

## MATH 320: Theory of Numbers - Dr. Miller - BRIEF Course Information - Fall 2018

Meeting Times/Place: MW 3:30-4:45 pm in VSC Room 202

Course Description/Content: Properties of natural numbers and number theoretic functions.

Prerequisite: C or better in MATH 235 - Modern Concepts

Post-requisite: Future teachers need a C or higher in MATH 320.

Text: Elementary Number Theory by Strayer

### Classroom environment:

- Calculators are allowed; for exams, some restrictions to protect honesty will be instituted.
- **I CANNOT PERMIT FOOD OR DRINKS** in the room due to a documented health condition.
- Plain, unflavored water will be permitted, but no other beverages. (See above.)
- Please see me immediately if these accommodations conflict with your own documented needs.

### Office Hours and Contact:

- My email address is [lyn.miller@sru.edu](mailto:lyn.miller@sru.edu); my office phone number is 724-738-2878.
- Drop-in office hours will be posted soon; I'm also available by "capture" for math major courses.
- My office is 200-B VSC in the Math office suite. (Please don't bring food/drinks into my office.)
- My web page is [granite.sru.edu/~lmiller](http://granite.sru.edu/~lmiller) . (No "www." and no D2L except for exam grades)
- Assignments, other information will be posted regularly on my web page, NOT on D2L.

Final Exam: Friday, Dec. 14, 1:00-3:00. You MUST take it at the scheduled time.

Grading: HW Score (100 pts), Exams #1-3 (100 pts each), Final Exam (150 pts)

- $A = 90 - 100\%$ ;  $B = 80 - 89\%$ ;  $C = 70 - 79\%$ ;  $D = 60 - 69\%$ ;  $F = 0 - 59\%$ .

### Homework Policy:

- Homework will be collected roughly once a week, usually on **Fridays** in my mailbox.
- Email, phone, or see me about difficulties in advance so that you are ready to turn in your HW.
- Write legibly, staple, and leave plenty of room for me to comment.
- I won't accept make-up/late HW, but drop your worst 1-2 assignments.
- Solutions must **show your own work**; lack of sufficient original work counts as a 0 for all involved.

### Exams:

- You'll get a Topics List listing the concepts on each exam one week prior to its date.
- Calculators may be allowed; honesty is expected else penalties will occur.
- Exams, including the Final, MAY have take-home components as well.
- TENTATIVE midterm exam dates are posted online; the Final is for sure on Friday, Dec. 14.

### Attendance and Make-Up Policy:

- Regular and prompt attendance is expected but does NOT count toward your grade.
- Late and make-up HW: NONE! Remember, I drop 1-2 assignments at the end of the semester.
- Make-up Exams require a **documented** reason and **meaningful** efforts to contact me in advance.
- Your percentage on the Final Exam will constitute your approved make-up exam score.
- If you are absent, get the notes from a **classmate**. This is **YOUR** responsibility.
- When you return from an absence, be prepared to hand in any HW that is due on that day.
- SEEK HELP EARLY AND OFTEN!

The full SYLLABUS is available online and describes my course policy in greater detail.  
YOU ARE RESPONSIBLE for reading it in its entirety.

• **What This Course Is About, Why You Need It, and How It's Taught**

**Content:** To mathematicians, the phrase “number theory” refers not just to any old numbers, but specifically to the set of integers. This course addresses basic definitions and properties that are in many cases exclusive to the integers, or at least our approach will always be so limited. While more advanced number theory can be segregated as “analytic” (based on studying functions that are often viewed in their continuous form also) versus “algebraic” (using the properties and behaviors of rings and ideals to represent those of  $\mathbf{Z}$  and its individual members), in this course, we study strictly “elementary” number theory - topics that are foundational for both of those specialized advanced branches. Many results from elementary number theory were in fact first written out by Euclid, the ancient Greek of geometry fame, and it is still studied from much the perspective that he established. Number Theory is more often named as a favorite course by math majors than almost any other. I hope you will enjoy your encounters with it this semester.

**Rationale:** Obviously, if you're a future teacher, you need a deep understanding of how the integers really operate, for the set of integers underlies every other type of number you will get to teach in your careers. However, for math students with other career hopes, the study of number theory creates an environment in which to hone reasoning and proof-writing skills, an environment that is often more comfortable than others because of our familiarity since childhood with the integers. Number theory is also a foundation for many endeavors in computer science, especially cryptography and internet security. I hope that this semester will allow us to look at one of the more well-known number theoretic approaches for electronic security - one in fact that was used by some ransom-ware that attacked my SRU computer a few years ago.

**Pedagogy:** It's a proof-based course, so you will definitely be writing lots of proofs. On my end, I still lean toward the lecture-as-model style of teaching, with quite a bit of discussion thrown in. I typically teach in this manner because I hope it lets you slowly work through each step of a proof that might involve some intricate “trick” or special technique: for some of you, this is your first post-Modern Concepts proof course, so you'll still need a lot of that kind of reinforcement. Lecture also gives you a model (at least, if the professor is good at it!) for how the material is logically organized and flows most clearly and even elegantly. However, there's also a potential weakness to lecture: during a polished lecture, even an excellent one, you typically don't get to see the professor DOING mathematics; you only get to see him/her PRESENTING mathematics. Most students may not realize that there's a difference. So we math professors face a dilemma: how do we in the same course demonstrate often what a good finished product of a proof should look like while also demonstrating how to arrive at one from scratch, with all the fits and starts, back-tracking and just plain re-booting that entails? There are a lot of valuable approaches and philosophies for attempting this, but in the end, most math faculty agree that we should each teach according to our own strengths. For me, that is still presenting proofs and techniques at the board with lots of annotation (discussion) about the rationale for each step, and expecting you to internalize that rationale so that you can recognize and use it in similar situations in this class and others. I hope this teaching technique will be successful in helping you to learn the material and the broader reasoning and proof skills the course

is used to develop.

- **What the Class Environment Is Like:**

**Physical Environment:** We meet MW 3:30-4:45 in Room VSC 202. I write on the board and occasionally use the front projector screen. Seat yourselves so everyone can see and hear well.

**Cognitive Environment:** You're math majors, so you already know the importance of staying focused during class: don't use cell phones or other technology during class, and don't distract your classmates with off-topic conversation. I encourage collaboration in and out of class, but collaborating isn't the same as copying (cheating) from a partner nor even having an entire group agree on a common response. You should always arrange your own work in your own way and give proofs in your own words, for when you don't, you set yourself up to do poorly in settings where you are expected to work alone, like on exams or in your own classroom. Also, remember that while one professor may allow collaboration in a course, another may not, or someone may allow collaboration on some tasks but not others in the same course. Always check to see whether working together is allowed in a math class.

**Health Environment:** **I CANNOT PERMIT FOOD OR DRINKS** in our classroom due to serious respiratory allergies. Unflavored water is allowed, but no other beverages. See me immediately if this health accommodation conflicts with your own documented needs, so that we can work to craft appropriate adjustments. In your future careers, you will likely be involved in situations necessitating accommodations for co-workers, clients, or even visitors with disabilities in your own workplace; federal law protects the rights of the disabled, including those with health disabilities. Start now to become more aware of such situations.

- **Background and Materials You Need for the Course:**

**Pre-/Post-Requisites:** The course prerequisite is a C or better in MATH 235 - Modern Concepts of Mathematics. Those planning to be certified to teach secondary mathematics need to earn a C or better in our course.

**Texts:** Our text is the blue-and-raspberry book Elementary Number Theory by Strayer. You may be interested to know that the author is a professor at Lock Haven University, one of SRU's sister schools in Pennsylvania.

**Online Tools:** Online notices and extra materials are posted daily on my web page at [granite.sru.edu/~lmiller](http://granite.sru.edu/~lmiller) (no "www.") but NOT on D2L. D2L's password-exclusive nature prevents others outside our course from viewing materials I'd like to share freely. I try to post your current course scores and grade on the D2L gradebook immediately after each exam, but be aware that SRU considers D2L gradebooks unofficial.

**In-Class Tools:** You ARE permitted to use a calculator for most tasks in this course, but it can't be your cell phone and on exams I may institute appropriate procedures to account for the text-based memory of the typical graphing calculator, such as asking you to clear your memory. If you prefer not to do so, a basic calculator with square root and exponentiation capabilities will be sufficient for our purposes. Calculator covers must be put away during exams.

- **How You Can Contact Me Or Get Extra Help:**

**Getting Help From Me:** I am always willing and happy to work with students who need extra help. You should make a good-faith effort to organize your thoughts before seeing me, however. The student who comes to me asking for help or extra practice on a specific problem or topic that he/she has already looked over will benefit much more than the student who has not tried to study for days and simply says “I’m lost; can you teach me everything again?”

**Office Hours and Contact Info:** My drop-in office hours for this semester will be posted online and on my office door; occasional health issues and other conflicts may require me to reschedule, which I’ll announce in advance when possible. We can also make an appointment to meet at other mutually convenient times, and I am available “by capture” for students in our course. This means that if I am in my office with the door open, you can ask me for help; be aware that sometimes, I may have to ask you to come back another time, though. My email address is **lyn.miller@sru.edu**; my office phone number is 724-738-2878. My office is 200-B VSC inside the Mathematics Department office suite. Please do not bring food or beverages into my office; there is a kitchenette counter a short distance from my door where you can leave such items.

**Other Sources of Help:** Remember, you are allowed and encouraged to study together for this course, but make sure you write up assignments in your own words. Please refrain from using solution manuals or web searches to look up answers, proofs, or solutions. Doing so deprives you of the opportunity to improve your own skills, and as I’ve often been told that my proof-based exams require students to “think on their feet,” losing out on genuine individual practice will probably put you at a noticeable disadvantage for exams.

- **How Your Grade Is Determined**

**Overall:** Your grade for the course is based on HW (scaled to 100 points total), three midterm exams (100 points each), and a final exam (150 points), for a semester total of 550 possible points. The letter grade designations are awarded by 10% increments:

$$A = 90 - 100\%; B = 80 - 89\%; C = 70 - 79\%; D = 60 - 69\%; F = 0 - 59\%.$$

I typically round to the nearest whole percent, so for instance an 89.7% rounds up to an A (90%) while an 89.4% rounds down to a B (89%). Students with SRU-documented disabilities should see me ASAP to discuss accommodations for which you have been approved on any of these components to your grade.

**HW:** I plan to collect HW roughly weekly in the course, usually on Fridays to allow for the weekend to grade. Since class doesn’t meet on Friday, your assignment is due in my mailbox (hard copy preferred, but I can accept emailed copies in a pinch). I try to give ample time between handing out an assignment and the intended due date, but you’ll be most successful if you work on it incrementally, rather than trying to do it all the night before (or day of) its due date. For computational or procedural courses such as calculus, problems are short enough that math majors can often put in just one attempt at your assignment near its due date and still be very successful. Proof-writing HW is NOT like that: first, it’s unlikely that your first draft will be perfect, so get into the habit of rereading your assignments very critically to see whether you’ve left anything out or

made any logical leaps that aren't supported. However, in order to get that critical eye really working, you need to let your first attempt rest for a bit: rereading it right after you wrote it is unlikely to help you spot something that, a few hours or a day later will jump up and tell you hey, wait a minute - that doesn't make sense. So start your HW in this course (and other proof courses) early, and plan to reread it before you turn it in to see whether it still makes sense. It's also helpful to have a classmate critique, for an even more unbiased opinion.

I can't grade every problem but will choose a variety to spot-check for correctness, honest effort, and completeness, and for proofs, also for mathematical precision and logical rigor. If you have multiple pages, you should staple them (there is a stapler in the Math Office suite - VSC 200). You may work together on HW, but do NOT copy from each other nor from the book, manual, or other sources - use your own words and organization of work. Any work that looks too identical - even accidentally - will count as a 0 for all involved.

Each homework assignment is worth 20 points, but your final total is scaled to be out of 100 COURSE points. To allow for the occasional missed or just poor assignment, I will be dropping your lowest 1-2 scores, like having personal days at work. **I DON'T ACCEPT LATE HW/QUIZZES** as they make grading criteria less uniform and delay feedback for everyone else in the class. I will try to return assignments as quickly as possible, sometimes the very next class day, but as this is a proof-based course, it usually takes me more than one class day to properly read and assess your proofs. Come in for help before an assignment is due if you have trouble with material on HW or for an upcoming quiz - I hardly ever review at the start of class.

**Exams:** Exams require you to solve new problems, explain or apply covered concepts, and prove both new and occasionally familiar results. I don't often reuse problems. You'll get a Topics List naming what's on each exam one week prior to its date; however, the List does not summarize nor give practice problems. Past successful students say the best way to use the Topics List is to make your own study guide, where you copy down **precise** statements and fully-worked examples or known proofs as well as cautions about the items listed. This requires you to review your own notes, reading, and HW to see what we have said/done about each item. Old exams on my web page are good examples of length or sources of a few practice problems, but they are NOT templates for this semester's exams - I seldom teach a course identically to the past! You need to let this semester's Topics Lists guide your study in order to do well. Each exam takes the whole period, and some may have a take-home component. I'll let you know the format in advance. You will be permitted to have your pen/pencil and a calculator out during exams, but nothing else: no cell phones, no water bottles/mugs, and you'll have to put away your calculator cover too. If I see evidence of dishonesty, everyone involved gets a 0.

**Final Exam:** The Final Exam is cumulative and will have its own Topics List. It is administered in our regular classroom, but on the date and time specified in SRU's official Final Exam Calendar. Honesty is expected, as above. **You MUST take the Final at the scheduled time for our course.** Do NOT plan travel or other activity that conflicts with it; make sure your family and employers understand this also. Our Final is Friday, Dec. 14, 1:00-3:00 p.m.

**Attendance:** Attendance, effort, and other subjective considerations do NOT count toward your grade. Regular, prompt attendance and meaningful effort to do your best are necessary for learning effectively, so it's artificial to include those as separate point-earning/losing components of your grade. If you are absent, it is YOUR RESPONSIBILITY to get the notes and materials from a classmate and the web site, make an effort to review them on your own first, and then see me for help – BEFORE the next class. Again, my assessment of your mathematical knowledge is based on objective standards, so I do NOT give extra credit assignments just to boost performances in the course. However, on a rare occasion, I may choose to encourage other highly valuable aspects of our discipline through SMALL rewards for participating in mathematical events on or near campus. Such opportunities will be equitably offered to all students in the course, will be limited to events that I believe should merit such exceptional reward, and will be announced in advance.

**Make-Ups:** Approval to make up a MISSED EXAM SCORE requires that you make meaningful efforts to contact me ASAP when you learn you'll be absent, and provide a documented, University-approved reason for your absence. If approved, you will NOT take an alternative exam at that time, though: waiting until after an absent classmate can take a make-up exam delays the return of everyone else's feedback. Rather, at the end of the semester, your Final Exam percentage will also count as your missed exam score. As already stated, if you miss handing in a HW or taking a quiz, you will not make it up or turn it in late; instead, I drop your lowest 1-2 scores. Be aware that faculty extend to you the privilege of make-up assignments in certain instances; we are NOT required to do so. You must fulfill your obligations in order to merit that privilege.

- **Important University-wide policy statement on sexual violence:**

The University requires the following statement to be included in all course syllabi. As members of an educational community, you will appreciate the importance of protecting minor-aged children from harm inflicted by adults. The statement below specifically outlines the University's stance toward sexual violence directed toward minors:

“Slippery Rock University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: <http://www.sru.edu/offices/diversity-and-equal-opportunity/sexual-misconduct-and-victim-resources>. ”