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PROPOSAL FOR COURSE ADDITION

To: **Curriculum Committee and Graduate Council**

From: **Department of Mathematics**

Date submitted:

Request for: **Course Creation**

Submitted by: **Vrege Amirkhanian, Ph.D.; Marcel B Finan, Ph.D.**

Approved by: **Department Head:** Tom Limperis

Dean of School: Wally Hoefler

Reviewed by: **Registrar:** Tammy Kuckle

Vice President:

I. Catalog description: *Introduction to Partial Differential Equations.* This Course is an introduction to partial differential equations with emphasis on applications to physical science and engineering. Analysis covers the equations of heat, wave, diffusion, Laplace, Dirichlet and Neumann equations. Course is suitable for senior level or first year graduate students in Mathematics, Physics, and Engineering.

V 12-12-08

Number: MATH 4343/5343

Course Prerequisite: MATH2934/MATH3243

Title for Catalog: Introduction to Partial Differential Equations

*Title for Course Inventory: Introduction to PDE

Descritpion: This course is an introductory course for partial differential equations. Topics that will be covered include include: First order partial differential equations, the method of characteristics. Classification of second order PDE's: parabolic, elliptic, and hyperbolic. The canonical form. Boundary value problems with applications to physical sciences and engineering. Analysis of the wave, heat, and Laplace equations. Application of Fourrier Series.

app CC 11/14/08
app FS 12/3/08

Effective date or term: Spring 2009

II. Justification and feasibility of course:

A. What is the need for this course?Who will take it?
This course will serve as an upper-level elective course for students who have an interest in the theory of partial differential equations and its applications. The course is also used by graduate engineering major to meet certain degree requirements. The addition of this course to the catalog is necessary for many reasons: A course in PDE is important for math majors who want to either pursue a profession in industry or pursue a graduate study in applied mathematics. Additionally, engineering students will be exposed to various equations in the field such as the equations of heat, wave, Lapalce's and Dirichlet equations.

B. How does it relate to other work being offered by your department? Is there an overlap with other courses in the department?
The creation of a course in partial differential equations serves both students in mathematics and engineering. This course further broadens the variety of courses offered by the mathematics department. There would be no overlap with other courses offered by the department. Partial differential equations acts as a valuable companion to ordinary differential equations in the sense that both serve as valuable topics for applications in the physical sciences and engineering.

C. Is this course part of any general plan of development within your department?
Without doubt, this course adds greater depth and breadth to the courses already offered by the department.

D. How often will the course be offered?
This course will be offered every spring semester.

E. How will the course be staffed?
The course will be taught by current faculty. No additional resources are required.

F. When applicable, state with which department you have specifically Coordinated this change?
Department of Electrical Engineering Dept Head: Dr. Ronald Nelson
Department of Mechanical Engineering Dept Head: Dr. John Krohn

Graduate Course Description

MATH 5343 Introduction to Partial Differential Equations. This is an introduction to partial differential equations. Topics include: First order partial differential equations, the method of characteristics. Classification of second order PDE's: parabolic, elliptic, and hyperbolic. The canonical form. Boundary value problems with applications to physical sciences and engineering. Analysis of the wave, heat, diffusion, Laplace, Dirichlet and Neumann equations. Application of Fourrier theory. Course is suitable for senior level or first year graduate students in mathematics, phyics and engineering.

Course Assessment

This course is mainly a required course for the Master's program offered by the Engineering departments at Arkansas Tech University. As a result, course assessment can be conducted by the departments at their own discretion. The department of Mathematics will count it as an elective course for students majoring in mathematics. Without doubt, this course will add strength and diversity to our program in the area of applied mathematics.

MATH 4343 / MATH 5343 Introduction to Partial Differential Equations
Class Information Sheet

Course Description: This course is an introduction to partial differential equations (PDEs) with a special focus on the significance of characteristics, solutions by Fourier series, integrals and transforms, properties and physical interpretations of solutions, and a transition to the modern function space approach to PDEs. The course begins with first-order linear and quasi-linear PDEs and the role of characteristics in the existence and uniqueness of solutions. Canonical forms are discussed for the linear second-order equation, along with the Cauchy problem, existence and uniqueness of solutions, and characteristics as carriers of discontinuities in solutions. Fourier series, integrals, and transforms are followed by their rigorous application to wave and diffusion equations as well as to Dirichlet and Neumann problems. In addition, solutions are viewed through physical interpretations of PDEs.

Prerequisites: MATH 2934 and MATH 3243

Text: *Beginning Partial Differential Equations,* by Peter O'Neil, Second Edition, published by Addison Wesley (2008).

Bibliography

• Stanley J. Farlow, *Partial Differential Equations for Scientists and Engineering,* Dover Publications (1993).

Course Objective

In the end of the course, a student:

• Can classify the partial differential equations and define the solution methods;

• Can define the canonical forms of partial differential equations;

• Can investigate the continuous dependence to the initial values of the Cauchy Problem for the wave equation by D'Alambert Formula;

• Can explain how the solution of the wave equation be affected from the alterations done inside or outside the domain by determining it at a point;

• Can expand a function to the Fourier Series and investigate its convergence;

Course Content

• General solution of the first order linear partial differential equations with

two variable and Cauchy Problem for this equations;
- General solution of the first order quasi-linear partial differential equations with two variable and Cauchy Problem for this equations;
- Reduction of the second order linear partial differential equations with two variable to the canonical form and classification of them;
- Wave, heat, and Laplace's equations;
- Cauchy Problem for wave equation and dAlambert formula;
- Fourier Series and the criterions for the convergence of this series;
- Solution of the initial and boundary value problems with Fourier Series;