هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	Numerical Analysis (1)
Course Code:	Math 352
Program:	Bachelor of Science in Mathematics
Department:	Department of Mathematics
College:	College of Science
Institution:	King Saud University
Version:	*Course Specification Version Number*
Last Revision Date:	20/8/2025

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A. General information about the course:

1. Course Identification

1. Credit hours: (4 (3+1+0))					
2. Course type					
A.	☒ University	☐College	☐Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 7/Third year)					
4. Course general Description:					
Numerical Methods for Solving Nonlinear Equations: Bisection method, fixed point method, Newton's method, secant method, multiple roots, modified Newton's method, rate of convergence (error analysis), Newton's method for solving nonlinear systems. Solving Systems of Linear Equations: Direct methods: Gaussian elimination, Gaussian elimination with partial pivoting, LU-decomposition. Iterative methods: Jacobi method, Gauss-Seidel method. Error analysis for solving Linear system. Interpolation and Polynomial Approximations Lagrange interpolation formula, divided differences, Newton's interpolation formula, error in polynomial interpolation, interpolation using linear splines. Numerical Differentiation and Integration First derivative: two-point formulas (forward and backward) and three-point formulas (forward, central and backward). Second derivative: the central method. Trapezoidal, Simpson's rules, and the error bounds.					
5. Pre-requirements for this course (if any):					
MATH 246					
6. Co-requisites for this course (if any):					
7. Course Main Objective(s):					
The main purpose for this course is to introduce the following concepts: 1. Learn the concepts of numerical methods in solving mathematical problems numerically 2. Analyze the error for these methods 3. Analyze the convergence for these methods					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	30
5.	**Others (specify)**	
Total		75

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**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.1	The student will be able to explain fundamental concepts of numerical analysis such as types of errors, error analysis, rate of convergence, direct methods, indirect methods, approximated solutions, exact solutions, numerical differentiation, Numerical integration, interpolation, etc….	K1	● At the beginning of studying each topic some examples will be laid out and discussed with the students encouraging them to discover the relevant concepts. ● At the beginning of each lecture a discussion is conducted with the students about what have been done in the previous lecture in order to establish a link with the current lecture. ● Pointing out the main goals of the course and connecting previous knowledge to the lectures material.	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.2	The student will be able to describe procedures of different numerical methods for solving nonlinear equations, direct methods and iterative methods to solve linear systems, approximating functions and data using polynomial interpolation, trapezoidal and Simpson's rules to approximate definite integrals, difference formulas to approximate derivatives, etc….	K2	● At the beginning of studying each topic some examples will be laid out and discussed with the students encouraging them to discover the relevant concepts. ● At the beginning of each lecture a discussion is conducted with the students about what have been done in the previous lecture in order to establish a link with the current lecture. ● Pointing out the main goals of the course and connecting previous knowledge to the lectures material.	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials
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2.0	**Skills**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	The student will be able to apply different numerical methods for solving nonlinear equations, direct methods, and iterative methods to solve linear systems, approximating functions and data using polynomial interpolation, trapezoidal and Simpson's rules to approximate definite integrals, difference formulas to approximate derivatives, error analysis etc….	S1	● Consulting instructors through office hours. ● Activity within tutorial sessions. ● Homework assignments and mini-projects. ● Orienting the students to how to think about formulating mathematical models through discussions during the lectures, and learning them how to come up with original solutions to problems.	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	The student will be able to evaluate these numerical techniques, solve complex problems and interpret solutions.	S2	● Consulting instructors through office hours. ● Activity within tutorial sessions. ● Homework assignments and mini-projects. ● Orienting the students to how to think about formulating mathematical models through discussions during the lectures, and learning them how to come up with original solutions to problems.	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	The student will be able to use mathematical techniques for solving problems in mathematics and engineering problems	S4	● Consulting instructors through office hours. ● Activity within tutorial sessions. ● Homework assignments and mini-projects. ● Orienting the students to how to think about formulating mathematical models through discussions during the lectures, and learning them how to come up with original solutions to problems.	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials.
3.0	**Values, autonomy, and responsibility**			
3.1	The graduates will be able to commit to lifelong learning through self-improvement and self-evaluation.	V2	● Activity within tutorial sessions. ● Homework assignments and mini-projects.	Evaluation of various activities during lectures and tutorials.
3.2				
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C. Course Content

No	List of Topics	Contact Hours
1.	Numerical Methods for Solving Nonlinear Equations: Bisection method, fixed point method, Newton's method, secant method, multiple roots, modified Newton's method, rate of convergence (error analysis), Newton's method for solving nonlinear systems.	20

2.	Solving Systems of Linear Equations: Direct methods: Gaussian elimination, Gaussian elimination with partial pivoting, LU-decomposition. Iterative methods: Jacobi method, Gauss-Seidel method. Error analysis for solving Linear system.	20
3	Interpolation and Polynomial Approximations. Lagrange interpolation formula, divided differences, Newton's interpolation formula, error in polynomial interpolation, interpolation using linear splines.	15
4	Numerical Differentiation and Integration First derivative: two-point formulas (forward and backward) and three-point formulas (forward, central and backward). Second derivative: the central method. Trapezoidal, Simpson's rules, and the error bounds.	20
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignment	Approx. 4th	**10%**
2.	Mid-term examination	Approx. 6th and 12th	**40%**
3.	Tutorial Mark	Approx. 8th	**10%**
4.	Final examination	By the end	**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	Numerical Analysis Numerical Analysis, by Richard L. Burden and J. Douglass Faires, Brooks/Cole, fifth edition.
Supportive References	An Introduction to Numerical linear Algebra using MATLAB, by Rizwan Butt, Heldermann Verlag, Germany. Elementary Numerical Analysis, An Algorithmic Approach, D. Cont and C. de-Boor, McGraw-Hill Book Company, N.Y. 1980.

Electronic Materials	Web sites involving computational mathematics.
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	A classroom which accommodates 25 students
Technology equipment (projector, smart board, software)	Smart board
Other equipment (depending on the nature of the specialty)	Textbooks in the university book stores. Book references in the university central libraries.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	students	survey
Effectiveness of Students assessment	Program Leaders	Direct
Quality of learning resources	students	survey
The extent to which CLOs have been achieved	Faculty	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	