Course Specification
(Bachelor)

Course Title:	**Numerical Analysis (1)**
Course Code:	**MAT 1341**
Program:	**Bachelor of Science in Applied Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (2 Lectures, 2 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 5/ Year 3					
4. Course general Description:					
This course is an introduction to numerical analysis. It presents the fundamental concepts and methods, and basic numerical analysis tools in the field. This course emphasizes not only numerical methods, but also the analysis of their convergence and convergence rates. It develops the basic understanding of numerical algorithms and skills **as well to implement algorithms to solve mathematical problems on the computer.**					
5. Pre-requirements for this course (if any)**:**					
MAT 1231 Introduction to Differential Equations and CS 1249					
6. Co-requisites for this course (if any)**:**					
None.					
7. Course Main Objective(s):					
The Numerical Analysis (1) is crucial course in the program as it connects theoretical mathematics with practical computation. It equips students with skills to solve complex problems using numerical methods, emphasizing error analysis and algorithm convergence. By integrating MATLAB for hands-on practice, the course prepares students for real-world applications in fields like engineering, finance, and data science.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**90**	**100%**
2	E-learning	**0**	**0%**
3	Hybrid • Traditional classroom • E-learning	**0**	**0%**
4	Distance learning	**0**	**0%**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30

2.	**Laboratory/Studio**	30
3.	**Field**	0
4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		90

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	Recognize theories and concepts used in Numerical Analysis.	K2	3 lecture hours\week 2 lab hour\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
1.2	Identify the concept of finite difference, approximation by iteration, numerical differentiation and integration, error analysis.	K1	3 lecture hours\week 2 lab hour\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
2.0	**Skills**			
2.1	Apply elementary numerical techniques and rules, including Floating Point Representation, interpolation, Trapezoidal and Simpson Rules, Gaussian Quadrature, Newton Divided Difference, Euler method, Runge-Kutta methods, and matrix algebra tools to solve given real-life problems.	S1, S2	Self-study Real-life problems	Participations Short Quizzes
2.2	Write efficient, well-documented Matlab code and present numerical results in an informative way.	S4	Self-study Real-life problems	Participations Short Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	Implement some numerical methods using Matlab software and CAS.	S5	Self-study Real-life problems	Participations Short Quizzes
2.4	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	S3	Self-study Real-life problems	Participations Short Quizzes
3.0	**Values, autonomy, and responsibility**			
3.1	work individually and in group	V1, V3	Class discussion and team work	Participation
3.2	formulate a variety of alternative numerical methods to estimate the solutions of ODEs according to their setting.	V1, V2	Class discussion and problem solving.	Homework and Mini-projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to data representation:** Numerical Errors; Floating Point Representation; Round-off; Significant Digit; Error Propagation.	**15**
2.	**Root Finding:** Bisection Method, Newton's Method, Secant Method, Fixed Point Iterations.	**15**
3.	**Interpolation and Approximation:** Taylor polynomials, Approximation of order n, Polynomial Error, Linear and Quadratic Interpolation, Lagrange Interpolation, Newton Divided Difference Method, Error Evaluation.	**15**
4.	**Numerical Integration and Differentiation:** The Trapezoidal and Simpson Rules, Gaussian Quadrature, Numerical Differentiation.	**15**
5.	**Numerical Solution of Linear Systems:** Gauss Elimination, LU and Cholesky Decompositions, Iterative Methods: Jacobi and Gauss-Siedel Methods, Error Analysis.	**20**

6.	**Numerical solution of differential equations:** Euler method, Runge-Kutta methods. Error and convergence analysis.	**15**
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini-projects	During the term	10%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15	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	*Elementary Numerical Analysis*, **3rdEdition, Kendall Atkinson; Weimin Han, 2004. (Main Reference)**
Supportive References	*An Introduction to Numerical methods and Analysis*, **James F. Epperson, Wiley, 2002.**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting the study of limits, continuity, and differentiation. • **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	**None**	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**