Department of Mathematics NIT Jamshedpur, Jamshedpur-831014

Autumn Semester 2019-2020

SEMESTER-I		**Course Handout**	**Date: 31/07/2019**
Course code	**:**	**MA3104**	
Course title	**:**	**Ordinary Differential EQuations**	**Credit-4 (4-0-0)**
Instructor In-charge	**:**	**Dr. Raj Nandkeolyar**	

Course Description

Scope:

The course is aimed at providing the students with the knowledge of fundamentals and advanced topics in ordinary differential equations which will help them in having in-depth theoretical knowledge of the subject.

Course Outcomes:

Upon completion of the course students will be able to:

1. discuss the existence and uniqueness of solutions of given initial value problems.

2. identify an IVP as ill-posed or well system.

3. draw the phase portraits of system of differential equations.

4. find the Green's function solution of an IVP.

5. discuss the stability of initial value problems.

Syllabus:

Existence and uniqueness of solution of differential equations.

Linear systems of differential equations, eigenvalue and eigenvector, fundamental matrix, solution of system of differential equations.

Green's function, Sturm-Liouville boundary value problem, Dirac-Delta function.

Lyapunov stability, Poincare-Bendixson theory: Autonomous systems, Poincare-Bendixson theorem, stability of solution, rotation, point, foci, nodes and saddle point.

References Books:

1. Differential equations and their Applications, Martin Barun, Springer
2. Elementary Differential Equations and Boundary Value Problems, William E. Boyce and Richard C. DiPrima, Wiley (**BDP**)

Lecture Plan:

Sl. No.	Topic	Suggested Book	No. Of Lectures
1.	Review of Basic Concepts: Introduction to ODE, types of ODE, order and degree, first order and second order differential equations.	**GFS**	3
2.	Important results on second order differential equations, Wronskian	**GFS**	3
3.	Qualitative properties of solutions, the Sturm Separation theorem	**GFS**	3
4.	Existence and Uniqueness of Solutions: Review of some basic definitions and results from real analysis	**SLR**	3
5.	The existence and uniqueness theorem (Picard's theorem)	**SLR**	3
6.	Condition for the existence of solution	**SLR**	01
7.	Continuation of solution	**SLR**	02
8.	Well-posed and ill-posed problems, stability	**SLR**	02
9.	Dependence of solution on initial condition and function	**SLR**	03
10.	Linear system of first order differential equations	**BDP**	02
11.	Liner system of first order homogeneous equations, Phase portraits, direction field, eigen value, eigen vectors, Fundamental matrix	**BDP**	06
12.	Solution of linear system of differential equations	**BDP**	03
13.	Green's function, Sturm-Liouville boundary value problems, Dirac-Delta function	**BDP**	05
14.	Lyapunov stability, Poincare-Bendixson theory: Autonomous systems, Poincare-Bendixson theorem, stability of solutions, rotation point, foci, nodes and saddle point.	**BDP**	08

Suggested readings:

1. Differential Equations with Applications and Historical Notes, G. F. Simmons, McGraw Hill Education (**GFS**)
2. Differential Equation, Shepley L. Ross, Wiley (**SLR**).

Evaluation Scheme:

Evaluation Component	Duration	Weightage	Date and Time	
Mid Sem Exam	2 hour	30	As per Academic Calendar	
End Sem. Exam	3 hour	50	As per Academic Calendar	
Internal Assessment	N/A	20	Quizzes (one before mid-semester and one before end semester exams) MCQs with -ve marking	10
			Assignment	05
			Teachers assessment	05

Notes:

1. Assignments will be given on a regular basis during the lecture class and will be asked to submit on a surprise basis. Some assignments will also be uploaded on the Course Website
2. All notices regarding the course will be displayed on the Notice Board of Department of Mathematics.
3. Students may discuss their doubts with the faculty during **3:00-5:00 PM** on every **Friday**.