Course Title/Number	**MTH 667, Numerical Partial Differential Equations**
Semester/Year	**Fall 2014**
Days/Time	**TR 6:30 to 8:20**
Location	**TBD**
Instructor	**Dr. Scott Sarra**
Office	**Morrow Library 110**
E-Mail	**sarra@marshall.edu**
Office/Hours	**2:00 to 5:00 on TR by appointment**
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy be going to www.marshall.edu/academic-affairs and clicking on "Marshall University Policies." Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802 Academic Dishonesty/ Excused Absence Policy for Undergraduates/ Computing Services Acceptable Use/ Inclement Weather/ Dead Week/ Students with Disabilities/ Academic Forgiveness/ Academic Probation and Suspension/ Academic Rights and Responsibilities of Students/ Affirmative Action/ Sexual Harassment

Course Description: From Catalog

Polynomial and non-polynomial methods for elliptic, parabolic, and hyperbolic PDEs. Study of properties such as consistency, convergence, and stability. Computer implementation.

Course Student Learning Outcomes

After completing the course the student will 1) understand the method of lines discretization method for time-dependent PDEs, 2) will understand the pros and cons of local and global spatial discretization methods based on polynomial and non-polynomial basis functions 3) will have knowledge of both physical space and transform space differentiation methods, 5) will understand how fast transform methods such as the FFT can be used to efficiently evaluate space derivatives, 6) will be exposed to the solution of PDE boundary value problems and numerical linear algebra methods used to evaluate the discretizations of the BVPs, 7) will be exposed to and complete a project in a current research area in numerical analysis, 8) will have gained experience in doing a literature search, 8) will have written a paper that was typeset using LaTeX, 9) will have had the experience of giving a presentation on a mathematical topic, 10) will have gained experience in using mathematical software, 11) will have experience writing mathematical software, 12) will have completed a project in an application area such as computational fluid dynamics.

Required Texts, Additional Reading, and Other Materials

1. Spectral Methods in MATLAB, ISBN-13: 978-0898714654

2. Multiquadric Radial Basis Function Approximation Methods for the Numerical Solution of Partial Differential Equations. Advances in Computational Mechanics, volume 2, 2009. ISSN: 1940-5820. (pdf)

3. Chebyshev and Fourier Spectral Methods 2nd Edition. ISBN 0-486-41183-4

Grading Policy

60% homework, 20% paper presentation, and 20% final project

Attendance Policy

In 600 level classes, attendance at every class is expected. I do not "read the text book'' to the class during lectures. The material presented in lectures is meant to supplement the text book.

Paper presentation:

A paper will be selected from a list of peer reviewed journal articles in the area of Numerical PDEs. Details of the presentation will be given in class.

Final Project:

The final project will involve the 2d Navier-Stokes equations that govern fluid flows. Details of the presentation will be given in class.

Homework:

Approximately 6 homework sets will be given in 2 to 3 week intervals. All solutions must be turned in in hard copy form. Electronic versions will not be accepted. A followup oral questioning may be given after HW solutions are submitted. This is to both clear up any misunderstandings on the HW solutions and to ensure that the solutions submitted are indeed the work of the particular student. HW due dates may be extended due to rare circumstances for the class as a whole, but not for individuals.

Computer Programming:

An essential part of Numerical Mathematics is implementing algorithms on a computer. The HW sets and the final project will require some (relatively) simple computer programs to be written. Computer languages that are appropriate for and that are commonly used in scientific computing include Fortran, C/C++, Python, and Julia. Python will be the language that is primarily used in class examples. Python is also suggest for use in HW problems and projects since you should be familiar with it from CS 205 which is a prerequisite to this class. However, any other (appropriate) language of your choice may be used.

Collaboration policy:

Collaboration on HW sets is not only allowed, but is encouraged. Each student must write up and turn in their own solutions. For problems involving computer programs, a listing of the computer code and its output must be submitted. If the computer program is a collaborative effort, each student in the group must separately type in and execute the program and then generate printed code and output. In addition to working with other students in the class, you are encouraged to use resources such as text books other than the official class text, journal articles, and internet searches. No matter whom you talk to or what you read, HW solutions should be written up on your own, without having the solutions produced by the entire group or other source in front of you. There is a huge difference between collaborating and copying. Copied HW solutions will be given zero credit. Copied HW solutions are usually very easy to identify. Even if copied solutions can not be identified in written form, the fact that they were copied always comes out in the follow-up oral questions on the HW.