Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2023 - 2024

Course Handout Part II

11-08-2023

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

Course No.	: MATH F312
Course Title	: Ordinary Differential Equations
Instructor-in-Charge	: Dr. K. Bhargav Kumar
Instructors	: K. Bhargav Kumar, Ankur Pandey, Shivangi Joshi

Scope and Objective of the Course:

Ordinary differential equations occur frequently as mathematical models in many branches of science, engineering and economics. For a mathematician confronted with such a model there are a number of issues to address and various approaches to choose from:

Is the problem well posed? Do you expect the differential equation to have a solution? If so, is there a unique solution satisfying the given initial or boundary conditions? Can you find an explicit analytical solution? This is only possible in rare circumstances.

Geometric or Qualitative Methods: These methods give insights into general and qualitative features of solutions of ordinary differential equations without solving them.

Stability and Dependence on Parameters: Having obtained a solution by any method, one would like to know how the solution changes if we change the initial data by a small amount (stability analysis) and if we change parameters in the differential equation (parameter dependence). This course helps deeper understanding of the complicated models that are there in the real life.

Textbooks:

1. **S. Ahmad & M.R.M. Rao**: Theory of Ordinary Differential Equations with Applications in Biology and Engineering, East West Press, 1999.

Reference books

1. Fred Brauer and John A. Nohel: The Qualitative Theory of Ordinary Differential Equations - An Introduction, Dover Publications, 1969.
2. Richard Bellman: Stability Theory of Differential Equations, Dover Publications, 2008.
3. E.A. Coddington and N. Levinson: Theory of Ordinary Differential Equations, Tata Mc Graw - Hill Publications, 1972.
4. Lawrence Perko: Differential Equations and Dynamical Systems, Springer, Third Edition, 2001.
5. Suman Kumar Tumuluri: A First Course in Ordinary Differential Equations, CRC press, 2021.

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1 - 2	To know the basic definitions and notations	Introduction and Overview of the Course, Notation and Definitions	Chapter 1 / Sections 1 - 2
3 - 6	To learn the existence and uniqueness theorems for scalar equations as well as general system of equations	Existence and Uniqueness of Solutions of Scalar Differential Equations	Chapter 1 / Section 3
7 - 9		Existence Theorems for System of Equations	Chapter 1 / Section 4
		Differential and Integral Inequalities (Self Study)	Chapter 1 / Section 5
10 -11	To understand the properties of linear systems	Introduction	Chapter 2 / Section 1
12 - 14		Properties of Linear Homogeneous Systems	Chapter 2 / Section 2
15 - 16		Inhomogeneous Linear Systems	Chapter 2 / Section 3
17 - 18	To understand the properties of higher order linear equations	Behavior of Solutions of *n*th order Linear Homogeneous Equations	Chapter 2 / Section 4
19 - 21		Asymptotic Behavior	Chapter 2 / Sections 5
22 - 24	To understand the concept of stability of a linear system	Introduction to Stability, Continuous Dependence and Stability Properties of Solutions	Chapter 3 / Sections 1 – 2
25 - 27	To learn the stability analysis of weakly non-linear and two dimensional systems	Linear Systems	Chapter 3 / Section 3
28 - 30		Weakly Nonlinear Systems	Chapter 3 / Sections 4
31 - 32		Two Dimensional Systems	Chapter 3 / Section 5
33 - 38	To study the Liapunov method for stability analysis	Introduction to Stability by Liapunov Second Method, Autonomous Systems, Non -	Chapter 5 / Sections 1 - 3

		Autonomous Systems	
39 - 40	To understand the qualitative behavior of solutions of second order equations	Second Order Differential Equations, Boundedness of Solutions, Oscillatory Equations (Self Study), Classical Equations (Self Study)	Chapter 4 / Sections 1 - 5

Evaluation Scheme:

Sl. No.	Evaluation Component	Duration	Weightage (%)	Date & Time	Nature of Component
1	Quiz-1		10	Will be announced through CMS	Open book
2	Assignment		5	Will be announced through CMS	Open book
3	Mid Sem Exam	1.5 Hour	30	11/10 - 4.00 - 5.30PM	Closed book
4	Quiz-2		10	Will be announced through CMS	Closed book
5	Assignment		5	Will be announced through CMS	Open book
6	Comprehensive Exam	3 Hours	40	13/12 AN	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 quizzes and project.

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

Notices: The notices concerning this course will be displayed in CMS 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