Course Outline 2020 MATH 257/316: Partial Differential Equations

Prerequisites: One of Math 215, 255, 258. **3 Credits:** Credit only given for one of Math 257, 316, 358, Mech 358, Phys 312

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

Course Canvas Page: https://canvas.ubc.ca/courses/55300

Lectures: Lectures will be pre-recorded and can be viewed asynchronously on Canvas. The videos for each week will be posted in advance.

Synchronous Discussion/Office Hours: Wednesdays 9-10 am and 4-5 pm PST. The link for these weekly synchronous Zoom meetings will be posted on the course Canvas page. **It is important to attend the first organizational meeting on the 9 th of September, which will be recorded and posted on Canvas.** Attending subsequent meetings is an optional drop-in and will not be recorded.

Piazza forum: We will be using Piazza for class discussion. The system is set up to get you help efficiently from classmates and the TAs. Rather than emailing questions, I encourage you to post your questions on Piazza. A link to register for the class Piazza group appears on the Course Canvas Page.

Assessment

Homework (non-credit): Homework will be assigned regularly (not to be submitted). Solutions will be provided for self-assessment.

WebWork Quizzes: Based on the homework problems there will be a WebWork problem assigned approximately every week. You will be able to complete this problem at any time in a 30 hour period. You can attempt these questions only once and will typically have 30-40 minutes to complete the problem. You will be asked to upload your written work for these problems separately. Missing a quiz normally results in a mark of zero. To avoid uploading difficulties, I recommend that the latest time you start the quiz is at least 2 hours before the end of the 30 hour window.

Numerical Assignments: You will be assigned numerical questions that you need to upload for marking.

Final Exam: There will be a final invigilated via Zoom and it is absolutely necessary to have a webcam. If you do not have a webcam on your computer, you will not be able to complete the course.

Missing deadlines: There are no make-up quizzes or assignments in this course. If you miss any of the assessment 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 the Canvas site).

Evaluation: The final mark will be calculated as follows:

Quizzes and Numerical Assignments : 60%

Final Exam: 40%

Textbook, topics covered, and approximate pacing:

Text: A comprehensive set of lecture notes will be available on Canvas. For those students who prefer a textbook, 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

Tips for success:

Make your own notes: When watching the lectures make your own comprehensive notes. It has been demonstrated that the note-taking process is a powerful tool in mastering new concepts. With the pre-recorded lectures you have the added benefit of being able to review a point you may not have understood on the first viewing.

Put in the time and effort: Math is not a spectator sport: you learn by doing, and the more you do, the more accomplished you become.

Keep up: For six days a week, schedule some time to work on this course. Don't fall behind. If you are struggling with some material, make sure to seek help, either from your classmates and TAs via Piazza or by coming to the online office hours.

Academic Misconduct:

1. UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year.

2. While students are encouraged to study together, they should be aware that blatant copying of another student's work is a serious breach of academic integrity. Please discuss with your instructors their expectations for acceptable collaboration on any assigned coursework. Cases of suspected cheating will be investigated thoroughly.

3. Note that academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of postponing an examination or quiz or otherwise obtaining an academic concession.

Statement on UBC's Policies and Resources to Support Student Success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available at:

https://senate.ubc.ca/policies-resources-support-student-success