King Fahd University of Petroleum & Minerals
Department of Mathematical Sciences
MATH 321
Introduction to Numerical Computing
(Term 172)
Course Syllabus

Course Coordinator: Dr. Muhammad Yousuf

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

Reference: "Numerical Methods for Engineers", Steven C. Chapra and Raymond P. Canale. (6^{th} 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 and evaluate the approximation errors.
2. Understand and program algorithms to locate the roots of equations.
3. Understand and program algorithms to solve linear system of equations.
4. Learn how to smooth collected engineering data using least squares method.
5. Use polynomials to interpolate collected engineering data or approximate function
6. Understand and program algorithms to evaluate the derivative or the integral of a given function and evaluate the approximation error involved.
7. Understand and program to solve engineering Ordinary Differential Equations (ODE) or Partial Differential Equations (PDE).
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	Jan 21 – 25	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	Jan 28 – Feb 01	1.3 ---	Algorithms and Convergence Introduction to MATLAB	1, 2
3	Feb 04 – 08	2.1 2.2	The Bisection Method Fixed-Point Iteration	2, 4a, 4b, 5c, 5d, 6*, 7* 3, 8, 9, 10*, 14
4	Feb 11 – 15	2.3	Newton's Method and its Extensions	2, 4a, 6a, 6b, 8a, 11*, 14*, 16*
5	Feb 18 – 22	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 February 28, 2018 at 06:00 – 08:00 pm in Building 57 Material: 1.1 up-to 3.3				
6	Feb 25 – Mar 01	3.5	Cubic Spline Interpolation	1, 2, 3d, 5d, 7d, 8d
7	Mar 04 – 08	4.1	Numerical Differentiation (Forward, Backward and Central for $f'(x)$ and Central for $f''(x)$	1, 2, 3, 4, 6a, 8a, 9a, 20
8	Mar 11 – 15	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	Mar 18 – 22	5.1 5.2	The Elementary Theory of IVPs (Review) Euler's Methods	 1a, 1d, 3a, 3d, 5a*, 5b*, 7a, 7b
10	Mar 25 – 29	5.4	Runge–Kutta Methods	1a, 1d, 3, 5, 9, 13
Exam 2 on Wednesday April 04, 2018 at 06:15 – 08:15 pm in Building 59 Material: 3.5 up-to 5.4				
11	Apr 01 – 05	6.1 6.2	Linear systems of Equation Pivoting Strategies (Partial Pivoting only)	1a, 1b, 3a, 5a, 5b 1a, 1b, 9, 15

12	Apr 08 – 12	6.5	Matrix Factorization	1a, 3a, 3c, 5a
13	Apr 15 – 19	7.3	The Jacobi and Gauss-Siedel Iterative Techniques	1a, 1c, 3, 5, 7
14	Apr 22 – 26	8.1	Discrete Least Squares Approximation (Degree one and two only)	1, 2, 3, 4
15	Apr 29 – May 03	11.3	Finite-Difference Methods for Linear Problems	1a, 1b, 3a, 3b, 4a, 4b

Note: 1. Suggested problems with * are to be done using Matlab.

2. No Proof of theorems.