

MA 59800 - Fall 2020- Syllabus

Topology and its Applications

Specific Syllabus Information

Faculty: Ralph Kaufmann
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Contact: Use e-mail, *do not* leave messages on phone and *do not* send messages via Brightspace.

Class times: MWF 9:30-10:20 pm in REC 113

Homepage for the course:
<http://www.math.purdue.edu/~rkaufman/MA598f20/598.html>

Office hours: M 3:00-3:50.
If you have a conflict with these times, we can arrange for another time to meet.

Texts: References will be on the webpage.

Course description: The course is an introduction to topological concepts and their applications. It is intended to be interdisciplinary in nature. The aim is to build on known concepts and connect them through theory. The pace and presentation will be adjusted to the participants in the course. The course will start with basic examples of topological phenomena known from multi-variable calculus. There are numerous application of this for instance in form of the Gauss law in Electrodynamics and other fields, where central potentials play a role. The analog in 2d is known as the winding number and appears in covering theory, holomorphic functions and in several applied contexts such as the Aharonov-Bohm effect and the Berry phase. Analyzing the ingredients of this we will proceed to discuss fundamental groups, homotopy groups, homology and cohomology. These are introduced in a practical way directed at understanding topological charges such as Chern classes. Physical examples would come from Bloch theory in condensed matter or families of Hamiltonians more generally. Further subjects may include bundles, K-theory, index theory, Chern-Simons classes, topological field theory and gauge theory. These would provide examples of Kitaev's periodic table classifying the various possible topological charges. Further applications would be in Quantum Field theory possibly including more detailed discussions of Dirac and Majorana Fermions and Anyons.

Required Work: Besides the expected participation in class there may be short voluntary homework assignments. Oral presentation by students are possible.

General Syllabus Information

All standard except that contact is only via e-mail.

Academic Integrity:

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

<http://www.purdue.edu/odos/osrr/academic-integrity/index.html>

Academic Adjustments for Students with Disabilities:

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. <http://www.purdue.edu/drc/faculty/syllabus.html>

CAPS Information:

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and <http://www.purdue.edu/caps/> during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Academic Guidance in the Event a Student is Quarantined/Isolated:

If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via **email**. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur.

Attendance Policy during COVID-19:

Students should stay home and contact the Protect Purdue Health Center (496-INFO) if they feel ill, have any symptoms associated with COVID-19, or suspect they have been

exposed to the virus. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, but the student still needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to take an exam. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by **email**. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via [email](#) or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Classroom Guidance Regarding Protect Purdue:

The [Protect Purdue Plan](#), which includes the [Protect Purdue Pledge](#), is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask [in classrooms and campus building](#), at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their instructor. Students also have the option of

reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#).