

**King Fahd University of Petroleum and Minerals**  
**College of Computing**  
**Mathematics Department**  
**Math 437 Syllabus**

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Semester 221

- **Course Code and Name:** Math 437, Partial Differential Equations
- **Course Credit Hours:** 3-0-3
- **Textbook:** Beginning Partial Differential Equation. by P. O’Neil.
- **Course Content:** First order quasilinear equations. Lagrange method and Characteristics. Classification of linear second order PDEs. Brief review of separation of variables. The one dimensional wave equation: its solution and characteristics. Cauchy problem for the wave equation. Laplace’s equation: The maximum principle, uniqueness theorems. Green’s function. Neumann’s function. The heat equation in one dimension.  
**Course Prerequisite:** MATH 333
- **Course Learning Outcomes:**  
Upon completion of the course, students should be able to:
  1. Solve linear and quasi-linear first order PDEs in two variables using the characteristic method.
  2. Classify second-order equations in two variables by type (parabolic, hyperbolic, elliptic).
  3. Use separation of variables to solve some PDEs.
  4. Apply the maximum principle to the Laplace and heat equations.

**Grading Policy:**

	<b>Date</b>	<b>Material</b>	<b>Percentage</b>
<b>Major Exam I</b>	Oct 2, 2022	<b>1.1, 1.2, 1.3, 2.1, 2.2 and 2.4</b>	20%
<b>Major Exam II</b>	Nov 6, 2022	<b>3.1, 3.2, 4.1, 4.2, 4.3, 4.4 and 4.5</b>	20%
<b>Final Exam</b>	Dec 28, 2022	<b>Comprehensive</b>	35%
Class work	—	Homeworks + Attendance	10%
<b>Project</b>	Dec 11-15, 2022	List of projects	15%

**Exam Questions:**

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

## **Exams Policy:**

- No student will be allowed to take the exam if he doesn't bring his KFUPM, National, or Iqama ID card with him to the exam hall.
- Students are not allowed to carry mobiles, smart watches, or electronic devices to the exam halls/rooms.
- 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 must bring an official excuse from Students Affairs. Otherwise, he will get zero in the missed exam.

## **Attendance:**

Attendance is a University Requirement (see p. 38 of the Undergraduate Bulletin 2006-2009).

- 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 9 unexcused absences.

## **Academic Integrity:**

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

Week	Date	Sections and Topics	Suggested Problems
1	Aug 28 - Sep 1	<b>1 First Ideas</b> 1.1 Two Partial Differential Equations	2, 4, 7, 8, 9, 10, 11, 12, 14, 16
2	Sep 4 - 8	1.2 Fourier Series 1.3 Two Eigenvalue Problems	1, 4, 6, 8, 10, 14, 16, 20 1, 2, 3, 4
3	Sep 11 - 15	<b>2 Solutions of the Heat Equation</b> 2.1 Solutions on an Interval $[0, L]$	6, 8, 10, 12, 14, 18, 20, 22
4	Sep 18 - 20	2.2 A Nonhomogeneous Problem 2.4 The Weak Maximum Principle	2, 4, 6, 7, 8, 9, 10 1, 2, 3, 4
	Sep 22	National Day Holiday	
5	Sep 25 - 29	<b>3 Solutions of the Wave Equation</b> 3.1 Solutions on Bounded Intervals	1, 2, 3, 7, 8, 9, 10, 14, 18, 19, 21, 22, 25, 26
	Oct 2	<b>Major Exam I: 1.1-2.4</b>	
6	Oct 2 - 6	3.2 The Cauchy Problem 3.2.1 d'Alembert's Solution 3.2.2 The Cauchy Problem on a Half-Line	— 1, 2, 4, 8, 10, 12, 13, 18 1, 3, 6, 9, 10
7	Oct 9 - 13	<b>4 Dirichlet and Neumann Problems</b> 4.1 Laplace's Equation and Harmonic Functions 4.2 The Dirichlet Problem for a Rectangle	— 1, 2, 3, 4 1, 2, 4, 6, 7
8	Oct 16 - 20	4.3 The Dirichlet Problem for a Disk 4.4 Properties of Harmonic Functions (Review)	2, 4, 6, 7, 8, 12, 16 —
9	Oct 23 - 27	4.4.3 Mean Value Property and Maximum Principle 4.5 The Neumann Problem 4.5.1 Uniqueness and Existence 4.5.2 Neumann Problem for a Rectangle 4.5.3 Neumann Problem for a Disk	2, 3, 4, 5, 8 — 2, 4 1, 2, 3, 4, 5 1, 2, 3, 4, 5
10	Oct 30 - Nov 3	4.6 Poisson's Equation 4.7 Existence Theorem for a Dirichlet Problem	1, 2, 3, 4 1, 2, 3
	Nov 6	<b>Major Exam 2: 3.1-4.5</b>	
11	Nov 6 - 10	<b>5 Fourier Integral Methods of Solution</b> 5.1 The Fourier Integral of a Function 5.2 The Heat Equation on a Real Line	4, 6, 10, 12, 14, 15, 16, 17 2, 4, 6, 8, 9, 12, 14, 16
12	Nov 13 - 17	5.5 The Cauchy Problem for a Wave Equation 5.6 Laplace's Equation on Unbounded Domains	7, 8, 10, 12, 14 7, 8, 10, 12, 14, 16
13	Nov 20 - 24	<b>8 First-Order Equations</b> 8.1 Linear First-Order Equations 8.2 The Significance of Characteristics	2, 4, 6, 8, 10, 12 2, 4, 6
	Nov 27 - Dec 1	Midterm Break	
14	Dec 4 - 8	8.3 The Quasi-Linear Equation	2, 4, 6, 8, 10, 12
15	Dec 11 - 15	<b>Project presentations</b>	—
16	Dec 18	Revision	—