King Fahd University of Petroleum and Minerals
Department of Mathematics & Statistics
Math 371 - Term 192 - Syllabus
Coordinator: Dr. S. Al-Homidan

Title Introduction to Numerical Computing

Credit 3-0-3

Textbook "Numerical Analysis" by Richard L. Burden, J. Douglas Faires, 10th Edition, 2016.

Reference Numerical Methods for Engineers", Steven C. Chapra and Raymond P. Canale, "6th Edition."

Course Description Floating-point arithmetic and error analysis. Solution of non-linear equations. Polynomial interpolation. Numerical integration and differentiation. Data fitting. Solution of linear algebraic systems. Initial and boundary value problems of ordinary differential equations.

Course Objectives This course is designed to introduce numerical methods for solving a variety of problems, linear, nonlinear, and numerical approximation. In this course, we focus on both: the theoretical and computational aspects.

Students Learning Outcomes

After completion of the course, the students should be able to:

1. Use Taylor Series to approximate functions, evaluate the approximation errors and estimate their upper bounds.
2. Understand and program algorithms to locate the approximate roots of equations.
3. Understand and program algorithms to numerically solve linear systems of equations.
4. Learn how to smooth collected engineering data using the least squares method.
5. Use polynomials to interpolate collected precise (Note: Interpolation applies to precise data while the least-squares method applies to data exhibiting a significant degree of error or scatter.) engineering data or approximate function.
6. Understand and program algorithms to evaluate the derivative or the integral of a given function, evaluate the approximation error involved and estimate its upper bound.
7. Understand and program algorithms to solve engineering ordinary differential equations (ODEs) or partial differential equations (PDEs).
8. Understand relationships among methods, algorithms, and computer errors.
9. Apply numerical and computer programming tools to solve common engineering problems.

Computer Usage A computer software will be used as a computational platform

Attendance KFUPM attendance policy will be enforced.

Grading Policy

Exam I	**Material:** 1.1 – 3.3	**Place:** TBA	20% (60 points)
	Date: Wednesday, Feb 26	**Time: 5:45-7:45 pm**	
Exam II	**Material:** 3.5 – 5.4	**Place:** TBA	20% (60 points)
	Date:Wednesday, April 1	**Time:** 6:15-8:15 pm	
Final Exam	**Material:** Comprehensive	**Place:** TBA	30% (90 points)
	Date: TBA	**Time:** TBA	
Class Work	Homeworks & Quizzes .		15% (45 points)
Programming assignments			15% (45 points)

Exam Questions The questions of the common exams are based on the examples, homework problems, recitation problems, and the exercises of the textbook.

Missing Exam I or Exam II No makeup exam will be given under any circumstance. When a student misses Exam I or Exam II for a legitimate reason (such as medical emergencies), his grade for this exam will be determined based on an existing formula, which depends on his performance in the non-missed exam and in the final exam.

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Pacing Schedule

Week	Date (2016)	Section	Topics
1	Jan 19 – 23	1.1	Taylor Polynomials and Series
		1.2	Round-off Errors and Computer Arithmetic(Rounding and Chopping)
2	Jan 26 – 30	1.3	Algorithms and Convergence
			Introduction to MATLAB
3	Feb 2 – 6	2.1	The Bisection Method
		2.2	Fixed-Point Iteration
4	Feb 9 – 13	2.3	Newton's Method and its Extensions
5	Feb 16 – 20	3.1	Interpolation and the Lagrange Polynomials (up-to Example 3)
		3.3	Divided Differences (up-to Example 1)
6	Feb 23 – 27	3.5	Cubic Spline Interpolation
		Exam I	**Wednesday, Feb 26, 2020.Time: 5:45-7:45 pm Location: TBA; Material [1.1 – 3.3]**
7	Mar 1 – 5	4.1	Numerical Differentiation (Forward, Backward, and Central for $f'(x)$ and Central for $f''(x)$ (Skip five point formulas)
8	Mar 8 – 12	4.3	Elements of Numerical Integration (up-to Definition 4.1) 4.4)
		4.4	Composite Numerical Integration (up-to Example 2
9	Mar 15 – 19	5.1	The Elementary Theory of IVPs (Review)
		5.1	Euler's Methods
10	Mar 22 – 26	5.4	Runge–Kutta Methods
		6.1	Linear systems of Equation
11	Mar 29 – April 2	6.2	Pivoting Strategies (Partial Pivoting only)
		Exam II	**Wednesday, April 1, 2020; Time: 6:15-8:15 pm Location: TBA ; Material [3.5 – 4.5]**
12	April 5 – 9	6.5	Matrix Factorization
13	April 12 – 16	7.3	The Jacobi and Gauss-Siedel Iterative Techniques
14	April 19 – 23	8.1	Discrete Least Squares Approximation (Degree one and two only)
15	April 26 – 30	11.3	Finite-Difference Methods for Linear Problems

Final Exam (Comprehensive): Follow the registrar final schedule on his webpage.