King Fahd University of Petroleum & Minerals
Department of Mathematical Sciences
MATH 371
Introduction to Numerical Computing
(Term 181)
Course Syllabus

Course Coordinator: Dr. Husain Al-Attas

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 Outcome: 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: Computer software is essential for this course. Mainly we will be using MATLAB as the computational platform.

Attendance: KFUPM attendance policy will be enforced.

Grading Policy:

1. Two Major Exams (20% each).
2. Final Exam (30%) (Comprehensive).
3. Classwork (15%).
4. Application Projects using MATLAB (15%).

Academic Integrity: All KFUPM policies regarding ethics apply to this course.

Week	Dates	Sec.	Topic	Suggested Problems
1	Sept 2-6	1.1 1.2	Taylor Polynomials and Series Round-off Errors and Computer Arithmetic (Rounding and Chopping)	1, 3, 5, 7, 10, 13a, 13b 1, 4, 5
2	Sept 9-13	1.3 ---	Algorithms and Convergence Introduction to MATLAB	1, 2
3	Sept 16-20	2.1 2.2	The Bisection Method Fixed-Point Iteration	2, 4a, 4b, 5c, 5d, 6*, 7* 3, 8, 9, 10*, 14
23rd September National Day Holiday				
4	Sept 24-27	2.3	Newton's Method and its Extensions	2, 4a, 6a, 6b, 8a, 11*, 14*, 16*
29th September is Normal Sunday Classes				
5	Sept 29-Oct 4	3.1 3.3	Interpolation and the Lagrange Polynomials (up-to Example 3) Divided Differences (up-to Example 1)	1a, 1c, 3, 6a, 8a, 9, 13a 1, 2
Exam 1 on Wednesday October 10, 2018 at 05:15-07:15pm in Building 59 Material: 1.1 up-to 3.3				
6	Oct 7-11	3.5	Cubic Spline Interpolation	1, 2, 3d, 5d, 7d, 8d
7	Oct 14-18	4.1	Numerical Differentiation (Forward, Backward, and Central for $f'(x)$ and Central for $f''(x)$ (Skip five point formulas)	1, 2, 3, 4, 6a, 8a, 9a, 20
8	Oct 21-25	4.3 4.4	Elements of Numerical Integration (up-to Definition 4.1) Composite Numerical Integration (up-to Example 2)	2c, 2d, 4, 6, 13 1a, 1e*, 3*, 7a, 7b, 9, 11a, 11b
9	Oct 28-Nov 1	5.1 5.2	The Elementary Theory of IVPs (Review) Euler's Methods	 1a, 1d, 3a, 3d, 5a*, 5b*, 7a, 7b
10	Nov 4-8	5.4	Runge–Kutta Methods	1a, 1d, 3, 5, 9, 13
Exam 2 on Wednesday November 14, 2018 at 05:15 – 07:15 pm Material: 3.5 up-to 5.4				
11	Nov 11-15	6.1 6.2	Linear systems of Equation Pivoting Strategies (Partial Pivoting only)	1a, 1b, 3a, 5a, 5b 1a, 1b, 9, 15

12	Nov 18-22	6.5	Matrix Factorization	1a, 3a, 3c, 5a
13	Nov 25-29	7.3	The Jacobi and Gauss-Siedel Iterative Techniques	1a, 1c, 3, 5, 7
14	Dec 2-6	8.1	Discrete Least Squares Approximation (Degree one and two only)	1, 2, 3, 4
15	Dec 9-13	11.3	Finite-Difference Methods for Linear Problems	1a, 1b, 3a, 3b, 4a, 4b

Notes: 1. Suggested problems with * are to be done using MATLAB.

2. No Proofs of theorems are required.