### MATH 9502A Homotopical Algebra II Course Outline — Fall 2025

# **1.** Course Information

#### **Course Information**

- Course code and title: MATH 9502A Homotopical Algebra II
- Lectures:
- Office hours: by appointment

#### List of Prerequisites

Math 9501A Homotopical Algebra, or permission of instructor.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

## 2. Instructor Information

- Instructor: Chris Kapulkin
- Office: Middlesex College 255C
- Office hours: by appointment
- Email: kkapulki@uwo.ca
- Phone: 519.661.2111, ext. 86534
- Fax: 519.661.3610. This is the fax number of the Department of Mathematics, so students should specify the addressee.

Students must use their Western (@uwo.ca or @ivey.uwo.ca) email addresses when contacting their instructors.

## 3. Course Syllabus, Schedule, and Delivery Mode

#### **Course Content**

- Examples of model structures: chain complexes, spectra.
- Examples of Quillen equivalences: topological spaces and simplicial sets.
- Homotopy limits and colimits via projective/injective model structure on diagram categories and weighted (co)limits.
- Introduction to stable homotopy theory.
- Localization of categories.

#### **Course Learning Outcomes**

- Students will be able to construct a model structure (if one exists) on a given category with a class of weak equivalences.
- Students will be able to compute homotopy limits and colimits of diagrams valued in model categories.
- Students will be able to state the definition and prove properties of stable  $\infty$ -categories.
- Students will be able to express standard constructions of algebraic topology and homological algebra in the language of model category theory.
- Students will be able to prove basic categorical facts in quasicategories.

#### **Key Sessional Dates**

Classes begin:	January 6, 2025
Last day to add:	January 31, 2025
Reading Week:	February 15 to 23, 2025
Last day to drop:	February 28, 2025
Classes end:	April 4, 2025
Exam period:	April 7 to 30, 2025

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

#### **Course Materials**

The following texts may be used to supplement lecture notes:

- D.-C. Cisinski, Higher Categories and Homotopical Algebra, 2019.
- M. Hovey, Model Categories, 1999.

#### Learning Management System (OWL)

Course announcements, including the recommended homework problems and grades, will be posted on the course OWL site.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

### 4. Methods of Evaluation

#### **Course Grade**

The final course grade will be determined by student performance on:

- ten weekly assignments: 50%
- tutorial presentations: 25%
- final presentation + lecture notes: 25%

*Tutorial presentations* [25%] *and assignments* [50%]: On **Constitution**, there will be tutorials instead of regular lectures. One week prior to the tutorial, the instructor will distribute a list of five problems, assigning three of them to specific students (taking into account students' input and preferences). These students will then present their solutions during the tutorial. The remaining two problems are to be solved by all students in writing and the solutions will be submitted via Gradescope prior to the tutorial.

Each student shall present solutions to at least four problems during the term. The solutions will be graded on the scale 0–5, taking into account both correctness of the solution and the clarity of the exposition.

Each written submission will also be graded on the scale 0-5, taking into account both correctness of the solution and clarity of the exposition. Solutions need to be typeset in  $ET_EX$ ; handwritten solutions will not be accepted.

The assignment due dates are as follows:

*Final presentation* + *lecture notes* [25%]: As part of the evaluation, each student will be required to give a 45-minute presentation during the last week of class or the examination period. The presentations cannot use slides, must include a theorem statement, and a proof of at least one short lemma.

The instructor will prepare a list of recommended projects, but students are welcome (in fact, encouraged) to suggest their own topics.

In addition to the presentation, each student must prepare accompanying lecture notes that include what will be written on the board and what will be communicated orally during the presentation. All students will be required to submit their lecture notes 48 hours before the first presentation.

### 5. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please contact the instructor at your earliest convenience.

#### **Absences From Final Examinations**

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., 3 or more exams in 23-hour period, 4 or more exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

# Accommodation and Accessibility

#### **Religious Accommodation**

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult the University's list of recognized religious holidays (click here), which is updated annually. Alternatively, you may wish to enter

• https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

directly into your browser.

#### **Accommodation Policies**

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. Students can consult the policy on Academic Accommodation for Students with Disabilities (click here). Alternatively, type

• www.uwo.ca/univsec/pdf/academic\_policies/appeals/Academic Accommodation\_disabilities.pdf

into a browser.

## 6. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca (click here).

In accordance with policy (click here), the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner. The policy referenced above can also be accessed by typing

• https://www.uwo.ca/univsec/pdf/policies\_procedures/section1/mapp113.pdf

into your browser.

Scholastic offences are taken seriously and students are directed to read the appropriate policy (click here), specifically, the definition of what constitutes a Scholastic Offence. This policy can also be accessed by typing

• http://www.uwo.ca/univsec/pdf/academic\_policies/appeals/scholastic\_discipline\_undergrad.pdf

into your browser.

In the event of a health lock-down, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at

https://remoteproctoring.uwo.ca (click here).

# 7. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/ (click here).

Students who are in emotional/mental distress should refer to Mental Health@Western by visiting their website https://uwo.ca/health/ (click here) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will information about support services for survivors, including emergency contacts is available (click here). If you cannot access the link you can type

• https://www.uwo.ca/health/student\_support/survivor\_support/get-help.html

into your browser. To connect with a case manager or set up an appointment, please email support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education (click here) if you have any questions regarding accommodations. If the link provided does nto work, type

• http://academicsupport.uwo.ca/accessible\_education/index.html

into your browser.

Learning-skills counsellors at the Student Development Centre (click here) are ready to help you improve your learning skills (alternatively, type https://learning.uwo.ca into your browser). They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/ (click here).