Advanced Calculus I

Fall 2017

MTH 427 Section 101, CRN 3188

T R 2:00 – 3:15 SH 518

(Revised 8/17/2017)

# Instructor: Dr. Bonita A. Lawrence

614 Smith Hall, Differential Analyzer Lab

696-3040, 696 3854 lawrence@marshall.edu

Office Hours: 10:00 A.M. – 11:30 A.M. M, T, W, 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 – Undergraduate Catalogs. At this point, choose the catalog you started under (or any catalog after that).

**University Attendance**

**Policy**: The University Policy that describes excused absences can be found in the Marshall University 2015– 2016 Undergraduate Catalog on pages 85 – 86.

I expect you to be in class everyday 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. You will be able to find your assignments at the Blackboard site for our class.

**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 2015 – 2016 Undergraduate Catalog on pages 71 - 73.

**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 2015 – 2016 Undergraduate Catalog on p. 68.

**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. (Prior to last year, during my time at Marshall, the University was only shut down for 1.5 days. However, last spring it was more than a week!) The policy can be found on pp. 69 -70 of the Marshall University 2015 – 2016 Undergraduate Catalog.

**Course Description from Catalog:** A rigorous study of the real number system, continuity and differentiability of functions of a single variable, integration of functions of a single variable, infinite series. (PR: *C* or better in MTH 231 and C or better in MTH 300 and CR/PR : MTH 331)

**Course Prerequisites:** MTH 231 – Calculus III, MTH 300 – Introduction to Higher

We will investigate many topics you studied in calculus, including topics in Calculus III. In this course, our goal is to expand your understanding of foundational concepts through proof and the investigation of insightful examples.

**Textbook:** Introduction to Real Analysis, 4th Edition

Robert G. Bartle and Donald R. Sherbert

John Wiley & Sons, Inc.

**Course Objectives:** This course is an in-depth study of the behavior of functions on the real line. We will begin with discussions of sequences and series and conditions that insure convergence. With this in mind we will study the limits of functions and continuity. Several classical theorems, such as Bolzano –Wierstrass will be studied with proof. Your understanding of these powerful ideas will be expanded as you construct your own proofs and create your own examples. We will return to the limit definition of the derivative and verify many results related to differentiable functions. If time permits, we will develop a structure for the development of the Riemann sum and use it to define the definite integral.

I am looking forward to an exciting semester!

Success in the course will be measured by your ability to meet the following learning outcomes.

The ability to

1. Exhibit an understanding of fundamental theorems related to the behavior of sequences and series, and differentiation and integration of functions.

Skill Development: Individual, small group and whole group discussions of a) the behavior sequences and series, b) differentiation of functions, and c) integration of functions. Daily exercises with review the following class period.

Assessment: Written and oral presentations of proofs of classical theorems including group constructions

1. Comprehend and apply the results found in classical theorems (and proofs of the theorems) in function theory of real variables to related problem settings.

Skill Development: Individual, small group and whole group discussions of applications of classical theorems. Daily exercises with review the following class period.

Assessment: Written and oral presentations as well as group presentations of the solutions process for exercises involving the application of classical theorems.

1. Construct (as well as restate in your own words) formal proofs of propositions that address concepts discussed during the course of the semester.

Skill Development: Individual, small group and whole group discussions about the construction of logical and valid proofs of classical theorems and related propositions. Daily exercises with review the following class period.

Assessment: Written and oral presentations (individual as well as group work) of proofs of classical theorems and related propositions.

1. Present your work clearly and concisely in both written and oral form. Organization and logical flow will be the secrets to success in meeting this objective.

Skill Development: Individual, small group and whole group discussions about precise and concise language in both written and oral form. Daily exercises with review the following class period.

Assessment: All written assignments and oral presentations at the board.

1. Recognize and appreciate various approaches to the same problem.

Skill Development: Individual, small group and whole group discussions about the construction of more than one approach to the proof of a theorem or proposition. This offers the group a chance to learn about the perspective of others. This is a valuable exercise!

Assessment: Exercises that require the construction of more than one approach to an exercise or proof of a proposition.

1. Describe convergence using a physical model.

Skill Development: Set up and run a dynamic equation on one of the Marshall Differential Analyzers.

Assessment: Written and oral descriptions of how the physical model describes the mathematical concept of convergence.

**Textbook and**

**Required Materials** Introduction to Real Analysis, 4th Edition

Robert G. Bartle and Donald R. Sherbert

John Wiley & Sons, Inc.

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

Homework: 35 %

Boardwork: 10 %

Exam I 15%

Exam II 20 %

Final Exam: 20 %

There will be three exams during the semester including the final exam, (**Thursday, December 14, 2017, 12:45 P.M. – 2:45P.M**.). The dates for the first two exams can be found in the schedule of events at the end of the document. In the event you are not able to take the exam on the scheduled date because of serious circumstances, (see Undergraduate Catalog, pp. 121 – 122) please contact me before the scheduled exam time so that we can plan a time for you to take the exam early.

You will be assigned homework in every class period. You will submit your homework at the beginning class. I will not accept late homework. 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 three 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.

**A Tentative Schedule of Topics MTH 527**

**Class Days Topics and Events**

**Week 1 Sets and Functions**

**August 22, 24 Mathematical Induction**

**Week 2 Finite and Infinite Sets**

**August 29, 31 Properties of the Reals and Absolute**

**Value**

**Week 3 The Completeness of the Reals**

**September 5, 7 Applications of the Supremum Property**

**Exam I - Thursday**

**Week 4 Intervals**

**September 12, 14 Exam I, Chapter 1 and Chapter 2**

**Boardwork**

**Week 5 Sequences and their Limits**

**September 19, 21 Limit Theorems**

**Boardwork**

**Week 6 Monotone Sequences**

**September 26, 28 The Bolzano – Weierstrass Theorem**

**Boardwork**

**Week 7 The Cauchy Criterion**

**October 3, 5 Properly Divergent Sequences**

**Week 8 Intro to Infinite Sets**

**October 10, 12 Limits of Functions**

**Week 9 Limit Theorems**

**October 17, 19 Extensions of the Limit Concept**

**Week 10 Exam II, Chapter 3 and Chapter October 24, 26 Continuous Function**

**Week 11 Combinations of Continuous Functions**

**October 31 Continuous Functions on Intervals**

**November 2**

**Week 12 Uniform Continuity**

**November 7, 9 Continuity and Guages**

**Week 13 Monotone and Inverse Functions**

**November 14, 16 The Derivative**

**Week 14 Thanksgiving Break!**

**November 21, 23 Enjoy yourself!**

**Week 15 The Mean Value Theorem**

**November 28, 30 L’Hospital’s Rule**

**Week 16 Integration and Review**

**December 4, 7 Boardwork**

**Final Exam:**

**Thursday, December 14, 12:45 P.M. – 2:45 P.M.**