King Fahd University of Petroleum & Minerals

Department of Mathematics

Math 208 Syllabus, Semester 252 (2026)

Coordinator: Dr. Bader Al Humaidi (humaidib@kfupm.edu.sa)

Course Code & Title: Math 208, Differential Equations and Linear Algebra.

Course Credit Hours: 3-0-3.

Textbook: Edwards, C. H., Penney, D. E., and Calvis, D. T., Differential Equations and Linear Algebra, **Fourth edition**, Pearson, 2021.

Course Description: Systems of linear equations. Vector spaces R^n: subspaces, bases, dimensions. Rank of matrices. Eigenvalues and eigenvectors. Similar matrices. Diagonalizable matrices. Matrix exponential. First order differential equations: separable, linear, exact, substitution methods. Applications to linear models of first order. The homogeneous differential equations with constant coefficients. Wronskian. Nonhomogeneous differential equations. Methods of undetermined coefficients and variation of parameters. Systems of differential equations. Non-homogeneous systems. Series solutions.

Prerequisite: Math 102.

Course Objectives:

1. Introducing students to the basics of linear algebra in R^n.
2. Introducing students to the basic types of differential equations and some of the various techniques for solving them.

Course Learning Outcomes: Upon the completion of the course, students should be able to

1. Discuss basic concepts of differential equations and linear algebra
2. Solve various types of ordinary differential equations of first order.
3. Apply differential equations to solve certain real-world problems.
4. Solve problems related to matrices (linear systems, eigenvalues and eigenvectors, matrix exponentials) and the vector space R^n.
5. Solve homogeneous and nonhomogeneous ODE with constant coefficients.
6. Solve linear systems of differential equations with constant coefficients.
7. Use infinite series to solve second order differential equations.

Grading Policy:

	Date	Time	Place	Material	Points /300
Exam I (15 MCQ)	Monday, Feb. 16, 2026	6:30 PM-8:00 PM	BLD 54	1.1-4.2	25% (75points)
Exam II (15 MCQ)	Monday, April. 13, 2026	7:00 PM-8:30 PM	BLD 54	4.3 – 6.2	25% (75points)
Final Exam (21 MCQ)				Comprehensive	35 % (105 points)
Class Work	▪ It is based on quizzes, class tests, or other class activities determined by the instructor. ▪ The average (out of 45) of the class work of each section has to be in the interval $[y-1.5, y+1.5]$, where $y = \frac{9}{40}(median\ Ex1\ \% + median\ Ex2\ \%)$.				15 % (45 points)
				Total	100 % (300points)

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.
- Using ChatGPT or any AI source.

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 classes.

- If a student misses a class, he/she is responsible for any announcement made in that class.
- After warned **twice** by the instructor, a DN grade will be awarded to any student who accumulates
    - 9 unexcused absences. (20%)
    - 15 excused and unexcused absences. (33.3%)

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.

Suggested Coverage Plan

Week	Date (2026)	Sec.	Topics (25 sections)
1	Jan. 11-15	1.1	Differential Eq. & Math. Models (Math Models: Examples 3, 5, 6 only)
		1.2	Integrals as General and Particular Solutions
2	Jan. 18-22	1.4	Separable Equations & Applications (**Natural Growth & Decay + Cooling & Heating)**
		1.5	Linear First-Order Equations
3	Jan. 25-29	1.6	Substitution Methods & Exact Equations
4	Feb. 1-5	Ch 3	Review only: Solving Linear Systems by Gaussian Elimination, Inverse, Determinant
		4.1	The Vector Space $\mathbb{R}^3$
5	Feb. 8-12	4.2	The Vector Space $\mathbb{R}^n$ and Subspaces
		4.3	Linear Combinations & Independence of Vectors
↓ EXAM I: Monday, Feb 16, 2026: Material: 1.1-4.2.			
6	Feb. 15-19	4.4	Bases & Dimension for Vector Spaces
		4.5	Row and Column Spaces (**Definition of the Rank of a Matrix only)**
↓ Sunday, February 22: Saudi Founding Day Holiday			
7	Feb. 23-26	5.1	Introduction: 2nd-Order Linear Eq.
		5.2	General Solutions of Linear Eq.
8	Mar. 1-5	5.3	Homogeneous Eq. with Constant Coefficients
		5.5	Nonhomogeneous Eq.: Undetermined Coeff. & Method of Variation of Parameters
9	Mar. 8-12	6.1	Introduction to Eigenvalues
		6.2	Diagonalization of Matrices
March 15-26: Eid Al-Fitr Holidays			
10	Mar. 29 – April 2	7.2	Matrices & Linear Systems
		7.3	The Eigenvalue Method for Linear Systems
11	April 5-9	7.6	Multiple Eigenvalue Solutions (**systems of 2x2 and 3x3 only**) Up to p. 462.
↓ EXAM II: Monday, April. 13, 2026; Material: 4.3-6.2.			
12	April 12-16	8.1	Matrix Exponentials & Linear Systems (up to p. 490)
13	April 19-23	8.2	Nonhomogeneous Linear Systems (only Variation of Parameters Method)
14	April 26-30	11.1	Introduction and Review of Power Series
		11.2	Power Series Solutions (Ordinary Points)
15	May 3-7	11.3	Frobenius Series Solutions (Singular Points)
16	May 10		**(Review/ Catching up)**
Final Exam: Comprehensive			

Suggested Practice Problems

Sec	Problems Numbers
1.1	6, 8, 10, 14, 20, 25, 35, 38, 39
1.2	2, 6, 7, 10, 11, 17
1.4	2, 8, 10, 24, 26, 29 (a, b), 33, 34, 40, 43, 49
1.5	3, 10, 18, 21, 24, 28, 30
1.6	16, 17// 2, 8, 13// 19, 24, 27// 32, 36, 40// 44, 46,52
Ch 3	3.1: 4, 13, 18, 19, 24 3.2: 2, 10, 15, 28 3.3: 2, 6, 10, 26, 28 3.4: 1, 10, 14, 23 3.5: 3, 13, 23 3.6: 2, 3, 7, 17, 21, 27, 33
4.1	1, 4, 6, 8, 10, 16, 19, 20, 25, 32, 34
4.2	2, 8, 12, 14, 17, 19
4.3	2, 6, 12, 17, 23
4.4	2, 8, 9, 12, 13, 16, 23
4.5	Find the rank of the matrix: 1, 4, 8, 12
5.1	10, 15, 19, 20, 26, 29, 38, 39, 43
5.2	3, 9, 14, 22, 26, 30
5.3	3, 4, 14, 19, 22, 28, 31, 33, 39, 40
5.5	1, 4, 8, 16, 27, 29, 39, 41// 48, 52, 57, 60, 62
6.1	3, 7, 14, 21, 25, 31
6.2	2, 10, 15, 18, 27
7.2	1, 6, 9, 12, 16, 20, 24
7.3	1, 3, 9, 18, 25, 26
7.6	4, 5, 9, 13, 16
8.1	2, 6, 7, 10, 17, 21, 24, 26, 27
8.2	17, 19, 21, 32
11.2	1, 4, 6, 7, 12, 15, 17, 18
11.3	4, 6, 8, 9, 12, 18, 21, 25, 27, 32