Course Outline 2019 MATH 257/316: Partial Differential Equations

Prerequisites: One of Math 215, 255, 265. **Credits:** 3 Credits. Credit only given for one of Math 256, 257, 316.

Learning Objectives: This course introduces the heat, wave, and Laplace equations in different physical contexts. Students are taught to formulate and implement finite difference numerical solution schemes as well as analytic methods to solve homogeneous boundary value problems (BVP) via separation of variables and Fourier Series and inhomogeneous BVP using eigenfunction expansions.

Instructor: Anthony Peirce, **Office:** Mathematics Building 108, **Home Page:** http://www.math.ubc.ca/˜peirce

Office Hours: Monday: 12:30-1:30 am, Wed: 3-3:55 pm, Fri: 10-11 am.

Test Dates: Friday, October 18th, Friday, November 15th.

Assessment: The final grades will be based on homework (10%) including EXCEL or MATLAB projects, two in-class midterm exams (2x20%=40%), and one final exam (50%).

Missing exams and homework deadlines: There are no make-up exams or assignments in this course. If you miss any of the exams or assignment deadlines for a valid reason, the weight of that assessment will be transferred to the final exam. Any student who misses an assessment must present to me within 72 hours the completed Department of Mathematics self declaration form (available on my website).

A student must get at least 40% on the final exam to pass this course.

Text: A comprehensive set of lecture notes will be posted online. Any edition of *Elementary Differential Equations & Boundary Value Problem* by W.E. Boyce & R.C. DiPrima, (John Wiley & Sons) will serve as an optional text.

Topics: (Chapters refer to the 2012 Edition of Boyce & DiPrima)	Approximate Time
1. Review of techniques to solve ODEs	1 hr
2. Series Solutions of variable coefficient ODEs (Chapter 5)	
a. Series solutions at ordinary points (5.1-5.3)	3 hrs
b. Regular singular points (5.4-5.7, 5.8 briefly)	4 hrs
3. Introduction to PDEs (Chapter 10): heat equation (10.5), wave equation (10.7), Laplace equation (10.8)	2 hrs
4. Introduction to numerical methods for PDEs using spread sheets	3 hrs
a. First and second derivative approximations using finite differences - errors	
b. Explicit finite difference schemes for the heat equation	
- Stability and derivative boundary conditions	
c. Explicit finite difference schemes for the wave equation	
d. Finite difference approximation of Laplace Equation and iterative methods	
5. Fourier Series and Separation of Variables (Chapter 10)	
a. The heat equation and Fourier Series (10.1-10.6)	9 hrs
b. The wave equation (10.7)	3 hrs
c. Laplace equation (10.8)	5 hrs
6. Boundary Value Problems and Sturm-Liouville Theory (Chapter 11)	
a. Eigenfunctions and eigenvalues (11.1)	1 hr
b. Sturm-Liouville boundary value problems (11.2)	1 hr
c. Nonhomogeneous boundary value problems (11.3)	2 hrs
Tests	2 hrs
Total:	36 hrs