Course Specification

(Postgraduate)

Course Title: **Numerical Solution of Ordinary Differential Equations**
Course Code:**MATH670**
Program: **Master Program in Mathematics**
Department: **Mathematics**
College: **Science**
Institution: **University of Tabuk, KSA**
Version: **2**
Last Revision Date:**1/12/1443 H**

Table of Contents

A. General information about the course:

Course Identification	
1. Credit hours:	3 H
2. Course type	
a.	University ☐ College ☐ Department ☒Track☐ Others☐
b.	Required ☐ Elective☒
3. Level/year at which this course is offered: Level-2 or higher	
4. Course general Description In this course, we will study some basic fundamentals of Numerical Solutions of Ordinary Differential Equations. Some important properties, theorems, problems, and applications will be also discussed.	
5. Pre-requirements for this course (if any): None	
6. Co- requirements for this course (if any): None	

7. Course Main Objective(s)

Upon completion of the course students will be able to:

1. Understanding of numerical solutions of ordinary differential equations through various numerical techniques.
2. Acquire knowledge of solving initial and boundary value problems of first and second orders.
3. Study the finite difference methods to solving second-order boundary value problems with boundary conditions at infinity.
4. Study some recent methods, such as Homotopy-Perturbation and Adomian's method for solving initial and boundary value problems.
5. Acquire knowledge of solving difference equations and use it in the stability analysis.
6. Know that the numerical methods have been recently implemented in many applications.

Acquire cognitive skills through thinking and problem solving.

1. Teaching mode

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	45	100 %
2.	E-learning		
3.	Hybrid • Traditional classroom • E-learning		
4.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours

1.	Lectures	3 H /week
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	
5.	Others (specify)	
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding The students will be able to:			
1.1	Demonstrate advanced techniques of numerical methods	K1	Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study, problem solving session	Exams, Quizzes, Research project, presentation, interactive discussion and participation, Surveys.
1.2	Describe importance of different numerical techniques in solving ODEs in different fields	K2		
2.0	Skills The students will be able to:			
2.1	Apply numerical techniques in solving ordinary differential equations.	S1	Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study, problem solving session	Exams, Quizzes, Home works, Assignments, Research project, presentation, interactive discussion and participation, Surveys.
2.2	Analyze numerical errors and stability of solutions of ODE problems.	S2		
2.3	Use computational algorithms to solve ODEs.	S3		
2.4	Communicate numerical methods ideas clearly.	S4		
3.0	Values, autonomy, and responsibility The students will be able to:			
3.1	Demonstrate originality and self-learning.	V2	Lectures, Group works, Presentations, Classroom discussion, Seminar, Case study,	Research project, Home works, Assignments,
3.2	Demonstrate ability to work effectively and respectfully	V2		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	individually or within a group.		problem solving session	presentation, interactive discussion and participation, Surveys.

C. Course Content

No	List of Topics	Contact Hours
1	Introduction to the methods of numerical and analytical methods	3
2	Euler's method for linear and nonlinear initial value problems	3
3	Euler's method for systems of first and second order ODEs	3
4	Runge-Kutta methods for first-order nonlinear initial value problem	3
5	Runge-Kutta methods for second-order linear and nonlinear initial value problem	3
6	Stability of Euler's and Runge-Kutta methods	3
7	**Mid-Exam #**	---
7	Homotopy perturbation method	3
8	Adomian Decomposition method	3
9	Solutions of difference equations and its stability	3
10	Finite difference methods for solving two-point boundary value problems	3
11	Shooting methods for solving two-point boundary value problems	3
12	Numerical Solution of two-point boundary value problems in unbounded domains,	3
13	Numerical Solution of two-point boundary value problems in unbounded domains, i.e., with infinity boundary conditions	3
14	Recent numerical methods for initial value problems.	3
15	Recent numerical methods for boundary value problems.	3
16+17	**Revision & Final Exam**	
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Home works and Assignments	Weekly basis	20%
2.	Mid-term exam	7th week	25%
3.	Presentation and discussion	During the Semester	15%
4.	Final Exam	At End of Semester	40 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Bruce Alan Wade ،Feliz Minhós ،Jesus Martin-Vaquero ،Juan L. G. Guirao , Analytical and Numerical Methods for Differential Equations and Applications ., Frontiers Media SA. (2021)
Supportive References	Steven C. Capra, Applied numerical methods with MATLAB for scientist and engineers, fourth edition (2017)
Electronic Materials	Digital Saudi Arabia
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture Room with capacity of 30 students and equipped with White Board, Library
Technology equipment (projector, smart board, software)	Overhead projector and internet connection.
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct and Indirect
Effectiveness of students assessment	Teacher	Direct
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	Teacher, Quality Committee	Direct and Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods(Direct, Indirect)

G. Specification Approval Data

Council / Committee	**Approval by the Department Council**
Reference No.	DEPARTMENT COUNCIL NO (26)
Date	**11/9/1444 H**