BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI - HYDERABAD CAMPUS

FIRST SEMESTER 2022 - 2023

(COURSE HANDOUT PART II)

Date: 07/08/2022

In addition to part-I (general handout for all courses in the time-table), this handout provides the specific details regarding the course.

**Course No.**: ME G535

**Course Title**: Advanced Engineering Mathematics

**Instructor(s)**: K. Ram Chandra Murthy, Bagadi Ramana Murthy

**Instructor-in-charge**: K. Ram Chandra Murthy

Description : Boundary value problems; wave equations; nonlinear partial differential equations; calculus of variations; Eigen value problems; iteration problems including forward and inverse iteration schemes – Graham Schmidt deflation – simultaneous iteration method – subspace iteration – Lanczo’s algorithm – estimation of core and time requirements

**1. Course Description:** Vectors, Matrices & Vector Calculus, Ordinary Differential Equations, Laplace Transform, Numerical Methods, Systems of Differential Equations, Partial Differential Equations, Probability & Statistics.

**2. Scope and Objective:** To equip the students of mechanical engineering with advanced mathematical tools and techniques. Students will be able to: Derive Mathematical models of physical systems, Solve differential equations using appropriate techniques, Apply MATLAB/ Appropriate computer tools to solve Engineering problems, Analyze variety of experimental and observational data by statistical methods

**3. Text Book(s):**

T1 Advanced Engineering Mathematics, 4th Edition, Dennis G. Zill and Warren S. Wright, Jones & Bartlett Learning, 2011.

**Reference Book(s) & other resources:**

R1 Advanced Engineering Mathematics, 2nd Edition, Michael Greenberg, 2002

R2 Advanced Engineering Mathematics, 9th Edition, Erwin Kreyszig, Willey-India Pvt. Ltd., 2011

**4. Course Plan**:

| **Lecture Nos.** | **Learning Objectives** | **Topics to be covered** | **Book** |
| --- | --- | --- | --- |
| 1-3 | Vectors, Matrices | Vectors in 2d, 3d, dot product, cross product, lines and planes in 3-space, Matrix Algebra, Systems of linear algebraic equations, Rank | T1 |
| 4-7 | Matrices, Vector Calculus | Determinants, Inverse of a matrix, Cramer’s rule, Eigen value problem, vector function, motion on a curve, curvature and components of acceleration, Partial derivatives, directional derivatives, tangent planes, normal lines, curl and divergence | T1 |
| 8-9 | Introduction to Differential Equations | Modelling using Ordinary Differential Equations | T1 |
| 10-12 | First Order Differential Equations: Analytical Methods | Solution curves, separable equations, linear equations, exact equations, solution by substitutions, linear and nonlinear models, modelling with system of first order differential equations. | T1 |
| 13-16 | Higher Order Differential Equations: Analytical Methods | Initial and boundary value problems, reduction of order, homogeneous linear equations with constant coefficients, undetermined coefficients, variation of parameters, Cauchy-Euler equations, Non-linear equations, linear models-IVPs, BVPs, Nonlinear models, systems of linear equations | T1 |
| 17-19 | Integral Transforms for the solution of ODEs | Definition of Laplace Transforms and Laplace Transforms of some standard functions, Translation Theorems | T1 |
| 20-22 | Integral Transforms | Additional Operational properties, systems of linear differential equations | T1 |
| 23-25 | Numerical methods | Euler method, Runge-Kutta methods: Solution using MATLAB / Excel | T1 |
| 26-28 | Systems of Differential Equations | System of linear differential Equations, theory of linear systems, homogeneous systems, solution by diagonalization, Non homogeneous linear systems | T1 |
| 29-32 | Orthogonal Functions and Fourier Series | Orthogonal Functions, Fourier Series, Fourier Cosine and sine series. Sturm-Liouville Problem | T1 |
| 33-38 | Boundary Value problems & Integral Transform Method | Separable PDEs, classical PDEs, BVPs, Heat Equation, Wave equation, Laplace Equation, Non Homogeneous BVP, Orthogonal Series Expansion, Error function, Applications of the Laplace transform | T1 |
| 39-40 | Miscellaneous Topics | To be announced | T1 |

**5. Evaluation Scheme**:

| Evaluation Component | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| --- | --- | --- | --- | --- |
| Mid-semester exam | 90 min | 20 | 05/11 11.00 -12.30PM | CB |
| Lab | --- | 25 | Continuous | OB |
| Project + Seminar | --- | 15 | To be announced in the class | OB |
| Comprehensive Exam | 180 min | 40 | 29/12 FN | CB |

**6. Chamber Consultation Hour**: To be announced in the class room.

**7. Notices**: All notices concerning this course shall be posted at **CMS**, the institute’s web based course management system.

**8. Make-up Policy**: Make-up for tests needs prior permission and strictly meant only for serious hospitalization cases with proper documents.

**9.** **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**

**ME G535**