King Fahd University of Petroleum and Minerals

Department of Mathematics & Statistics

Syllabus

Math 371	Introduction to Numerical Computing	Term 211

Coordinator: Dr. Muhammad Munir Butt

Course Code: Math 371 **Credit Hours: 2-2-3**

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).

The Course Objective: The objective of the course is to:

1. Introduce students to the field of Numerical Methods.
2. Use computing software for hands on knowledge.

The Course Content: 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.

Computer Usage: Computer software is an integral part of this course and mainly we shall use MATLAB as the computational platform.

The Course Learning Outcome: After completion of the course, the students should be able to:

1. Formulate Taylor Series to approximate functions, errors, and their upper bounds.
2. Devise algorithms to locate approximated roots of equations and numerically solve linear systems of equations.
3. Analyze engineering data using the least squares method.
4. Use polynomials to interpolate collected precise engineering data or approximate function.
5. Program algorithms to compute the derivative and the integral of a given function, estimate the approximation error involved and upper bound, and interpret engineering ordinary and partial differential equations.
6. Identify relationships among methods, algorithms, and computer errors.
7. Apply numerical and computer programming tools to solve common engineering problems

The Course Grading Policy:

	Date	Place and Time	Materials	Percentage
Major Exam I	Oct. 02, 2021	Building#57 06:00-08:00 PM 90 minutes	1.1 – 3.3	**20%** (60 points)
Major Exam II	Nov. 10, 2021	TBA 90 minutes	3.5, 8.1, 4.1– 5.2	**20%** (60 points)
Final Exam	TBA	TBA 150 minutes	Comprehensive	**30%** (90 points)
Classwork	Homeworks + Quizzes			**20%** Subjective bounds [70%, 75%] (60 points)
LAB	MATLAB Assignments			**10 %** (30 points)

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

Misconduct in Exams: Cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of **F** in the course along with reporting the incident to the university higher administration. Cheating in exams includes (but is not limited to) receiving help from anyone or any other outside source, and unauthorized use of the book, course notes, calculators, phones, or websites.

Missing an Exam:

Midterm Exam: No make-up exam will be given under any circumstances. In case a student misses midterm exam for a legitimate reason (such as medical emergencies etc.), his grade for this exam will be determined based on the existing formula which depends on his performance in the final exam.

Final Exam: If a student misses the final exam for a legitimate reason (such as medical emergencies), he will be given a make-up final exam.

Attendance: Students are expected to attend all lecture classes.

- If a student misses a class, he is responsible for any announcement made in that class.
- A DN grade will be awarded to any student who accumulates 20% unexcused absences in Lecture + Laboratory classes.

Academic Integrity: All KFUPM policies regarding ethics apply to this course. See the Undergraduate Bulletin.

The Pacing Schedule

Week	Date	Section	Topics	Important Problems
1	Aug 29 – Sep 2	1.1	Taylor Polynomials and Series Introduction to MATLAB LAB	2a,3b, 5, 7, 10, 14,15,19
2	Sep 05 – 09	1.2 1.3	Round-off Errors and Computer Arithmetic (Rounding and Chopping) Algorithms and Convergence LAB	1b, 4c, 7b, 9, 11a 1, 2, 3, 6, 7
3	Sep 12 – 16	2.1 2.2	The Bisection Method Fixed-Point Iteration LAB	2, 4a, 5c, 7* 3, 8, 9, 10*, 14
4	Sep 19 – 22	2.3	Newton's Method and its Extensions (Newton's method and Secant method) LAB	2, 5a, 8a, 11*, 14*, 16*
23 September 2021, National Day Holiday				
5	Sep 26 – 30	3.1 3.3	Interpolation and the Lagrange Polynomials (up-to Example 3) Divided Differences (up-to Example 1) LAB	1c, 3, 6a, 8a, 9, 13a 1, 2
6	Oct 03 – 07	3.5	Cubic Spline Interpolation LAB	1, 2, 3d, 5d, 7d, 8d
7	Oct 10 – 14	8.1	Discrete Least Squares Approximation (Degree one and two only) LAB	2, 3, 4
17 Oct 2021, Student Break				
8	Oct 18 – 21	4.1	Numerical Differentiation (Forward, Backward and Central for $f'(x)$ and Central for $f''(x)$ (Skip five point formulas) LAB	2, 4, 6a, 8a, 9a, 20
9	Oct 24 – 28	4.3 4.4	Elements of Numerical Integration (up-to Definition 4.1) Composite Numerical Integration (up-to Example 2) LAB	2c, 2d, 4, 6, 13 1a, 1e*, 3*, 7b, 9, 11b
10	Oct 31 – Nov 04	5.1 5.2	The Elementary Theory of IVPs Euler's Methods LAB	1a, 3d, 5a*, 7a 1d, 5a, 8d, 9
11	Nov 07 – 11	5.4 6.1	Runge-Kutta Methods Linear systems of Equation LAB	1d, 3, 5, 9, 13 1b, 3b, 5a, 5c
12	Nov 14– 18	6.2	Pivoting Strategies (Partial Pivoting only) LAB	1b, 1c, 9b, 15
13	Nov 21 – 25	6.5	Matrix Factorization LAB	1b, 3b, 5a, 6c
28 Nov - 2 Dec Midterm Break				
14	Dec 05 – 09	7.3	The Jacobi and Gauss-Seidel Iterative Techniques LAB	1b, 2a, 3, 5
15	Dec 12 – 16	11.3	Finite-Difference Methods for Linear Problems	1a, 3a, 4c, 5
16	Dec 19 – 20	20 December. Normal Thursday Class - Last day of classes for the term (Revision)		

Note: Suggested problems with * need to be done using MATLAB. No proof of theorems.

Final Exam (Comprehensive): 22 December - 3 January 2022. Follow the registrar final schedule on his webpage.