Partial Differential Equations/MTH 615 (CRN 4255)

Spring 2014

**T,R 3:30 – 4:45 Smith Hall 513**

**(Tentative, 1/12/2014)**

# Instructor: Dr. Bonita A. Lawrence

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Office Hours: 10:00 – 11:00 A.M. M,W, F

11:00 A.M. – 12:00 P.M. T,R

Or a time that we can find that

works for both of us!

**General University**

**Policies:** By enrolling in this course, you agree to the University Policies presented below. You can read the full text of these important policies online using the following path: Marshall Home Page - Course Catalogs – Graduate Catalogs. At this point, choose the catalog you started under (or any catalog after that).

**Attendance Policy**: I expect you to be in class every day you are physically able. It is your responsibility to determine what you missed in the event you are unable to attend class. Requesting notes from a colleague would be wise. I am happy to give you information about any assignments you missed. If you miss an exam or a deadline for an assignment and your absence is excused, you have one week after the date of the excused absence to make it up. The University Policy that describes excused absences can be found in the Marshall University 2013 – 2014 Graduate Catalog on page 61.

**Academic Dishonesty Policy:** I expect you to do your own work. You can certainly discuss the homework problems with your colleagues but what you present to me for any type of assessment must be your own. The University’s policy concerning academic dishonesty can be found in the Marshall University 2013 -2014 Graduate Catalog on pages 53 - 55.

**Policy for Students with Disabilities:** Marshall University is committed to equal opportunity for all. Students with physical, learning or psychological disabilities should contact the Office of Disabled Students Services (DSS) in Prichard Hall Room 117, 304 696-2271 and provide documentation of their disability. After consultation the DSS coordinator will send a letter to the student’s instructors describing the accommodations the student will need. For more information, go to <http://www.marshall.edu/disabled> or call or visit the office in Prichard Hall.

**Affirmative Action Policy:** In the spirit of equal opportunity for all, Marshall

University has an Affirmative Action Policy. This can be found in the Marshall University 2013 - 2014 Graduate Catalog on p. 41.

**Inclement Weather Policy:** In the event of bad weather that may prevent us from coming to school, Marshall has a policy that describes how things will be handled. (Note that I have been here for 12 years and we have only shut down school one day during this time.) The policy can be found on p. 42 of the Marshall University 2013 – 2014 Graduate Catalog.

**Catalog Course Description:** Elementary partial differential equations. Heat equation, Laplace equation, separation of variables, Fourier series, vibrating strings, eigenvalue problems, finite differences, Bessel functions, Legendre polynomials. (PR: *C* or better in MTH 331 and *C* or better in MTH 335).

**Course Prerequisites:** This course has no formal prerequisite. It is of great benefit if you have had a course in Ordinary Differential Equations (our MTH 335 – Differential Equations).

**Course Objectives:** This course extends your study of differential equations to the study of equations with solutions of more than one independent variable. In this case the differential equation contains partial derivatives and is therefore known as a partial differential equation. We will study classical models that will include the wave equation, the heat equation (and other models of diffusion equations), and the Laplace Equation. We will investigate methods for solving particular classes of problems that will utilize the methods you studied in your ordinary differential equations course such as the Laplace Transform. We will also investigate the use of the Fourier Transform as a solution technique.

As with so many fields of mathematics, PDE’s developed out of an interest for studying particular applications. We will discuss a variety of applications that include, among others, heat flow and wave propagation and models developed from laws of conservation.

Success in the course will be measured by your success at meeting the following objectives.

The ability to:

1. Understand what is required for a given function on a prescribed region to be a solution to particular partial differential equations.

*Learning Outcome:* Utilize the definition of the solution of particular classes of partial differential equations to determine if a particular function is a solution.

*Skill Development:* Small group and whole group analysis of solutions of PDEs. Exercises assigned daily followed by timely feedback.

*Assessment:* Evaluation of written and oral presentations of analysis of PDE’s and their solutions for validity and logical flow.

1. Classify certain partial differential equations and understand how the presented methods can be used to solve them.

*Learning Outcome:* Choose the appropriate method and solve certain models that belong to particular classes of partial differential equations.

*Skill Development:* Small group and whole group discussions of classifications and methods for solving certain classes of partial differential equations. Exercises assigned daily followed by timely feedback.

*Assessment:* Evaluation of written and oral presentations for proper selection and uses of presented techniques.

1. Recognize the relationships between physical systems and differential equations that are used to model them.

*Learning Outcomes:* Describe the connection between a physical system and a given model used to study it. Create a mathematical model from the known behavior of a physical system.

*Skill Development:* Small group and whole group discussions of the construction of mathematical descriptions of physical systems. Exercises assigned daily followed by timely feedback.

*Assessment:* Evaluation of written and oral presentations of the construction of mathematical models from a given physical system.

1. Present all of your mathematical analyses clearly in both written and oral form. Organization and logical flow will be the secrets to success in meeting this objective.

*Learning Outcome:* Presentation of written or oral discussions in a valid and logical format.

*Skill Development:* Small group and whole group discussions of the organization of information when presenting the solution to exercises that involve modeling physical phenomena, solving the associate partial differential equation and analyzing the results.

*Assessment:* Evaluation of all written assignments and oral presentations at the board for validity and logical flow.

1. To recognize and appreciate various approaches to the same problem.

*Learning Outcome:*  Construction of at least two different valid and logical approaches to a given problem.

*Skill Development:* Small group and whole group discussions of multiple approaches to a single exercise.

*Assessment:* Evaluation of solutions of exercises that require the use of more than one approach to an exercise presented in both written and oral form.

If time permits, we will study some applications on the Marshall Differential Analyzer.

1. Understand the mechanics of the differential analyzer and how it can be used to model differential equations. .

*Learning Outcome:* Program and solve a differential equation using the Marshall Differential Analyzer and analyze your results.

*Skill Development:* Small group and whole group laboratory experiences in the Marshall Differential Analyzer Lab. Lab experience supported and enhanced by formatted lab reports.

*Assessment:* Evaluation of lab reports describing setup and output of the differential analyzer and analysis of what the output offers.

**Textbook:** Applied Partial Differential Equations, Second Edition

J. David Logan

Springer

**Grading Procedure:** You grade will be calculated using the following percentages:

Homework and Boardwork 30%

Mid-Term Exam 40%

Final Exam: 30%

There will be two exams during the semester, including the final exam (**Tuesday, May 6, 2014, 3:30 P.M. – 5:30 P.M.).**  . In the event you have a University excused absence and are not able to take an exam on the scheduled date (See Attendance Policy on the first page of this document), if possible, contact me before the scheduled exam time so that we can plan a time for you to take the exam early. Otherwise, with an excused absence, you have one week from the date of the excused absence to make-up your exam.

I will ask to you present some of your fine works of art at the board for my enjoyment as well as that of your peers. This is what I call “Boardwork”. You must visit the board at least four times during the semester to get full credit for your boardwork.

Your final grade will be determined using the following scale:

90% - 100% A

80% - 89% B

70% - 79% C

60% - 69% D

0% - 59% F

My best advice (It’s free!) is for you to keep up with your reading and homework assignments.

**Have a great semester and let me know if I can help you.**

**Cheers!**

**Dr. Lawrence**