Course Title/Number	**MTH 443/643, Numerical Analysis**
Semester/Year	**Fall 2017**
Days/Time	**TR 5:00 to 6:15**
Location	**WAEC 3119**
Instructor	**Dr. Scott Sarra**
Office	**WAEC 3227**
E-Mail	**sarra@marshall.edu**
Office/Hours	**Tuesdays and Thursdays by appointment from 3:15 to 5:00 and after my last class is over at approximately 8:20.**
University Policies	By enrolling in this course, you agree to follow University Policies. The policies can be found at www.marshall.edu/academic-affairs/policies/.

Course Description: From Catalog

Introduction to Numerical Analysis. Floating point number systems, interpolation methods, solutions of linear and nonlinear systems of equations, numerical integration and differentiation, and methods of solution of ordinary differential equations. **Prerequisites:** MTH 331 Linear Algebra, and CS 205 Scientific Computing (may take concurrently).

Course Student Learning Outcomes

After completing the course the student will 1) understand the basic topics of numerical analysis: computer representation of numbers, floating point arithmetic, root finding, interpolation, condition numbers, and basic numerical linear algebra, 2) be prepared to embark upon more advanced study in numerical analysis, 3) understand how numerical mathematics fits into science as a whole, 4) will be exposed to and complete a project in a current research area in numerical analysis, 5) will have gained experience in doing a literature search, 6) will have written a paper that was typeset using LaTeX, 7) will have had the experience of giving a presentation on a mathematical topic, 8) will have gained experience in using mathematical software, and 9) will have experience writing mathematical software.

Required Texts, Additional Reading, and Other Materials

1. *Numerical Analysis* (2nd Edition) by Tim Sauer, ISBN: 0321783670
2. A laptop computer.

Grading Policy

60% homework, 20% class participation, and 20% final project

Attendance Policy

In 400/600 level classes, attendance at every class is expected.

Homework:

Approximately 6 homework sets will be given in 2 to 3 week intervals. A follow up 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.

Class participation:

A flipped classroom approach will be taken in the course that puts more of the responsibility for learning on the shoulders of the students. Students will be given reading material in advance and then be asked to discuss it during class time. Students will be expected to collaboratively discuss problem solutions during class as well as to clearly explain solutions to problems that have been assigned.

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 suggested 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 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.

Final Project:

The final project is to write a 8 to 20 page paper (typed using LaTeX), surveying an interesting numerical algorithm not covered in the course. The paper should be written for a target audience of your classmates in the course. The paper should include the following: 1) numerical results (produced from computer code that you write) from applying the algorithm to a model problem, 2) proofs of theoretical properties (stability, convergence rate, etc.) of the algorithm and numerical examples illustrating and verifying the properties, 3) a comparison to a competing algorithm for solving the same problem, 4) references (in a bibliography) to published literature (journal articles and books - not web pages) that document the development of the method as well as subsequent improvements of the method. The paper will be summarized in a 10 to 15 minute presentation to the class. The project should not be started on until a one page proposal that outlines the work to be done in the project has been approved. The proposal should be submitted and approved no later than the end of the fourth week of class.

Course Schedule: Selected topics from chapters 0, 1, 2, 3, 5, and 6 of the Sauer textbook will be discussed. A more detailed schedule will be given in class as we proceed through the semester.