

King Fahd University of Petroleum & Minerals

Department of Mathematics

Instructor: Dr. Abdullah Shah (abdullah.shah.1@kfupm.edu.sa) Office: Building# 5, Room# 419.

Course Number	MATH 576, Semester 252
Course Title	Applied Numerical Methods I

Course Main Objectives

1. Introduce the fundamental concepts in the numerical solution to differential equations.
2. Discuss various numerical methods.
3. Implement numerical methods to specific applications.

Course Learning Outcomes

By the end of this course, students will be able to:

4. Apply numerical methods for solving differential equations.
5. Describe mathematical algorithms for solving differential equations.
6. Analyze numerical solutions based on accuracy and stability.
7. Implement the algorithms of the numerical methods using suitable software.
8. Work individually or within a team.

Catalog Course Description

This course introduces implementable numerical methods for solving initial value problems, stability and convergence. One-step, multistep, and Runge-Kutta methods. Shooting and bisection methods. Finite difference methods and applications to equilibrium and non-equilibrium models including steady-state, heat, and wave problems.

Pre-Requisites

Graduate Standing

Textbook

Numerical Analysis: Mathematics of Scientific Computing by Kincaid and Cheney (Third Edition), Brooks/Cole Publishing (2002).

References

1. Numerical Methods for Ordinary Differential Equations (Third Edition) by John C. Butcher (2014).
2. Introductory Finite Difference for PDEs by Causon, D. M., and C. G. Mingham. Bookboon (2010).
3. Applied Numerical Methods with MATLAB: For Engineers and Scientists (Fourth Edition) by Steven, C. C. (2018).

Assessment

- Project: 20%
- Assignments: 25%
- Major Exam: 25%
- Final Exam (Comprehensive): 30%

Office Hours

Sunday and Tuesday 14:30 pm – 15:30 pm (or by appointment).

Course Outline

Topics and associated number of lectures:

Part	Topics	Details	Lectures
1	Introduction	- Introduction to differential equations - Taylor's series method	3
2	Initial value problems	- Euler's methods - Runge-Kutta methods - Stiff differential equations - Multistep methods - Adams multistep methods - Convergence and stability	13
3	Steady-State and Time Dependent Problems	- Shooting method - Bisection method - Finite difference methods for - Elliptic equation in one and two dimensions - Diffusion (including Heat) equation - Wave equation	14

Total number of lectures: **30**