

COURSE INSTRUCTOR

Samprit Ghosh

Lectures (Online) : Wednesdays 10-11, Fridays 10-12
(Will be conducted via Zoom, link posted on Quercus.)

Lectures begin on Wednesday, **May 10**.

Office hours : Mondays, 3-4 pm via Zoom.

You can also talk to me on Fridays, right after class, or send me an email and make an appointment.

email : samprit.ghosh@mail.utoronto.ca

TEACHING ASSISTANT(S)

Aaron Tronsgard

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Tutorials (Online) : Wednesdays 11-12
(Will be conducted via Zoom, link posted on Quercus.)

Tutorials start on Wednesday, **May 17**.

TEXT BOOK

Galois Theory by Joseph Rotman, Second edition, Springer.
ISBN 0-387-98541-7 (We will closely follow this textbook.)

Another useful reference : Contemporary Abstract Algebra by Joseph A. Gallian.
This is supplementary, you do not need to purchase this.

COURSE WEBSITE(S)

All the relevant course information will be communicated via Quercus.

Quercus : <https://q.utoronto.ca/courses/305315>

COURSE DESCRIPTION

Commutative rings, quotient rings. Construction of the rationals. Polynomial algebra. Fields and Galois theory : Field extensions, adjunction of roots of a polynomial. Constructibility, trisecting angles, construction of regular polygons. Galois groups of polynomials, in particular cubics, quartics. Insolvability of quintics by radicals.

Prerequisite : MAT301H1 (Exception : MAT347Y1)

GRADING SCHEME

Weight	Assessment	Further breakdown	Submission
35 %	6 Problem sets	best 5, equal weight of 7% each.	Online, Crowdmark
15 %	Mid-term test	Approx. 2 hr long test with a 24 hour window to work on and submit.	Online, Crowdmark
10 %	Research paper	Topics and material will be provided. You'll write a 3-4 page paper. There might be a presentation component.	Online, Crowdmark
40 %	Final Exam	Writing the exam is mandatory , even if you have a passing grade in the rest.	In-person

MISSED ASSESSMENT

Late submissions will not be accepted unless an extension has been explicitly granted by the instructor for legitimate reasons. Missed assessments will be dealt in a case by case basis. If you're missing more than one HW or the midterm due to legitimate reasons, an **Oral test via Zoom** might be conducted and the weight might be distributed between the Oral test and the Final.

Just to remind you that like last term medical notes are not needed, instead students who are absent from class for any reason (e.g., COVID and other illness or injury, family situations) and who require consideration for missed academic work should report their absence through the online absence self-declaration tool and report it to their course instructor. In case the University's policy changes we'll let you know. For more details see the website :

<http://www.illnessverification.utoronto.ca/index.php>

COURSE ORGANIZATION

This course will consist of three hours of lectures and a tutorial per week. First lecture is on **Wed, May 10** whereas the first tutorial is on **Wed, May 17**.

As you might already know, the mode of this course is :

"Online - Synchronous (In Person Final)"

All assessments **except Final Exam**, will be online. We will use **Crowdmark** for Homework submissions. The Final exam will be **in-person** and will be scheduled by FAS in the exam week of August. A tentative course schedule is included in the last page of the syllabus.

TECHNICAL REQUIREMENTS

In order to participate in this course, students will be required to have:

- Reliable internet access. It is recommended that students have a high speed broadband connection (LAN, Cable, or DSL) with a minimum download speed of 5 Mbps.
- A computer satisfying the minimum technical requirements :
<https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>
- Other recommended items include headphones, microphone, webcam, and a tablet or printer. If you are facing financial hardship, you are encouraged to contact your college or divisional registrar for emergency bursaries :
(<https://future.utoronto.ca/current-students/registrars/>)

COURSE OBJECTIVES

- Understand the language of two key abstract structures namely Rings and Fields, their substructures and morphisms between them.
- Study the relationship between Field extensions and (Galois) Groups.
- Abel-Ruffini Theorem : a “general formula” to solve quintic (degree 5) polynomials do not exist! (Also, understanding what constitutes a “general formula”.)
- Constructibility : Certain geometric constructions (e.g a regular 7-gon or trisecting an arbitrary angle) are impossible using only a ruler and a compass.
- More generally, improve your math skills, especially writing proofs, build a strong foundation for studying algebraic structures, discover relationships with other areas of mathematics and have fun!

EMAIL POLICY

- Please note that all communications with the Course Instructor or TA's must be sent from your official utoronto email address, with the **course number included in the subject line**.
- Be specific. We're better able to help you if you're specific about your issue and you include all necessary information. If your situation is complex, it is best to schedule a meeting to discuss it.
- Replying to math questions via email is hard and time consuming. I'll prefer if you come to office hours to discuss the math and use the email for queries related to logistics.

ACCESSIBILITY

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs. Students with diverse learning styles and needs are welcome in this course. If you have a disability that may require accommodations, please feel free to approach your Course Instructor and/or the Accessibility Services office as soon as possible. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Link to Accessibility Services website:

<https://studentlife.utoronto.ca/department/accessibility-services/>

ACADEMIC INTEGRITY

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters (<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-201>). If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to your Course Instructor. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the University of Toronto website on Academic Integrity : <http://academicintegrity.utoronto.ca/>).

EQUITY, DIVERSITY AND INCLUSION

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

COPYRIGHT

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course materials or videos without the explicit permission of the instructor. For questions about the recording and use of videos in which you appear, please contact your instructor.

SCHEDULE*

Lectures + Office Hours : May 8 - June 19, (none on May 22, Victoria Day)

Midterm week : June 21-26 (exact date TBA) followed by a short break.

Lectures + Office Hours : July 5 - Aug 14 (none on August 7, Civic Holiday)

Final Exam week : August 17-25. (exact date and place TBA).

Week	Dates	Section	Notes
1	May 8 - 14	Rings, Domains and Fields	
2	May 15 - 21	Homomorphisms, ideals, quotient rings	
3	May 22 - 28	Polynomial rings	PS1 due on Tue, May 23, 11:59pm
4	May 29 - June 4	Prime ideals and Maximal ideals [†]	
5	June 5 - 11	Irreducible polynomials, Classical Formulas [†] ,	PS2 due on Mon, June 5, 11:59pm
6	June 12 - 19	Splitting Fields, Midterm Review	PS3 due on Mon, June 19, 11:59pm
Mid term	June 21 - 26	Exact date TBD	
Break	till July 3	No classes!	
7	July 3 - 9	Splitting Fields contd.	PS4 due on Fri, July 7, 11:59pm
8	July 10 - 16	The Galois Group	
9	July 17 - 23	Roots of unity	(Optional) Initial project draft submission, July 23, 11:59 pm
10	July 24-30	Solvability by radicals	PS5 due on Mon, July 24, 11:59pm
11	Jul 31 - Aug 6	More Galois Theory [†]	
12	Aug 7 -14	Constructibility (App. C)	PS6 due on Tues, Aug 8, 11:59pm Project due on Fri, Aug 11, 11:59pm
Final	Aug 17 -25		Date and Place TBD.

* This schedule is tentative and subject to change depending on course speed.

† These topics will be somewhat different from what is presented in the textbook. In some cases we will go over the topic in more detail, in other cases we might just glance through it skipping the details.