

MATH 3093— Elementary Number Theory

Fall 2021

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Office hours: Virtual, to be scheduled.

Class meetings: TTh 10:00 – 11:20 in Kinesiology 208

We recognize and respectfully acknowledge that all UNB course interactions take place on unsundered and unceded traditional lands of Wolastoqiyik.

Course description

Number theory is the study of the integers and their properties. Because the objects of study are so fundamental, the subject has roots in ancient Arab, Chinese, Greek and other cultures. Yet, some of the most sophisticated mathematics of the twentieth century was applied (and in some cases developed) in solving a simply stated problem about integers. This problem is known as Fermat's Last Theorem, and asks whether the equation $x^n + y^n = z^n$ has any solutions – any positive integers that satisfy the equation – when n is greater than 2.

In this course we focus on the methods and theory of solving equations and congruences in the integers. Topics will include: divisibility, primes, linear and quadratic congruences, linear diophantine equations, quadratic reciprocity.

Text: M. Erickson, A. Vazzana and D. Garth, *Introduction to Number Theory, Second Edition*, Chapman & Hall/CRC, 2016. This is on order at the campus bookstore and is also available from crcpress.com in hardcover and e-book formats. Please respect the authors and obtain your text legally.

Course marking scheme

30% 6 quizzes or assignments

50% 5 problem sets

20% final exam, to be scheduled.

Quizzes and short assignments

Due dates Sept 16, Sept 30, Oct 14, Oct 28, Nov 18, Dec 2.

These are each worth 5% of your grade and will be administered through Crowdmark, which can be accessed through a browser using your D2L login. The purpose of these relatively short assignments is to test understanding of the main concepts and encourage you to stay on schedule. You are expected to work on these individually as the main point of the assessment is to evaluate your (individual) knowledge of the course material.

Problem sets

Due dates Sept 21, Oct 5, Oct 19, Nov 2, Nov 23.

These are each worth 10% of your grade and will be administered through Crowdmark. The difference between a short assignment and a problem set is that the problem sets are meant to be challenging, and will require more than a surface level understanding of the material. As part of your learning, you will need to work hard at times to solve a problem. This is normal. It is also when the most learning takes place and that is why these assignments form a significant portion of your grade.

Working with others is encouraged, but there are some guidelines you must follow when doing so. The 'others' you are working with should be students in this class. Asking experts for help with your homework

is not collaboration, it is cheating. Finding and using solutions – online, in a book, in a video – that are produced by anyone else is also not collaboration, it is plagiarism – and this is no less true if the author willingly shares their work. Getting help from your instructor when you are stuck is the most acceptable and encouraged form of help available. It is also most likely to yield good results, in the form of a good solution that demonstrates appropriate methods relevant to the course, and is written in the expected style and notation. You will be marked on style, notation, and clarity as well as on the logic and general correctness of the work.

Assignments will be marked using the rubric below. Each question is assessed on a 4-point scale, according to each of three categories shown in the table. The average of these is the score for that question.

Problem	logic	explanation	presentation	overall score
1.	1 2 3 4	1 2 3 4	1 2 3 4	
2.	1 2 3 4	1 2 3 4	1 2 3 4	

Logic refers to the underlying structure of an argument, calculation, or explanation.

Explanation refers to how clearly the ideas are expressed, and whether the argument is complete or misses some details or includes extraneous information.

Presentation includes correct use of notation and terminology, neatness, grammar, spelling.

Grading scale: Letter grades are assigned as final grades in the course, according to the scale below.

A	excellent
B	good
C	satisfactory
D	less than satisfactory
F	failure

This scale is clearly subjective in that it does not spell out how numerical percentages (see the marking scheme above) translate to letter grades. This allows for fair assessment that takes the context of the course into consideration.

Preparing for class

Reading and exercises will be assigned each day of class. It is expected that you will come to class prepared to discuss the reading. This does not mean that you have mastered the material, only that you have made an effort to understand it and have noted down your questions and points of confusion. Since we learn mathematics by doing it, it is essential that you be a participant and not a spectator in this class. **Classroom etiquette**

1. **Use of electronic devices:** Reasonable use during class time is permitted. Please use good judgement regarding activities that do not pertain to the class and/or might be distracting to your classmates.
2. **Sharing of course materials:** No video or audio recording of lectures or class discussions is permissible without prior written consent of the instructor. Copies of course notes or other materials provided by me cannot be shared without prior written consent, and this includes photos of notes written on the board. All such reproduction is prohibited as an infringement of copyright and is subject to academic penalties. In the case of private use by students with documented disabilities, consent will not be unreasonably withheld.

3. **Late arrival or early departure:** This is distracting to me and is strongly discouraged. On occasion it might be unavoidable, in which case a simple apology or explanation is warranted and will be accepted graciously.

University plagiarism policy

The University of New Brunswick places a high value on academic integrity and has a policy on plagiarism, cheating and other academic offences. Please see the Undergraduate Calendar, University-Wide Academic Regulations, Regulation VIII, or visit nocheating.unb.ca. It is the student's responsibility to know the regulations.

Weekly schedule

The schedule below is an approximation. Check D2L for updates.

DATE	TOPIC	SECTION
Sept 9	natural numbers	1.1–1.3
Sept 14–16	divisibility	2.1–2.2
Sept 21–23	Euclidean algorithm	3.1, 3.2
Sept 28–30	linear diophantine equations	3.3
Oct 5–7	primes, FTA	4.1–4.3
Oct 12–14	Pythagorean triples, residue classes	11.1, 5.1
Oct 19–21	linear congruences	5.2, 5.4
Oct 26–28	congruence theorems	6.1–6.3
Nov 2–4	primitive roots	7.1–7.4
Nov 8–12	reading week	
Nov 16–18	quadratic congruences	9.1
Nov 23–25	quadratic reciprocity	9.2, 9.3
Nov 30–Dec 2	Jacobi symbol	9.4
Dec 7–9	Gaussian integers	11.2, 11.3