

# Course Syllabus

## MAT 536 - Algebraic Topology

### Spring 2023

**Lecture Meeting:** W 4:25 PM - 7:10 PM, 25 University Ave. Room 120

**Professor:** Dr. Jeremy Brazas

Office: 25 University Ave. Room 110

Office Hours:

MW 1:00 PM - 2:00 PM

F 12:00 PM - 1:00 PM

Tuesday 2:00 - 4:00 PM (Zoom Appointment)

or by appointment

Office Telephone: 610-436-2054

Public Safety: 610-436-3311

email: [jbrazas@wcupa.edu](mailto:jbrazas@wcupa.edu) (*this is, generally, the most effective way to contact me*)

**Course content:** This course will provide a rigorous introduction to algebraic topology. Topics covered will include:

1. Basic homotopy theory
2. Elementary category theory
3. Fundamental groups and groupoids
4. Covering space theory
5. Homological algebra
6. Simplicial homology
7. Singular homology (if time permits)

**Textbook:** We will use my own notes but I may recommend more than one textbook. The following are particularly good resources:

1. for fundamental groups and covering space theory:  
J. Munkres, *Topology (2nd Edition)*, Pearson, 2000, ISBN 0131816292. A cheap paperback can be purchased online.
2. for simplicial and singular homology:  
J. Munkres, *Elements of Algebraic Topology*, Westview Press, 1984, ISBN 9780201627282.
3. an excellent but more advanced reference for most of this:  
A. Hatcher, *Algebraic Topology*, [Click here for free online pdf](#)
4. a non-traditional approach with lots of category theory in it is:  
R. Brown, *Topology and Groupoids*, [Click here for free online pdf](#)

**For review of general topology, I recommend my own notes as well as the following textbooks.**

- J. Munkres, *Topology (2nd Edition)*, Pearson, 2000, ISBN 0131816292.
- S. Willard, *General Topology*. Dover Publications, 2004, ISBN 0486434796.

**Prerequisites:** There are no official prerequisites. Experience with general topology is recommended.

**D2L:** Course-related materials and grades will be posted throughout the semester on [Desire2Learn](#)

**Student Learning Outcomes (SLO):** Upon completion of this course, students will:

1. have a working knowledge of algebraic invariants used in algebraic topology such as the fundamental group(oid) and simplicial homology groups,
2. be able to compute fundamental groups using the van Kampen Theorem,
3. have a working knowledge of covering space theory and its application to fundamental groups,
4. be able to apply the concepts of category theory to topology,
5. be able to compute simplicial homology groups using exact sequences,
6. be prepared for more advanced studies in algebraic topology.

**Evaluation:** Student learning outcomes will be assessed through 6 graded homework assignments and 3 exams (see the table below). Your grade will be determined (**as a weighted average**) by your performance on these assessments.

%	Component	Date	SLO
20 %	Exam 1	Week 6	(1)-(3),(6)
20 %	Exam 2	Week 12	(1),(3)-(6)
20 %	Final Exam (comprehensive)	Finals Week	(1)-(7)
40 %	Written Homework	bi-weekly	(1)-(7)

Exam dates are tentative. Once your numerical grade is computed, your letter grade will be assigned according to the following breakdown:

92.5-100.0 %	A	72.5-76.4 %	C
89.5-92.4 %	A-	69.5-72.4 %	C-
86.5-89.4 %	B+	0.0-69.4 %	F
82.5-86.4 %	B		
79.5-82.4 %	B-		
76.5-79.4 %	C+		

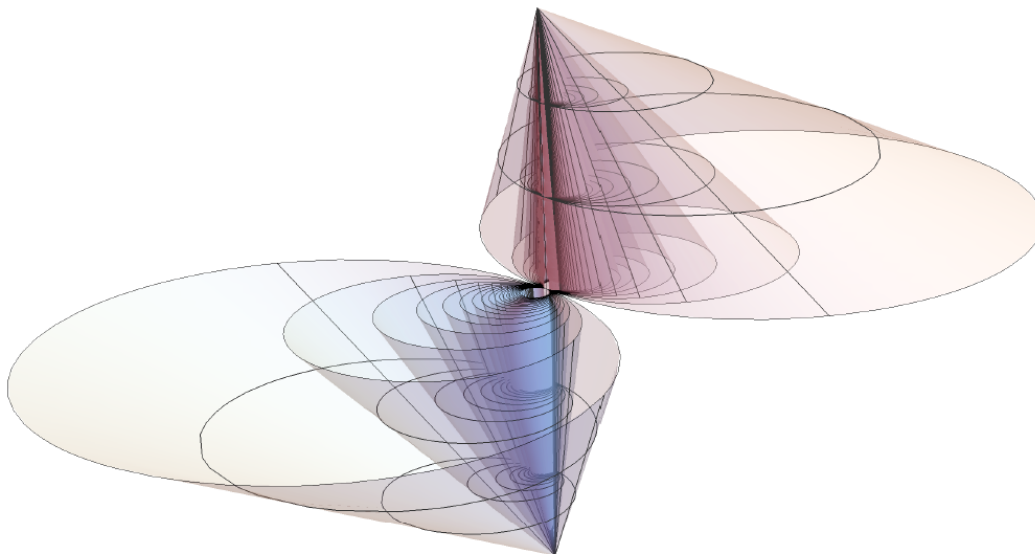
**Exams:** Generally exams will be split into two portions: an in-class exam and a take-home portion (think of it as a kind of like a glorified homework assignment). The in-class exam will be worth 70 points and the take-home portion will be worth 30 points. You will have a week after the in-class exam to complete the take-home portion. The final exam will NOT have a take-home portion associated with it.

**Written Homework Assignments:** It can be difficult to feel comfortable with an area of mathematics without exploring a variety of examples. To this end, homework will be assigned regularly and scored out of 100 points. Typically, the option to complete some corrections to certain homework problems may be possible upon request. Homework corrections must be turned in with a brief reflection describing what went wrong the first time and what you learned from doing it again.

**Class cancellation policy:** If a class must be canceled, you will be informed at a prior class meeting.

**Make-up Policy:** Make-up exams will be granted only for excused absences accompanied with documentation, e.g. a doctor's note, police report, etc. In order to be approved for a make-up quiz or exam, you must notify me prior to the start of that assessment. Exceptions to this policy only occur in special, emergency circumstances. The University has a support system if you miss more than three days of classes due to an illness, personal/family emergency. In such a situation, you may be asked to fill out an absence form through [student services](#).

**Academic Integrity:** All West Chester policies regarding ethics and honorable behavior apply to this course. Dishonest behavior includes (but not limited to) plagiarizing, giving or receiving information during an exam, altering a graded exam and then claiming it was improperly marked, and facilitating dishonest acts by others.



Griffiths Double Cone

## Tentative Course Outline

Week	Topic	Assignments & Reading
1	Fundamental Groups	<b>HW 1</b> , Topology 9§51-52
2	Homotopy Type	Topology 9§58
3	Covering Spaces	<b>HW 2</b> , Topology 9§53-54
4	van Kampen theorem	Topology 9§59, 10§68-70
5	Classification of Covering Spaces	<b>HW 3</b> , Topology Ch.13
6	Exam 1	Exam 1 Take-home
7	Simplicial Complexes	Homework 3, <b>HW 4</b> , Elements AT Ch.1§1-3
8	Simplicial Homology, $H_0$	Elements AT Ch.1§4-5,7
9	Homology of Surfaces	<b>HW 5</b> , Elements AT Ch.1§6
10	Homology of Surfaces	Elements AT Ch.1§6
11	Relative Homology	<b>HW 6</b> , Elements AT Ch.1§9
12	Exam 2	Exam 2 Take-home
13	Homological Algebra	<b>HW 7</b> , Elements AT Ch.3§23-24
14	LES of a pair	Elements AT Ch.3§23-24

## Bibliography

1. Brazas, J. (2019). *Algebraic Topology*, Unpublished Notes.
2. Munkres, J. (2000). *Topology (2nd Edition)*, Pearson.
3. Munkres, J. (1984). *Elements of Algebraic Topology*, Westview Press.
4. Hatcher, A. (2002). *Algebraic Topology*, Cambridge University Press.

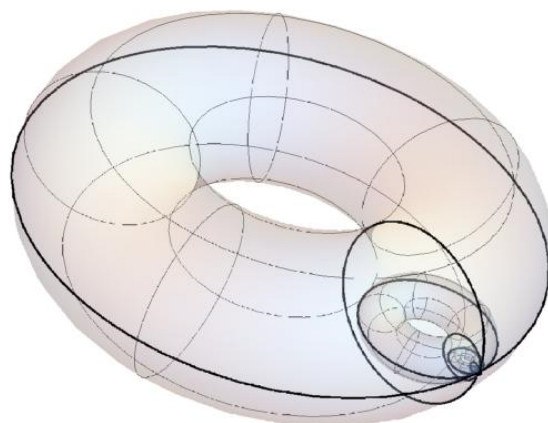
**The withdrawal deadline for the Spring 2023 semester is TBA.**

## University Policies

**Academic Integrity & Personal Integrity:** It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Graduate Handbook, the Graduate Catalog, the Ram's Eye View, and the University website at [www.wcupa.edu](http://www.wcupa.edu)

**Accommodations for students with disabilities:** West Chester University is committed to providing equitable access to the full WCU experience for Golden Rams of all abilities. Students should contact the [Office of Educational Accessibility \(OEA\)](#) to establish accommodations if they have had accommodations in the past or if they believe they may be eligible for accommodations due to a disability, whether or not it may be readily apparent. There is no deadline for disclosing to OEA or for requesting to use approved accommodations in a given course. However, accommodations can only be applied to future assignments or exams; that is, they can't be applied retroactively. Please share your letter from OEA as soon as possible so that we can discuss accommodations. If you have concerns related to disability discrimination, please contact the university's ADA Coordinator in the [Office of Diversity, Equity, and Inclusion](#) or 610-436-2433.

**Excused absences policy:** Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Graduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.



Shrinking Wedge of Tori

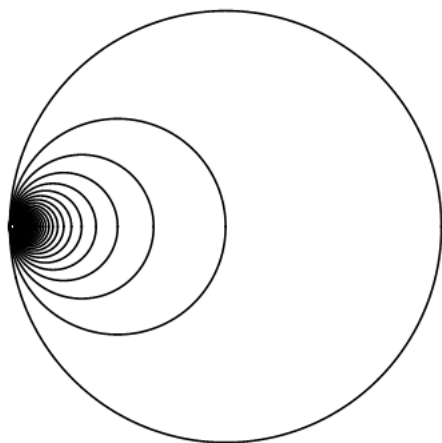
### **Inclusive Learning Environment and Anti-Racist Statement:**

Diversity, equity, and inclusion are central to West Chester University's mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#), and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized

groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism.

Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU's [Office for Diversity, Equity, and Inclusion \(ODEI\)](#), DEI committees within departments or colleges, the [student ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)). Guidance on how to report incidents of discrimination and harassment is available at the University's Office of Diversity, Equity and Inclusion.

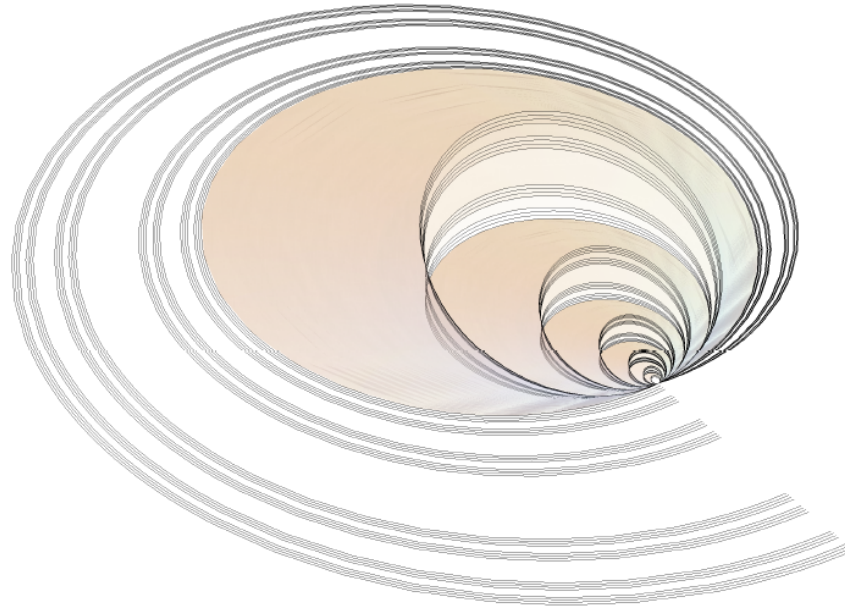


Infinite Earring Space

**Reporting incidents of sexual violence:** West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse

of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: [The sexual misconduct reporting page](#).

**Emergency Preparedness:** All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit [www.wcupa.edu/wcupalert](http://www.wcupa.edu/wcupalert). To report an emergency, call the Department of Public Safety at 610-436-3311.



### Edward's Continuum

**Electronic Mail Policy:** It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.