

Math 4959B*/9141B: Commutative Algebra

Winter 2023

* Course will receive a new permanent course number.

Meeting Times and location: MWF 9:30-10:30, MC 108

Office Hours: MF 10.30-11.30.

Marks: Final exam worth 40%

6 assignments worth 10% each. (submitted online using gradescope.ca)

Assignments will be due approximately every two weeks. Tentative due dates January 20th, February 3rd and 16th, March 3rd and 17th, April 6th. Homework is due at 11pm on specified days. Late homework will be accepted with a 25% penalty for each day late.

Instructor: Ajneet Dhillon adhil3@uwo.ca

Syllabus: Localisation, tensor products. Primary decomposition of modules. Jacobson rings and the nullstellensatz. Integral dependence. Dedekind domains. Dimension theory. Applications to algebraic geometry.

Required Textbook: None. Notes will be provided. All course material will be hosted on owl.uwo.ca

Supplementary texts: Atiyah and Macdonald, "Introduction to Commutative Algebra"

Matsumura, "Commutative Ring Theory"

Eisenbud, "Commutative Algebra with a view towards algebraic geometry".

Prerequisites: Successful completion of Math 4123, "Rings and Modules"

Objectives and Course Content: The course is an introduction to commutative algebra, an important tool in modern mathematics. We will discuss localisation, chain conditions, primary decomposition, integral dependence, the general form of the nullstellensatz, dimension theory and applications to algebraic geometry.

Learning Outcomes:

- You will be able to manipulate tensor products using their basic properties. In addition you will be able to interpret some basic operations in algebra, such as quotients and localisation in terms of tensor products.
- You will be able to transform difficult questions into simple ones by judicious use of localisation and quotients.
- You will understand the power of the Noetherian hypothesis and why it is preferable to finite generation.

- You will understand the inheritance properties, when passing to polynomial rings and their quotients and localisations, of the conditions, Noetherian, finite generation, Jacobson and Krull dimension.
- You will understand the interplay between prime ideals and the notions of integral dependence and flatness.
- You will be able to understand the geometric consequences of certain algebraic notions such as finiteness and dimension.

Contingency plan for an in-person class pivoting to 100% online learning:

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

Senate Policy on Prerequisites

Unless you have either the requisites for this course or written special permission from your Dean 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.

Course Websites

Students should check OWL (<http://owl.uwo.ca>) or the course website, if not hosted on OWL on a regular basis for news and updates for all of the courses in which they are enrolled. This is the primary method by which information will be disseminated to all students in each class. Students are responsible for checking OWL on a regular basis.

Accommodation and Accessibility

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac@uwo.ca.

For further information, please consult the university's policy on academic consideration for student absences: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf.

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (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” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Academic Policies

The website for Registrarial Services is <http://www.registrar.uwo.ca>

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html>, 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 his/her official university address is attended to in a timely manner.

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

Electronic devices (including cell phones, ipods and calculators) are NOT allowed on exams and may be confiscated.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

In the event of a health lockdown, 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>.

Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below:

Assessments worth less than 10% of the overall course grade:

Please contact your instructor as soon as possible to seek accommodation. If your accommodation is accepted, the first step would be to arrange a short term extension of at most one week. If the accommodation period is longer than a week and at most 2 assignments have been accommodated to date, the assignment will be dropped and the remaining assignments will be averaged to determine the assignment component of the grade. If the accommodation period is longer than a week and 2 or more assignments have been accommodated to date, the weight of the missing assignment will be transferred to the final exam component of the grade.

Assessments worth 10% or more of the overall course grade:

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

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 University's list of recognized religious holidays (updated annually) at

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

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. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf.

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/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) 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 find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact 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 at http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (<https://learning.uwo.ca>) are ready to help you improve your learning skills. 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.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.