2023
TPG-153

Course Specification

(Postgraduate)

Course Title: Numerical Solution of Ordinary Differential Equations
Course Code: MATH 627
Program: MSC APPLIED MATHEMATICS
Department: MATHEMATICS
College: COLLEGE OF SCIENCE AND HUMANITIES
Institution: PRINCE SATTAM BIN ABDULAZIZ UNIVERSITY
Version: 1
Last Revision Date: *Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (2)				
2. Course type				
A.	☐University	☐College	☒ Department	☐Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: (4)				
4. Course general Description:				
Introduction: Taylor, Euler, and modified Euler methods. Linear Multistep Methods: Order, consistency, zero-stability, convergence, Bounds for local and global truncation error, Absolute and relative stability, Skob predictor-corrector methods, Milne's error estimate. Runge-Kutta Methods: Derivation of classical RK methods of 2nd order, stability of RK methods. Boundary value problems: Finite difference methods, shooting methods, collocation method and variational methods.				
5. Pre-requirements for this course (if any)**:**				
Nil				
6. Pre-requirements for this course (if any)**:**				
Nil				
7. Course Main Objective(s):				
At the end of the course, the students will : The student shall: • Be aware of various methods such as Taylor, Euler and Modified Euler methods to solve ODE problems • Be able to compute bounds for local and global truncation error • Understand the concept of absolute and relative stability • Be thorough with various numerical methods such as Skob predictor-corrector methods, Milne's error estimate. Runge-Kutta Methods • Be able to Derive classical RK methods of 2nd order, and ascertain their stability • Be able to solve boundary value problems				

- Be conversant with finite difference method in solving mathematical problems
- Able to apply various techniques such as shooting methods, collocation method and variational methods in finding solution of ODEs
- Able to make presentation to a given topic
- Pursue research in the arena of ODE and its applications

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	3 hours a week	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning	**E-learning**: In case of suspension of regular classes due to any unforeseen eventualities	Not applicable
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	15
5.	**Others (Office Hours)……**	15
	Total	60

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**			
1.1	**Describe the theories and underlying principles of single-step and multi-step numerical methods for solving ODEs**	**K1, K2**	1. Class Room Lectures 2. Interactive sessions 3.Exclusive Office Hours for clearing doubts in small groups	1. Two Internal Exams 2.At least two Quizes 3.End Semester Exam
1.2	**Recall the error bounds for the**	**K2**		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	numerical solutions of ODEs			
1.3	**Demonstrate a thorough understanding of the fundamentals of numerical techniques for solving boundary value problems.**	**K1, K3**		
2.0	**Skills**			
2.1	**Apply various numerical techniques to solve real-world mathematical models based on ODEs and BVPs**	**S1**	Application oriented exercises during tutorial session.	1.Homework 2.Assignments 3.Quiz 4.Mid Term and Final Exam
2.2	**Efficiently use numerical methods to find solutions of real-world mathematical models based on BVPs**	**S1**		
3.0	**Values, autonomy, and responsibility**			
3.1	**Work effectively in groups**	**V1**	Group Discussion during lectures Brain storming	1. Group Assignment 2.Presentation/ seminar

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction to single-step methods**	**3**
2.	**Taylor, Euler, and modified Euler methods**	**6**
3.	**Linear Multistep Methods**	**6**
4.	**Error Estimation**	**3**
5.	**Skob predictor-corrector methods and Milne's error estimate**	**6**
6.	**Runge-Kutta Methods**	**6**
7.	**Numerical solution of boundary value problems**	**9**
8.	**Applications**	**6**
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid Term Exam I	6	15%
2.	Quiz (At least 2 quiz)	4 & 10	10%
3.	Mid Term Exam II	13	15%
4.	Continuous Assessment – Homework, Assignment, Attendance etc.	--	10%
5.	End Semester Exam	17	50%

*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	**B. S. Grewal , NUMERICAL METHODS IN ENGINEERING AND SCIENCE C, C++, AND MATLAB®, MERCURY LEARNING AND INFORMATION, 2019.**
Supportive References	**S. Chapra, Numerical Methods for Engineers, McGraw-Hill Education, 2015.**
Electronic Materials	**Saudi Digital Library**
Other Learning Materials	**https://ocw.mit.edu/**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms with Smartboards with seating facilities for at least 30 students
Technology equipment (projector, smart board, software)	• Smartboard, Internet Connection for Blackboard
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students Peer Review/Classroom Observation**	**Indirect**

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Students assessment	Independent member teaching staff	Check marking by an independent member teaching staff of samples of student work.
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	CLO /PLO Assessment Committee	CLO PLO Attainment Evaluation
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	