**Department of Mathematics**

**MATH 3150A Course Outline**

**1. Course Information**

**Course Information**

Course name: Elementary Number Theory I

Course number: MATH 3150A

Academic Term: Fall 2024-2025

Lecture Time: MWF 12:30 P.M. – 1:30 P.M.

**List of Prerequisites**

1.0 course in Mathematics, Applied Mathematics, or Calculus at the 2100 level or higher.

Unless you have either the requisites for this course or written special permission from your Dean’s Designate (Department/Program Counsellors and Science Academic Advisors) 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** | **Email** | **Office Hours (in office)** |
| Dr. Hyun Jong Kim | [hkim2293@uwo.ca](mailto:hkim2293@uwo.ca) | MW 1:30-2:30PM or by appointment |

Students must use their Western (@uwo.ca) email addresses when contacting the instructor. Students are encouraged to contact the instructor to discuss more personalized questions/accommodations (e.g. about assessment flexibilities as they pertain to their own personal situations). Students should use the course page on Owl Brightspace (https://westernu.brightspace.com/) to ask questions pertaining to the course contents (e.g. questions on math problems) or non-personal course logistics commonly applicable to students (e.g. questions about general course policies).   
  
Students are encouraged to send the instructor reminder emails if the instructor has not responded to an email within 2 business days. Students are also encouraged to send the instructor reminder emails *for urgent matters* if the instructor has not responded within 24 hours.

**3. Course Syllabus, Schedule, Delivery Mode**

Divisibility, primes, congruences, theorems of Fermat and Wilson, Chinese remainder theorem, quadratic reciprocity, some functions of number theory, diophantine equations, simple continued fractions.

**Course-level learning outcomes:**

* Demonstrate knowledge and critical understanding of the basic principles within Elementary Number Theory
* Demonstrate the capability to use a range of established techniques and a reasonable level of skill in calculation and manipulation of the material to solve problems relevant to the topics listed above.
* Apply the concepts and principles in Elementary Number Theory in well-defined contexts beyond those in which they were first studied, showing the ability to evaluate critically the appropriateness of different tools and techniques.

Rough course schedule (the following schedule may change and the topics of some weeks may blend into prior or following weeks; the listed chapters are from the required textbook, see Section 4):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Week Number | Dates | Topic | Chapters | Assignment due and/or Midterm |
| 0 | Sep 5 – Sep 6 | Introduction, Divisibility and prime numbers. | 1.2.3, 6.1, 6.3 |  |
| 1 | Sep 9 – Sep 13 | Integer division, greatest common divisors, and Euclidean algorithms | 2 | Assignment 1 Due Sep 13 |
| 2 | Sep 16 – Sep 20 | Congruences and modulo arithmetic | 4, 5, 6.5 | Assignment 2 Due Sep 20 |
| 3 | Sep 23 – Sep 27 | Linear congruences and prime numbers | 5, 6.4 | Assignment 3 Due Sep 27 |
| 4 | Sep 30 – Oct 4 | First Steps with General Congruences | 7 | Assignment 4 Due Oct 4 |
| 5 | Oct 7 – Oct 11 | The (additive) group of integers modulo n and the multiplicative/unit group of integers modulo n | 8, 9 | **Midterm 1 tentatively (time TBA) on Oct 9, to focus on the material of Weeks 0 – 4.**  Assignment 5 Due Oct 11 |
| 6 | Oct 14 – Oct 18 | Fall Reading Week |  | None |
| 7 | Oct 21 – Oct 25 | Quadratic Congruences | 16 | Assignment 6 due Oct 25 |
| 8 | Oct 28 – Nov 1 | Quadratic Reciprocity | 17 | Assignment 7 due Nov 1 |
| 9 | Nov 4 – Nov 8 | Continued Fractions | Chapter 5 *of Stein’s textbook* | **Midterm 2 tentatively on Nov 6 (time TBA), to focus on the material of Weeks 5 – 8**  Assignment 8 due Nov 8 |
| 10 | Nov 11 – Nov 15 | Functions in number theory | 18, 19 | Assignment 9 due Nov 15 |
| 11 | Nov 18 – Nov 22 | Asymptotic behaviour of functions | 20 | Assignment 10 due Nov 22 |
| 12 | Nov 25 – Nov 29 | More on Prime Numbers | 21, 22, 23 | Assignment 11 due Nov 29 |
| 13 | Dec 2 – Dec 6 | Miscellaneous topics and/or review |  |  |

**Note**: Homework 1 is an assignment which is graded by whether a submission is made by the deadline.

Here are some Key Sessional Dates for the course:

Classes begin: September 5, 2024

(Tentative Midterm 1 Date): October 7

Fall Reading Week: October 12 – 20

(Tentative Midterm 2 Date): November 8

Classes end: December 6, 2024

Exam period: December 9 – 22, 2024

**4. Course Materials**

**Textbook: (Required, main)** The June 2024 edition of the PDF version of*Number Theory: In Context and Interactive* by Karl-Dieter Crisman.

The author has made this textbook available at <https://math.gordon.edu/ntic/download.html>

**(Required, but only for chapter 5)** *Elementary**Number Theory: Primes, Congruences, and Secrets* (January 2017 version) by William Stein.

PDF freely and legally available at <https://wstein.org/ent/>

All course material will be posted to OWL: https://westernu.brightspace.com/

All assignment submissions will be done on GradeScope (<https://www.gradescope.ca>). Students are expected to login to Gradescope using their UWO account and enroll in this course on Gradescope. (See also Section 5)

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the [OWL Brightspace Help](https://brightspacehelp.uwo.ca/) page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

**Technical Requirements**

It is recommended, but not required, that students use SageMath, an open-source mathematics software system, for running calculations relevant to the course. One simple way to run SageMath is by making a free account on Cocalc (<https://cocalc.com/>). Students are encouraged to visit the instructor during office hours or to ask question on the course page on Owl Brightspace for help on getting started with using SageMath.

**5. Methods of Evaluation**

**Grading Scheme and Assessment Dates**

The overall course grade will be calculated as listed below:

Assignments (#) 35%

Midterm1 20%

Midterm2 20%

Final Exam 25%

See Section 3 for assignment due dates and tentative midterm dates.

Tentatively, Makeup Midterm 1 will be held on Oct 11 and Makeup Midterm 2 will be held on Nov 8, time and location TBA

Assignment assignments will typically be released at least one week before they are and will be due on the Friday of the week that they are due.

**Requirements on Assessment Submissions**

Writings on assignment, midterm, and final exam submissions must be clear and legible to receive full credit. Assignment submissions on Gradescope (See section 4) must be as PDF files. Students are encouraged, but not required, to submit assignments using typesetting software/software that displays mathematical notations LaTeX, TeX, and/or MathJax. Handwritten submissions that are scanned, photocopied, and/or photographed are also acceptable as long as they are clear and legible.

Unless otherwise specified, solutions to assignments, midterms, and the final exam must be justified and/or calculations must be shown as appropriate to receive full credit.

On the beginning of all assignment submissions, **students must** compile any sources other than the required textbooks (See Section 4) and lecture contents that they may have consulted in formulating their solutions. Such sources may include, but are not limited to: collaborations/discussions with other people (including, but not limited to, the instructor and other students), Internet resources, articles or textbooks other than those listed in Section 4, AI or ML models or interfaces thereof (students are advised, however, that AI or ML models often generate inaccurate and even incoherent statements and that students are responsible for all statements that they include in their assignment submissions), and computer software (such as SageMath). The compilation of these sources should include a brief description of how to identify these sources. The following is a list recommending students on how to identify the aforementioned potential sources:

* For collaborations/discussions with other people: describe who these people are, say by listing their names (Unless an individual wishes to remain anonymous) and relationship to the submitter of the assignment (e.g. friend, classmate, instructor).
* For Internet resources: write out/copy and paste the URL of the web page consulted.
* For articles or textbooks other than those listed in Section 4: indicate the title, author, and journal/publisher as available, along with identifying information on which parts were specifically consulted (e.g. page number, theorem number, section number) .
* For AI or ML models or interfaces therefore: indicate which AI or ML models (e.g. GPT3.5, GPT4, Llama3.1) or interfaces (ChatGPT, perplexity.ai) were used, and summarize what prompts were inputted into said models or interfaces and what responses were outputted.
* For computer software (such as SageMath): summarize what kinds of computations were performed or include a screenshot of relevant code.

Here is a sample statement that compiles sources:

Sources consulted: I collaborated with classmates A, B, along with a friend who wishes to remain anonymous. I also consulted the following webpages: https://www.blahblahblah.com/weeemathisfun, https://www.numbertheoryismindnumbing.com/lalalala . I also consulted Section 1.1.1 of the January 23, 2017 version of William Stein’s *Elementary Number Theory: Primes, Congruences, and Secrets*. I also consulted perplexity.ai with the following prompt “Can negative numbers be prime numbers?” to which it responded that “…negative numbers cannot be prime numbers…” and listed reasons why, and yet suggested that “researchers might explore concepts like ‘negative primes’ with modified definitions”. Lastly, I used the following code via SageMath: `Integer(1001).next\_prime()` to find the next prime number after 1001.

If no sources were consulted in formulating the solutions to the assignment submission, then the compilation must indicated as such, for example by stating “**Sources consulted: None**”.

Each Gradescope assignment will have a place where these compilations are to be submitted. All solutions in assignment submissions must be formulated in the submitter’s “own words”, no matter what sources may have been consulted. Failure to submit a compilation of sources and/or plagiarism on any given assignment **may result in a grade of zero on that assignment and/or treated as “Scholastic Offence”** (see Section 6).

**General information about missed coursework**

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf>,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](http://academicsupport.uwo.ca/accessible_education/).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar’s webpage:

<https://registrar.uwo.ca/academics/academic_considerations/>

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

* Examinations scheduled during official examination periods (Defined by policy)
* Midterm (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

**Evaluation Scheme for Missed Assessments**

Midterm 1 submissions will not be accepted after Oct 11 and Midterm 2 submissions will not be accepted after Nov 8, even with Academic Consideration granted. A missed midterm will be reweighted to the student’s percentage grade of the final exam.

When defining the rules for missed assessments, you should ensure that the essential learning requirements of the course are still met (see below).

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under [Special Examinations](https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_70)), especially for those who miss multiple final exams within one examination period.

**Coursework with Assessment Flexibility**

By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

**Flexible Completion**

**Assignments.** This course has 11 assignments, and the 9 assignments with the highest marks are counted towards your final grade. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first 2 missed assignments. Academic consideration requests will be denied for the first 2 missed assignments. Academic Consideration requests may be granted when students miss more than 2 assignments, and these additional (3rd, 4th…) missed assignments will be reweighted to the final exam.

**Deadline with a No-Late-Penalty Period**

**Assignments.** Students are expected to submit each of the 10 assignments by the deadline listed. Should extenuating circumstances arise, students do not need to request Academic Consideration and they are permitted to submit their assignment up to 48 hours past the deadline without a late penalty. Should students submit their assessment beyond 48 hours past the deadline, a late penalty of 25% per day will be applied. Academic Consideration requests may be granted only for extenuating circumstances that started before the deadline and lasted longer than the No-Late-Penalty Period (48 or 72 hours).

**6. Additional Statements**

**Religious Accommodation**

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university’s EDID website for the recognized religious holidays:

[https://www.edi.uwo.ca](https://www.edi.uwo.ca/).

**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](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf).

**Academic Policies**

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

<https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf>,

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.

No electronic devices will be permitted on exams.

**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:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf>.

**Support Services**

Please visit the Science & Basic Medical Sciences Academic Advising 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 Learning Development and Success ([https://learning.uwo.ca](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.

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