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:

	Date	Material	Percentage
Major Exam I	Oct 2, 2022	**1.1, 1.2, 1.3, 2.1, 2.2 and 2.4**	20%
Major Exam II	Nov 6, 2022	**3.1, 3.2, 4.1, 4.2, 4.3, 4.4 and 4.5**	20%
Final Exam	Dec 28, 2022	**Comprehensive**	35%
Class work	—	Homeworks + Attendance	10%
Project	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	**1 First Ideas** 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	**2 Solutions of the Heat Equation** 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	**3 Solutions of the Wave Equation** 3.1 Solutions on Bounded Intervals	1, 2, 3, 7, 8, 9, 10, 14, 18, 19, 21, 22, 25, 26
	Oct 2	**Major Exam I: 1.1-2.4**	
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	**4 Dirichlet and Neumann Problems** 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	**Major Exam 2: 3.1-4.5**	
11	Nov 6 - 10	**5 Fourier Integral Methods of Solution** 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	**8 First-Order Equations** 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	**Project presentations**	—
16	Dec 18	Revision	—