هيئة تقويم التعليم
Education Evaluation Commission
المركز الوطني للتقويم والاعتماد الأكاديمي
National Center for Academic Accreditation and Evaluation

ATTACHMENT 5.

T6. COURSE SPECIFICATIONS (CS)

هيئة تقويم التعليم
Education Evaluation Commission

Course Specifications

Institution: King Saud University	Date:
College/Department : College of Science / Department of Mathematics	

A. Course Identification and General Information

1. Course title and code: Numerical Methods (MATH254)

2. Credit hours: 3(3+0+0)

3. Program(s) in which the course is offered.
(If general elective available in many programs indicate this rather than list programs)

Programs of the College of Engineering:
Civil Engineering, Electric Engineering and Industrial Engineering
Program of the College of Science: Bachelor of Science in Operation Research.

4. Name of faculty member responsible for the course
Dr. Rizwan Butt (Course coordinator),
and a group of the teaching staff in the Department of Mathematics in the speciality of computational mathematics.

5. Level/year at which this course is offered: 6th Level / 3rd year

6. Pre-requisites for this course (if any):) (MATH107 or MATH202 or MATH244) and (CSC101 or CSC206 or CSC207)

7. Co-requisites for this course (if any): None

8. Location if not on main campus: Al-Deriya, Main campus: College of Science, Building No. 4.

9. Mode of Instruction (mark all that apply):

a. traditional classroom	X	What percentage?	90%
b. blended (traditional and online)		What percentage?	
c. e-learning	X	What percentage?	10%
d. correspondence		What percentage?	
f. other		What percentage?	

Comments:

B Objectives

1. What is the main purpose for this course?

Students enrolled in this course will:

1. Learn the concepts of numerical methods in solving mathematical problems numerically
2. Analyse the error for these methods
3. Write computer algorithms to implement these methods for solving certain mathematical problems using computer.

2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)

1.Encourage students to read certain books about some applications of numerical methods.
2. Encourage students to use internet to look for related websites, computer softwares, and references.
3- Train students to write and implement computer algorithms for different problems.

C. Course Description (Note: General description in the form used in Bulletin or handbook)

Course Description:

- Solve a nonlinear equation using different numerical methods: Bisection method, fixed point method, Newton's method, secant method.
- Analyze the errors in these methods
- Compute the multiplicity of the root of an equation.
- Compute the rate of convergence of a convergent iterative scheme.
- Solve a systems of linear equations using direct methods and analyze the related errors
- Solve a systems of linear equations using iterative methods and analyze the related errors
- Approximate functions and data using polynomial interpolation and analyzing the related errors
- Approximate first and second derivatives using difference formulas and analyze the errors
- Approximate definite integrals using trapezoidal and Simpson's rules and analyze the errors
- Solve an initial value problem involving ordinary differential equations numerically using Taylor methods, Runge-Kutta method of order two.

1. Topics to be Covered

List of Topics	No. of Weeks	Contact hours

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.	4	12
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	4	12
Interpolation and Polynomial Approximations Lagrange interpolation formula, divided differences, Newton's interpolation formula, error in polynomial interpolation, interpolation using linear splines.	3	9
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.	3	9
Ordinary Differential equations Taylor methods, Runge-Kutta method of order two, and the local truncation error for Euler's and Taylor's formulas.	1	3

2. Course components (total contact hours and credits per semester):

		Lecture	Tutorial	Laboratory/ Studio	Practical	Other:	Total
Contact Hours	Planed	45	30				75
	Actual	45	45				75
Credit	Planed	3	1				4
	Actual	3	1				4

3. Additional private study/learning hours expected for students per week.
6 hours weekly for independent study and doing homework assignments

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy

On the table below are the five NQF Learning Domains, numbered in the left column.

First, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
1.1	• Using different numerical methods for solving nonlinear equations and analyzing the error in these methods • Computing the rate of convergence for iterative schemes • Solving systems of linear equations using direct methods and analyzing the error • Solving systems of linear equations using iterative methods and analyzing the error	• Introducing the topics in the lectures • Discussions in the class	• Homework assignments • Short exams
1.2	• Approximating functions and data using polynomial interpolation and analyzing the error in these formulas • Applying difference formulas to approximate derivatives and analyzing the error in these formulas • Applying the trapezoidal and Simpson's rules to approximate definite integrals and analyzing the error in these methods • Solving initial value problems of ordinary differential equations using different methods.	• Homework assignments • Independent study	• Mid-term exams and a final exam
2.0	**Cognitive Skills**		
2.1	• The ability to apply the numerical methods to solve mathematical problems. • To analyse the error for different numerical methods • The ability to write and run	• Lectures • Discussions in the lectures	• Follow up homework assignments • Short exams

	algorithms to solve mathematical problems using computers.		
2.2	• The ability to apply numerical methods in solving some mathematical models appearing frequently in the daily life situations. • Differentiate between exact and numerical solutions	• Homework assignments Independent study	• Discussions with the students in the class • Mid-Term and final exams
3.0	**Interpersonal Skills & Responsibility**		
3.1	• To participate in the discussion and take initiative in asking and answering questions during the lecture.	• The discussion with the students and asking questions during the lecture.	• Instructor's assessment of student's performance through discussions during lectures
3.2	• Ability to work individually or in a team • To be able to do homework assignments independently.	• Homework assignments. • Group assignments.	• Follow up the homework assignments.
4.0	**Communication, Information Technology, Numerical**		
4.1	• Write algorithms and solve mathematical problems numerically	• Computer assignments.	• Follow up the homework assignments and discussing it with students
4.2	• Discuss and compare computational results • Use available information technology to access the supporting materials and references.	• Encourage students to train on the available software concerning the course	

		topics.	
5.0	**Psychomotor**		
5.1	Not applicable	Not applicable	Not applicable
5.2			

5. Schedule of Assessment Tasks for Students During the Semester			
	Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	First midterm	6	20%
2	Computer assignments	Monthly	6%
3	Quizzes	Monthly	4%
4	Second midterm	12	20%
5	Final examination	16	50%
6			
7			
8			

D. Student Academic Counseling and Support

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week) - 10 scheduled office hours per week - 5 hours weekly for academic advice through the academic guidance unit in the department.

E Learning Resources

1. List Required Textbooks An Introduction to Numerical Analysis using MATLAB, by Rizwan Butt, Copyright 2008 by Infinity Science Press, Hingham, Massachusetts, New Delhi.
2. List Essential References Materials (Journals, Reports, etc.) 1- Numerical Analysis, by Richard L. Burden and J. Douglass Faires, Brooks/Cole, fifth edition. 2- An Introduction to Numerical Linear Algebra using MATLAB, by Rizwan Butt., Heldermann Verlag, Germany. 3- Elementary Numerical Analysis, An Algorithmic Approach, D. Cont and C. de-Boor, McGraw-Hill Book Company, N.Y. 1980.
3. List Electronic Materials, Web Sites, Facebook, Twitter, etc. - Software such as: Basic, Fortran, C. Maple, Mathematica and MATLAB. - Web sites involving computational mathematics.
4. Other learning material such as computer-based programs/CD, professional standards or regulations and software. - 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++

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access, etc.)
1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) • Classroom to accommodate 25 students equipped with usual blackboard or smart board. • Computer laboratory equipped with hardware and software.
2. Technology resources (AV, data show, Smart Board, software, etc.) • Computers connected to internet and equipped with required software. • Printers.
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) None

G Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching Course evaluation by the students at the end of the semester
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department • Analysing the course evaluation conducted by students at the end of the semester • Observations of the group of faculty teaching the course.
3. Processes for Improvement of Teaching • Workshops on teaching and learning methods conducted by the deanship of skills development. • Discussing the teaching methods by the group of faculty members teaching the course at the beginning of each semester.
4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution) Check the marking of a sample of student answer sheets in the final exam by an independent faculty member
5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. Reviewing the course contents every five years in coordination with the departments in which the

course is offered in their programs.

Name of Course Instructor: _____

Signature: _____ Date Specification Completed: _____

Program Coordinator: _____

Signature: _____ Date Received: _____