Syllabus for MATH 478-01
Topology, Fall 2015

Professor: Dr. James Rohal

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Description: Topology is a relatively new branch of geometry that studies very general properties of geometric objects, how these objects can be modified, and the relations between them. Three key concepts in topology are compactness, connectedness, and continuity, and the mathematics associated with these concepts is the focus of the course. Compactness is a general idea helping us to more fully understand the concept of limit, whether of numbers, functions, or even geometric objects. For example, the fact that a closed interval (or square, or cube, or n-dimensional ball) is compact is required for basic theorems of calculus. Connectedness is a concept generalizing the intuitive idea that an object is in one piece: the most famous of all the fractals, the Mandelbrot Set, is connected, even though its best computer-graphics representation might make this seem doubtful. Continuous functions are studied in calculus, and the general concept can be thought of as a way by which functions permit us to compare properties of different spaces or as a way of modifying one space so that it has the shape or properties of another. Economics, chemistry, and physics are among the subjects that find topology useful. The course will touch on selected topics that are used in applications.

Course Objectives: The primary goal of this course is to introduce you to topology, which is a major branch of modern mathematics. We will explore the foundations of mathematics (logic and set theory) at a level and depth appropriate for someone aspiring to study higher-level mathematics and/or to become a professional mathematician. Another goal is to learn how to do research in mathematics, including how to write concise but complete proofs, and how to present to others what you have learned. Finally, this course hopes to expose the students to both mathematical rigor and abstraction, giving there an opportunity further to develop his mathematical maturity.

Text: *Introduction to Topology: Pure and Applied*, 1st Edition, by Colin Adams and Robert Franzosa. ISBN-13: 978-0131848696.

Homework: For each section in the book, a set of problems will be assigned online on Sakai. The due date for these assignments will be posted under the Assignments tab on Sakai. It is your responsibility for keeping track of these due dates. When we complete a section, I will assign the homework to be due at least two class periods after.

- I encourage you to work together on assignments. If you work together with someone, you must include their name on the assignment that you turn in.
- *It is important that you write up your proofs on your own.* You may share ideas with your classmates, but ultimately your proof should be in your own words.
- The only resources you can use when completing these assignments are myself, other professors, other classmates, or your book. I understand that lots of these proofs are available online in some form. It is important that you attempt to work on these problems on your own before you decide to collaborate with someone else. This will improve your mathematical maturity.

Encyclopedia: Throughout this class you will be creating an encyclopedia of definitions, theorems, etc. Every two weeks, I will check your progress on this encyclopedia. It should include at a bare minimum any definition, theorem, lemma, or corollary that we have covered in class. In the book, the definitions are marked as DEFINITON or via **bolded text**, theorems are marked as THEOREM, lemmas are marked as LEMMA, and corollaries are marked as COROLLARY. Be aware that some examples also include definitions, in which case, these should be included. Your encyclopedia must be typed. You should only type the bare minimum needed to state the definition, theorem, etc; do not include any flavor text.

Exams: There will be two take home exams and a take home final. The anticipated dates the exams will be handed out are listed below and are subject to change:

Week of Sep 21	Exam #1
Week of Oct 26	Exam #2
Dead Week	Final Exam

Late Assignments: If you fail to turn in an assignment on the due date, then the score for that item will be zero unless you and I discuss it, and we both agree on an alternative. Adjustments will be made for students who must miss the date

due to illness, observance of a religious holiday, and for students who miss due to a university sponsored activity (with letter from coach, sponsor, etc).

Cheating: Don't do it. Take home exams are to be worked on individually. Students are expected to adhere to the official Academic Dishonestly Policy as stated below:

> *Academic Dishonesty, in whatever form, belies the stated philosophy of WLU "to promote the development of the intellectual, cultural, social, physical, emotional, moral, and vocational capacities of all persons within its sphere of influence." Individuals who commit acts of academic dishonesty violate the principles, which support the search for knowledge and truth. The academic community has established appropriate penalties and disciplinary action for such behavior that can include being expelled from WLU.*

Grading:

Encyclopedia	10% of total
Homeworks	50% of total
Exams	25% of total
Final	15% of total

The standard grading scale will be used.

Special Attention: If you have a disability that affects your academic experience and plan to seek accommodations, it is your responsibility to inform Disability Support Services as soon as possible. Disability Support Services is located in the Learning and Student Development Center (LSDC) in Main Hall. Kateryna Forynna is the ADA representative; she can be reached at (304) 336-8216 or by email at kateryna.forynna@westliberty.edu. It is important to request accommodations early enough to provide adequate time to facilitate your request and provide faculty with written verification of eligibility.

Course Outline:

Chapter 1 Topological Spaces
- 1.1 Open Sets and the Definition of a Topology
- 1.2 Basis for a Topology
- 1.3 Closed Sets

Chapter 2 Interior, Closure, and Boundary
- 2.1 Interior and Closure of Sets
- 2.2 Limit Points
- 2.3 The Boundary of a Set

Chapter 3 Creating New Topological Spaces
- 3.1 The Subspace Topology
- 3.2 The Product Topology
- 3.3 The Quotient Topology
- 3.4 More Examples of Quotient Spaces
- 3.5 Configuration Spaces and Phase Spaces

Chapter 4 Continuous Functions and Homeomorphisms
- 4.1 Continuity
- 4.2 Homeomorphisms
- 4.3 The Forward Kinematics Map in Robotics

Chapter 5 Metric Spaces
- 5.1 Metrics
- 5.3 Properties of Metric Spaces

Chapter 6 Connectedness
- 6.1 A First Approach to Connectedness
- 6.2 Distinguishing Topological Spaces via Connectedness
- 6.3 The Intermediate Value Theorem
- 6.4 Path Connectedness
- 6.5 Automated Guided Vehicles

Chapter 7 Compactness
- 7.1 Open Coverings and Compact Spaces
- 7.2 Compactness in Metric Spaces
- 7.3 The Extreme Value Theorem