --- | --- | --- | --- | --- |
| Course Code | Course Title | L | P | U |
| **MA556** | **Mathematical Methods** | **4** | **0** | **4** |

**Scope & Objective of the course**:

Integral transforms have become essential working tools of every engineer and applied scientist. This course help us to know about several transformations and some special functions.

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

1.solve many physical situations modelled by Bessel and Legendre equations.

2. competence in solving applied problems which may arise in various engineering approach.

3. learn various transformation technique and its applications.

4. understand basic concepts that will be required to start a research

**Mapping of Course Outcome(s):**

|  |  |
| --- | --- |
| PO/CO | Program Outcomes |
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| Course Outcomes | CO1 |  | S | L |  |  | M | L |
| CO2 |  | S | L |  |  | M | L |
| CO3 |  | S |  | S |  | M | M |
| CO4 |  | S | L | S |  | M |  |

L-Low, M-Medium, S-Strong

**Course Contents:**

**Unit 1: (12 L)**

General solution of Bessel equation, Recurrence relations, Orthogonal sets of Bessel functions, Modified Bessel functions, Applications.

**Unit 2: (8 L)**

 General solution of Legendre equation, Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomials, Application.

**Unit 3: (13 L)**

 Fourier Series, Generalized Fourier series, Fourier Cosine series, Fourier Sine series, Fourier integrals. Fourier transform.

**Unit 4: (20 L)**

Laplace transform, Hankel transform, Mellin transform.

**Unit 5: (7 L)**

Discrete transforms, Solution of differential equation by  transform methods.

**Textbook(s):**

T1: Integral Transforms for Engineers, L. C. Andrews, B. K. Shivamoggi: PHI Pvt. Ltd., 2007.

**Reference book(s)**:

 R1: The Transforms and Applications-Handbook, A.D. Poularikas: CRC Press, 1996.

 R2: Mathematical Methods In Science and Engineering, S. Selcuk Bayin, John Wiley & Sons, 2006.

**Lecture-wise plan**:

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objective** | **Topics to be covered** | **Reference (Ch./Sec./ Page Nos. of Text Book)** |
| 1 | Introduction | Review of series solution of ordinary differential equations, singularities of ODEs. |  |
| 2-12 | Bessel equation & function | General solution of Bessel equation, recurrence relations, orthogonal sets of Bessel functions, modified Bessel functions, applications. | T1: 1.4 p. 21-28 |
| 13-20 | Legendre equation | General solution of Legendre equation, Legendre polynomials, associated Legendre polynomials, Rodrigues formula, orthogonality of Legendre Polynomials, applications. | R2: 2.1-2.5, p. 9-36 |
| 21-29 | Fourier Integrals and Fourier Transforms | Fourier integral representations, Fourier transforms and its properties, Transformations of more complicated functions, Convolution integrals of Fourier | T1: 2.1-2.10, p. 37-97 |
| 30-33 | Applications involving Fourier Transform | T1: 3.1-3.2. p. 102-112. |
| 34-42 | The Laplace Transform, Inverse Laplace Transformation and Applications | Introduction, The transformations of some typical functions, Basic operational properties, Transformations of more complicated functions.  | T1: 4.1-4.4, p. 162-189. |
| 43-48 | The Inverse Laplace Transformation Complex Inversion Formula, Solution of Differential Equations | T1: 4.5-4.6, 5.1-5.4, p.-190-229 |
| 49-54 | The Mellin Transform, Hankel Transform | Evaluation of Mellin Transform, complex variable methods, evaluation of Hankel Transform, applications.  | T1: 6.1-6.5, 7.1-7.4, p. 245-273, 274-290. |
| 54-60 | Discrete Transforms | The *Z* Transform, applications | T1: 9.3-9.5, p. 321-333 |

**Evaluation Scheme**:

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| --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Remarks** |
| Internal I | 50 mins. | 25 | Closed Book |
| Mid term | 2 hrs. | 20 | Closed Book |
| Internal II | 50 mins. | 25 | Closed Book |
| Comprehensive Exam | 3 hrs. | 30 | Closed Book |

1. **Attendance Policy:** A Student must normally maintain a minimum of **75% attendance** in the course without which he/she shall be disqualified from appearing in the respective examination.
2. **Make-up Policy:** A student, who misses any component of evaluation for genuine reasons, must immediately approach the instructor with a request for make-up examination stating reasons. **The decision of the instructor in all matters of make-up shall be final.**
3. **Chamber Consultation Hours:** During the Chamber Consultation Hours, the students can consult the respective faculty in his/her chamber without prior appointment.