King Fahd University of Petroleum and Minerals

Department of Mathematics

MATH 371 Syllabus, Term 231

Coordinator: Dr. Said Algarni

Course Code: Math 371 - **Introduction to Numerical Computing - 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.

Prerequisite: MATH 201

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 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	**Materials**	
Major Exam I	TBA	1.1 – 3.3	**20%** (80 points)
Major Exam II	TBA	3.5, 8.1, 4.1– 5.2	**20%** (80 points)
Final Exam	TBA	Comprehensive	**30%** (120 points)
Classwork	**Part I**: It is based on quizzes, class tests, or other class activities determined by the instructor. The average (out of 40) of the class work of each section has to be in the interval $[y-1, y+1]$, where $y = \frac{median(Exam\ I)\% + median(Exam\ II)\%}{5}$.		**10%** (40 points)
	Part II: MATLAB Assessment		**15%** (60 points) Subjective bounds [70%, 75%]
	Part III: Online Home works		**5%** (20 points)

Letter Grades: The letter grades will follow a grading curve, which depends on the average of all students enrolled in the course.

Exam Questions: The questions of the exams are similar to the examples and exercises in the textbook.

Cheating in Exams: Cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of DN in the course along with reporting the incident to the higher university administration for further action. Cheating in exams includes (but is not restricted to):

- Looking at the papers of other students.
- Talking to other students.
- Using mobiles, smart watches or any other electronic devices.

Other Exam Issues:

- No student will be allowed to take the exam if he/she does not bring his/her KFUPM ID, or National/Iqama ID, or Driver's License with him/her to the exam hall.
- Students are not allowed to have their mobiles, smart watches, or any electronic device in the exam hall. A violation of this will be considered an attempt of cheating.
- A student must sit in the seat assigned to him/her. A violation of this will be considered an attempt of cheating.

Missing an Exam: In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), he/she must bring an official excuse from Students Affairs. Otherwise, he/she will get a score of zero in the missed exam.

Attendance: Students are expected to attend all lecture and lab classes

- If a student misses a class/lab, he/she is responsible for any announcement made in that class/lab.
- After warned **twice** by the instructor, a DN grade will be awarded to any student who accumulates
    - 12 unexcused absences in lecture and lab classes. (20%).
    - 20 excused and unexcused absences in lecture and lab classes. (33.33%)

Note that, missing one Lab class is equivalent to two absences.

The Usage of Mobiles in Class: Students are not allowed to use mobiles for any purpose during class time. Students who want to use electronic devices to take notes must take permission from their instructor. Violations of these rules will result in a penalty decided by the instructor.

Academic Integrity: All KFUPM policies regarding ethics apply to this course. See the Undergraduate Bulletin in the Registrar's website.

Weekly Coverage of Course Material

Week	Date	Sec.	Topic
1	Aug. 27-31	1.1 1.2	Review of Calculus: Taylor Polynomials and Series Round-off Errors and Computer Arithmetic: (Skip Binary Machine Numbers)
2	Sep. 3-7	1.3 2.1	Algorithms and Convergence:(Def. 1.17, Def. 1.18, Def. 1.19 - Algorithms to be covered in the Lab) The Bisection Method
3	Sep. 10-14	2.2 2.3	Fixed-Point Iteration Newton's Method and its Extensions (Newton's method and Secant method only)
4	Sep. 17-21	3.1 3.3	Interpolation and the Lagrange Polynomials (up-to Example 3) Divided Differences (up-to Example 1)
Sunday, Sep. 24: National Day Holiday			
5	Sep. 25-28	3.5 8.1	Cubic Spline Interpolation (up-to Example 4) Discrete Least Squares Approximation (Polynomial of degree one and two)
6	Oct. 1-5	4.1	Numerical Differentiation (for $\acute{f}$ and $\acute{\acute{f}}$) (**Skip** five-point formulas and Round-off Instability)
7	Oct. 8-12	4.3 4.4	Elements of Numerical Integration (up-to Definition 4.1) Composite Numerical Integration (up-to Example 2 and skip Composite Midpoint rule)
8	Oct. 15-19	5.1	The Elementary Theory of IVPs
9	Oct. 22-26	5.2	Euler's Methods (Skip Lemma 5.7, Lemma 5.8, and Theorem 5.10)
10	Oct. 29-Nov. 2	5.4	Runge-Kutta Methods (only Midpoint Method and Runge-Kutta Method of order 4)
11	Nov. 5-9	6.1	Linear systems of Equation
12	Nov. 12-16	6.2	Pivoting Strategies (Partial Pivoting only)
Nov. 19-23: Midterm Break			
13	Nov. 26-30	6.5	Matrix Factorization
14	Dec. 3-7	7.3	The Jacobi and Gauss-Seidel Iterative Techniques (up-to Example 3)
15	Dec. 10-14	11.3	Finite-Difference Methods for Linear Problems (up-to Example 1)
16	Dec. 17		A Normal Sunday Class (**Review/ Catching up**)

Note: No proof of theorems.
Final Exam (Comprehensive): Follow the registrar final schedule on his webpage.