King Fahd University of Petroleum and Minerals

Department of Mathematics

Syllabus

Math 371	Introduction to Numerical Computing	Term 223

Coordinator: Yaqoub Shehadeh

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	12, Jul.	TBA	1.1 – 3.3	**20%** (80 points)
Major Exam II	27, Jul.	TBA	3.5, 8.1, 4.1– 5.2	**20%** (80 points)
Final Exam	TBA	TBA	Comprehensive	**30%** (120 points)
Classwork	Quizzes			**10%** Subjective bounds [70%, 75%] (40 points)
LAB	MATLAB Assignments			**15 %** Subjective bounds [70%, 75%] (60 points)
Home Work	Online			**5%** (20 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:

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.
- Students are not allowed to carry mobile phones Smart Watches and apple watches to the exam halls.

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	Jun 11-15	1.1	Taylor Polynomials and Series Introduction to MATLAB LAB	2a,3b, 5a&d,6d ,7b&c, 10, 14,15,19
		1.2	Round-off Errors and Computer Arithmetic (Rounding and chopping) (Skip Binary Machine Numbers)	1b, 4c, 7b, 9, 11a
		1.3	Algorithms and Convergence:)Def. 1.17, Def. 1.18 and Def. 1.19 - Algorithms to be covered in the Lab)	2, 3
2	Jun 18-22	2.1 2.2	The Bisection Method Fixed-Point Iteration	2, 4a, 5c, 7*,13,17 3, 8, 9, 10*, 14
		2.3	Newton's Method and its Extensions (Newton's method and Secant method only)	2, 5a, 8a, 11*, 14*a&b, 16*
Hajj Holidays 25 Jun to 8 Jul.				
3	Jul. 09-13	3.1	Interpolation and the Lagrange Polynomials (up-to Example 3)	1c, 3, 6a, 8a, 9, 13a
		3.3	Divided Differences (up-to Example 1)	1, 2,16
		3.5	Cubic Spline Interpolation (up-to Example 4)	1, 2, 3d, 5d, 7d, 8d,11,12
4	Jul. 16-20	8.1	Discrete Least Squares Approximation (Degree one and two only)	2, 3, 4
		4.1	Numerical Differentiation (Forward, Backward and Central for $f'(x)$ and Central for $f''(x)$ (Skip five point formulas)	2, 4, 6a, 8a, 9a, 20
5	Jul. 23-27	4.3	Elements of Numerical Integration (up-to Definition 4.1)	2c, 2d, 4, 6, 13
		4.4	Composite Numerical Integration (up-to Example 2 and skip Composite Midpoint rule)	1a, 1e*, 3*, 7b, 9, 11b
		5.1	The Elementary Theory of IVPs	1a, 3d
		5.2	Euler's Methods (Skip Lemma 5.7, Lemma 5.8, and Theorem 5.10)	1d, 5a, 8d
6	Jul. 30-Aug.03	5.4	Runge-Kutta Methods (Midpoint Method and Runge-Kutta Method of order 4)	13a&d, 14(a&b)
		6.1	Linear systems of Equation	1b, 3b, 5a, 5c
		6.2	Pivoting Strategies (Partial Pivoting only)	1b, 1c, 3(b&c),9a, 15
7	Aug.06 -10	6.5	Matrix Factorization	1b, 3b, 5a, 6c,9a
		7.3	The Jacobi and Gauss-Seidel Iterative Techniques (up-to Example 3)	1b, 2a, 3, 5
8	Aug. 13-14	11.3	Finite-Difference Methods for Linear Problems (Up-to Example 1)	1a, 3a, 4c, 5

Note: Suggested problems with * need to be done using MATLAB. No proof of theorems.
Final Exam (Comprehensive): Follow the registrar final schedule on his webpage.