Course Specification
(Bachelor)

Course Title:	**Numerical Methods**
Course Code:	**MAT 1346**
Program:	**Bachelor of Science in Civil Engineering**
Department:	**Civil Engineering**
College:	**Engineering**
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:					
3 (3 Lectures, 0 Lab, 1 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 6/ Year 3					
4. Course general Description:					
Introduction to numerical methods for students in science and engineering, Topics include floating-point computation, systems of linear equations, approximation of functions and integrals, the single nonlinear equation, and the numerical solution of ordinary differential equations. Applications in science and engineering: include some programming as well as the use of high quality mathematical library routines.					
5. Pre-requirements for this course (if any):					
MAT 1236 and CS 1108					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
The course is intended to introduce the following important aspects of Numerical Methods in Engineering: 1. Demonstrate basic numerical methods for solution of root finding, linear and nonlinear systems, curve fitting, differentiation and integration; 2. Estimate numerical errors in application of numerical methods; 3. Demonstrate basic programming techniques using MATLAB; 4. Present numerical results in appropriate fashion.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	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	45
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	15
5.	Others (specify)	0
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	Recognize theories and concepts used in Numerical Analysis.	K2	4 lecture hours\week 2 tutorial hours\week Self-study	Direct: Regular Exams Assignments Short Quizzes
1.2	Identify the concept of finite difference, approximation by iteration, numerical differentiation and integration, error analysis.	K1	4 lecture hours\week 2 tutorial hours\week Self-study	Direct: 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	Direct: 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	Direct: Participations Short Quizzes
2.3	Implement some numerical methods using Matlab software and CAS.	S4	Self-study Real-life problems	Direct: 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	Direct: Participations Short Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually and with responsibility	V1, V3	Class discussion and team work	Direct: Participation

C. Course Content

No	List of Topics	Contact Hours
1.	**Roundoff and Truncation Errors.**	**10**
2.	**Root Finding: Bracketing and Open Methods.**	**10**
3.	**Linear Algebraic Equations: Gauss Elimination; LU Method; and Iterative Methods.**	**10**
4.	**Curve Fitting: Least-Squares Regression; Interpolation.**	**10**
5.	**Numerical Differentiation and Integration.**	**10**
6.	**Initial-Value Problems: Euler's methods, Runge-Kutta methods, and Multistep Methods.**	**10**
Total		**60**

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 6-7	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15-16	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	**Chapra, S.C., Raymond P. Canale (2015).** *Numerical Methods for Engineers, 7th Edition, McGraw Hill.*
Supportive References	1. **Chapra, S.C., (2005).** *Applied Numerical Methods with Matlab for Engineers and Scientists, 3rd Ed., McGraw Hill* 2. **S. Rao, S., (2002).** *Applied Numerical Methods for Engineers and Scientists. TA345.R36*
Electronic Materials	**None**
Other Learning Materials	**None**

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)