Course Title: Numerical analysis of Ordinary Differential Equations

Course Description: Theory and implementation of numerical methods for initial and boundary value problems in ordinary differential equations. One-step, linear multi-step, Runge-Kutta, and extrapolation methods; convergence, stability, error estimates, and practical implementation, Study and analysis of shooting, finite difference and projection methods for boundary value problems for ordinary differential equations.

Prerequisite: Graduate standing

Textbook: Numerical Methods for Ordinary Differential Equations, Butcher, 3rd ed, 2016

References: Numerical solution of ODEs, Suli, 2022
Numerical methods for ODEs, Griffiths & Higham, 2010
Numerical solution of ODEs, Atkinson, 2009

Learning Outcomes:
1. Define the fundamental concepts of numerical methods for ODEs.
2. Explain the merits and limitations of each numerical method.
3. Use numerical methods for solving ordinary differential equations.
4. Analyze numerical methods based on their accuracy and stability.
5. Develop algorithms that describe the steps of numerical methods.
6. Implement algorithms for solving ODEs using suitable software.

Assessment: Assignments 30%, Project 10%, Midterm Exam 25%, Final Exam 35%

WK	Date	Topics
1	Jan 14-18	Preliminaries and IVP
2	Jan 21-25	One-step methods
3	Jan 28-Feb01	
4	Feb 04-08	Runge-Kutta methods
5	Feb 11-15	
6	Feb 18-20	
	Foundation Day	
7	Feb 25-29	Linear multistep methods
8	Mar 03-07	
9	Mar 10-14	
10	Mar 17-21	Stiff problems
11	Mar 24-28	
	Eid break	
12	Apr 21-25	Boundary value problem methods
13	Apr 28-May 02	
14	May 05-09	Project presentations
15	May 12-16	Review