Instructor: Prof. Boaz Ilan  
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Lecture Time & Location:  
Wednesday, 5:00 pm – 6:20 pm, KL 396  
Friday, 1:30 pm – 2:45 pm, COB 270  

Office hours: By appointment.

Course Goals and Objectives: Partial Differential Equations (PDEs) are at the heart of applied mathematics and many other scientific disciplines. My goals are that by the end of this course you will have learned:

- Where and how PDEs arise in applications.
- Fundamental concepts of PDE theory.
- Analytical methods for solving PDEs.

Graduates of MATH 221 should be able to fulfill the following learning objectives:

1. Describe real-world systems using PDEs.
2. Solve first order PDEs using the method of characteristics.
3. Determine the existence, uniqueness, and well-posedness of solution of PDEs.
4. Solve linear second order PDEs using canonical variables for initial-value problems, Separation of Variables and Fourier series for boundary value problems.

Prerequisites: Multi-variable calculus; Ordinary differential equations, Linear Algebra.

Outline:

- Introduction: PDEs and their solutions; initial and boundary value problems; existence, uniqueness, and well posedness; derivation of PDEs from conservation laws.
- First order PDEs: method of characteristics, linear and quasi-linear PDEs, shock formation in Burgers equation.
- Second order linear PDEs: classification; d’Alembert’s solution to the wave equation and propagation of discontinuities; Separation of Variables: homogeneous equations, examples from the heat, wave, and Laplace equations; Fourier series and their convergence; energy and maximum principles; elements of Sturm-Liouville and spectral theories; introduction to Green’s functions

Course webpage: MATH 221’s website is part of the UCMCROPS course management system.

Primary Textbooks:

- *An Introduction to Partial Differential Equations*, Y. Pinchover and J. Rubinstein

Additional Reading:

- *Partial Differential Equations of Applied Mathematics*, E. Zauderer
Discussion Sessions: Lectures will on occasion become discussion sessions as necessary to serve any of the following purposes: working out examples, solving homework problems, supplementary material.

Grade Determination: Your final grade in the course will be based on the following approximate scheme: 10% for participation in class; 30% by the mid-term exam; 60% by the final exam.

Homework: Homework will be given approximately every week, but will not be collected. You are encouraged to work in groups. At the end of the day, you must comprehend the material and be able to solve the problems on your own.

Mid-term Exam: Unless otherwise decided, the mid-term exam will be given during the lecture on Wednesday, October 14. The mid-term exam will be constructed to take one hour and focus on Learning Objectives 1 & 2 above. There will be not make-up exam.

Final Exam: The date and time will be coordinated during the course. The final exam will be 3 hours and focus on Learning Objectives 2 & 3 above. There will be not make-up exam.