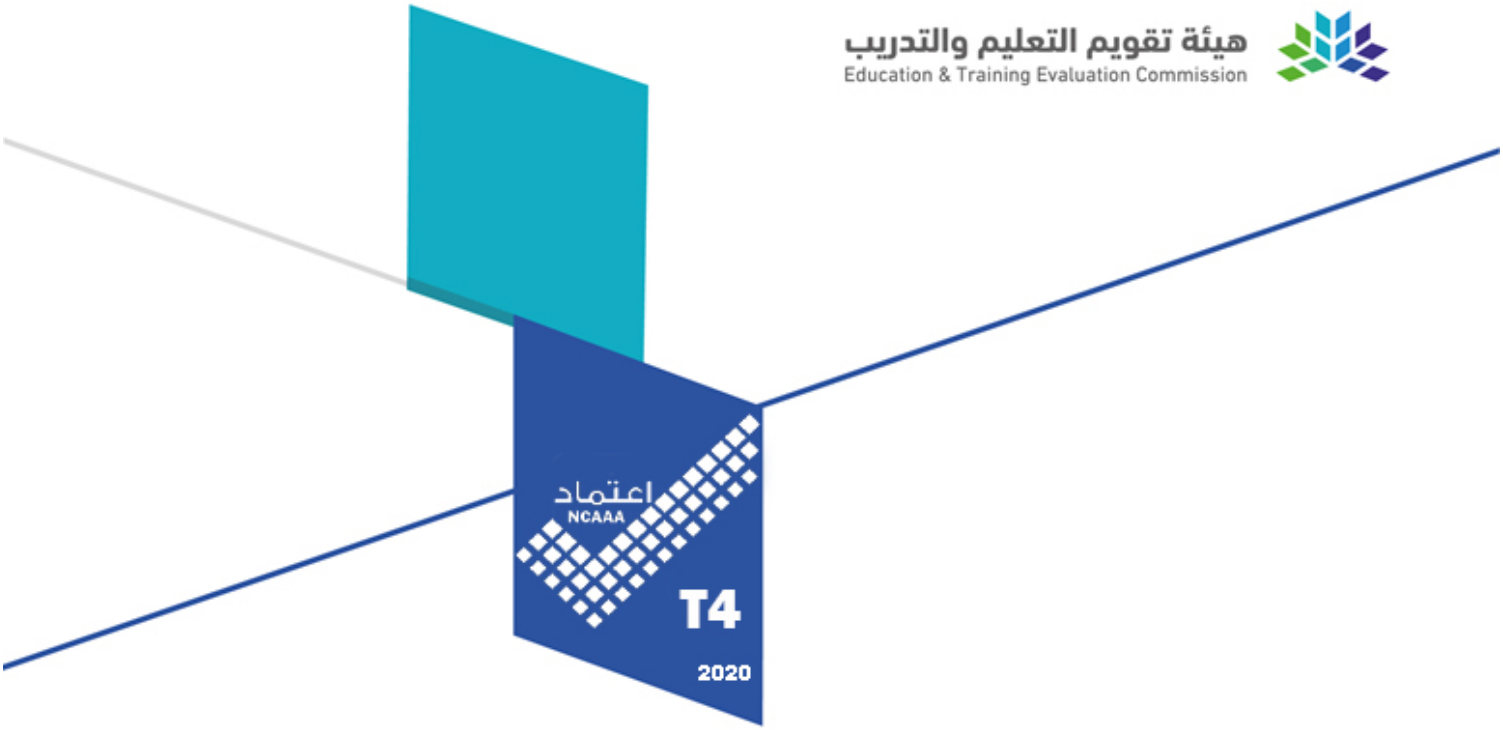
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

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

Table of Contents

A. Course Identification

1. Credit hours: 4 (3+1+0)
2. Course type **a.** University [√] College [ ] Department [ ] Others [ ] **b.** Required [√] Elective [ ]
3. Level/year at which this course is offered: Level 7/Third year
4. Pre-requisites for this course (if any)**:** MATH 246
5. Co-requisites for this course (if any)**:**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	75	100%
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	45
2	**Laboratory/Studio**	0
3	**Tutorial**	30
4	**Others** (specify)	0
	Total	75

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

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. Write computer algorithms to implement these methods for solving certain mathematical problems using computer.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding:** The student will be able to	
1.1	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
1.2	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
2	**Skills :** The student will be able to	
2.1	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
2.2	Evaluate these numerical techniques, solve complex problems and interpret solutions.	S2

CLOs		Aligned PLOs
2.3	Use mathematical techniques and software for solving problems in mathematics and engeneering problems	S4
3	**Values:** The student will be able to	
3.1	Commit to lifelong learning through self-evaluation and self-improvement.	V2

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.	12
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.	12
3	Interpolation and Polynomial Approximations. Lagrange interpolation formula, divided differences, Newton's interpolation formula, error in polynomial interpolation, interpolation using linear splines.	9
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.	12
Total		45

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	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….	● 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	● Quizzes in lectures and tutorial classes. ● Two mid-term exams. ●Final exam. ● Evaluation of various activities during lectures and tutorials
1.2	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,		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	trapezoidal and Simpson's rules to approximate definite integrals, difference formulas to approximate derivatives, etc….	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.	
2.0	**Skills**		
2.1	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….	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.
2.2	Evaluate these numerical techniques, solve complex problems and interpret solutions.		
2.3	Use mathematical techniques and software for solving problems in mathematics and engeneering problems		
3.0	**Values**		
3.1	Commit to lifelong learning through self-evaluation and self-improvement.	Activity within tutorial sessions.	Evaluation of various activities during lectures and tutorials.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quizzes	4rd and 11th	20%
2	Mid-term examination	Approx. 6th	30%
3	Tutorial Mark	Approx. 8th	10%
4	Final examination	By the end	40%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice : 4 office hours are made available for students for consulting the teacher and for academic advice.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• Numerical Analysis Numerical Analysis, by Richard L. Burden and J. Douglass Faires, Brooks/Cole, fifth edition. • التحليل العددي د. عيسى السعيد. طباعة: جامعة الملك سعود.
Essential References Materials	• 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	• Software such as: Basic, Fortran, C. Maple, Mathematica and MATLAB. • Web sites involving computational mathematics.
Other Learning Materials	• In order to do the computer assignments one of the following computer software must be available for the student • Basic, Fortran, Maple, Mathematica, MATLAB, or C++

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	A classroom which accommodates 25 students equipped with usual blackboard and smart board.
Technology Resources (AV, data show, Smart Board, software, etc.)	Computer lab equipped with relevant software.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Securing the textbooks in the university book stores. Securing the book references in the university central libraries.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course evaluation by students.	students	survey
Students-faculty meetings.	Students- Faculty	Direct
Department's council discussions.	Faculty	Direct
Preparation of model answers with detailed distribution of grades.	Faculty	indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Mathematics Department's Accreditation Unit
Reference No.	
Date	