



SUMMER TERM 2022

Course Handout Part II

28.05.2022

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 : **Jagan Mohan Jonnalagadda**
Instructors : Jagan Mohan Jonnalagadda

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.

Course Plan:

| Lecture No. | Learning objectives | Topics to be covered | Chapter in the Text Book |
|-------------|-----------------------------------|--|--------------------------|
| 1 - 2 | To know the basic definitions and | Introduction and Overview of the Course, | Chapter 1 / |



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|---------|--|---|----------------------------|
| | notations | Notation and Definitions | 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 - Autonomous Systems | Chapter 5 / Sections 1 - 3 |
| 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:



| Component | Duration | Weightage (%) | Date & Time | Nature of Component |
|---------------------------|------------------------------|---------------|--------------------------|---------------------|
| Quiz - 1 | To be announced in the class | 10 | --- | Open book |
| Assignment | To be announced in the class | 10 | --- | Open book |
| Mid Semester Examination | 90 Minutes | 30 | 24/06 9.30 - 11.00 AM | Closed book |
| Quiz - 2 | To be announced in the class | 10 | --- | Open Book |
| Comprehensive Examination | 180 Minutes | 40 | 21/07 FN | Closed Book |

Chamber Consultation Hour: To be announced in the class.

Notices: All notices regarding MATH F312 will be displayed in CMS.

Make-up Policy: Make up of other evaluation components will be granted only in genuine cases. Permission must be taken in advance except in extreme cases.

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

