Math 615, Elementary Number Theory, Spring, 2017

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Prerequisites: Math 344 with 2.000 or better or departmental consent

How to use this syllabus

This syllabus provides you with information specific to this course, and it also provides information about important university policies. This document should be viewed as a course overview; it is not a contract and is subject to change as the semester evolves.

Academic Honesty

Students are responsible for knowing and following the Student Code of Conduct [http://webs.wichita.edu/inaudit/ch8_05.htm](http://webs.wichita.edu/inaudit/ch8_05.htm) and the Student Academic Honesty policy [http://webs.wichita.edu/inaudit/ch2_17.htm](http://webs.wichita.edu/inaudit/ch2_17.htm).

Course Description

Studies properties of the integers by elementary means.  
The course will begin with a study of mathematical induction and then move on to the study of the Division Algorithm. From there we move to the divides relation and then to congruences. We will then spend some time on solving various types of linear congruences including the use of the Chinese Remainder theorem. This will be followed by the theorems of Fermat and Wilson. We will then study some of the major number-theoretic functions, in particular the multiplicative functions such as: the number and sum of the positive divisors of a given positive integer, the Möbius function and the Euler function.  
In the next chapter we will study quadratic reciprocity and the solution of quadratic congruences. If time permits, we will take up the topic of continued fractions.

Definition of a Credit Hour

Example for 3 credit hour class: Success in this 3 credit hour course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction and preparation/studying or course related activities for a total of 135 hours. Go to: [http://webs.wichita.edu/?u=academicaffairs&Hp=definitionandassignmentofcredithours](http://webs.wichita.edu/?u=academicaffairs&Hp=definitionandassignmentofcredithours) for the policy and examples for different types of courses and credit hour offerings.

Measurable Student Learning Outcomes for Undergraduate Credit

Upon successful completion of this course, students will be able to:

- Recognize when when to use mathematical induction.
- Recognize the appropriate use of the division algorithm, the divides relation and congruences in problem solving.
- Apply basic techniques to solve problems involving linear congruences.
- Apply the properties of multiplicative functions to solve problems involving the number-theoretic functions.
- Use the properties of quadratic residues to determine whether certain quadratic congruences are solvable.
Measurable Student Learning Outcomes for Graduate Credit

Upon successful completion of this course, students will be able to:

- Recognize when to use mathematical induction.
- Recognize the appropriate use of the division algorithm, the divides relation and congruences in problem solving.
- Apply basic techniques to solve problems involving linear congruences.
- Apply the properties of multiplicative functions to solve problems involving the number-theoretic functions.
- Use the properties of quadratic residues to determine whether certain quadratic congruences are solvable.
- Prove basic theorems of number theory.

Required Texts/Readings Textbook


Since there is no single book, currently in print, that covers the topics I want to cover in this course and reasonably priced, we will be using notes that I have prepared for this course. These notes can be obtained in one of the following forms: I will have a PDF file in the "Content" folder on Blackboard that you can download (free). These notes are in book format and are designed to be printed on both sides of the paper (duplexed). You can print them yourself, or have them printed at a copy center, then put them in a three hole binder and have a book in which you can insert your own notes. These notes are formatted as 6” by 9” pages and are easily used as an ebook. Or if you would like a soft-cover, coil-bound copy of the notes, you can order a copy from lulu.com. The cost is $12.49. $8.50 for book plus $3.99 mailing. Before you order the book go to [http://www.lulu.com](http://www.lulu.com) to see if there are any special offers like free shipping or a percentage discount. Note the offer code to enter in order, if applicable.


Other Equipment/Materials

I will be using a computer and data projector for my lectures and after each class I will post, on Blackboard, a PDF file of my lecture. The exception being when I put some examples on the chalkboard. In addition, if I remember to turn everything on, there will be a movie produced of the class that will contain everything I write on the computer as well as everything I say.

Class Protocol

To be successful in a mathematics course one must work problems and attend class. We consider mathematics to be a participation course, not a spectator course. You cannot learn by just watching someone else do mathematics. You should do all problems assigned whether they carry point value or not. If you have difficulties with any concept or problem ask questions in class or come to my office for help. Don’t allow difficulties and problems accumulate until they are too numerous to deal with. Don’t be bashful!

Most homework problem sets will be assigned at least a week before the due date—normally a Wednesday. Do not wait until the day before the due date to start the problem sets. The reason you will be given a week to work on the problems is that some may take a while to solve.

Attendance is not graded; however, students who attend their mathematics classes do better than those who don’t! It should be noted that for the past two years I have been taking attendance with the following results: students have been attending class with more regularity and grades have gone up! If you are planning to leave Wichita at the end of the Full Semester, make your travel plans early. "I have plane reservations." is not an acceptable reason for missing the final examination.

Don’t hesitate to ask questions in class. This is part of the learning process.

Grading Scale

WSU uses a +/- grading scale for final grades and to calculate grade point averages. In this class, grades are assigned according to the following chart. (Note: the chart below is a sample that may be used). (Other classes might assign grades differently: Be sure to understand the different grading scales in all of your classes.)
<table>
<thead>
<tr>
<th>Points/percentages, as instructor chooses</th>
<th>Letter grade</th>
<th>Grade Points</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>A</td>
<td>4.00</td>
<td>The A range denotes excellent performance.</td>
</tr>
<tr>
<td>87-89</td>
<td>A−</td>
<td>3.70</td>
<td></td>
</tr>
<tr>
<td>83-89</td>
<td>B+</td>
<td>3.30</td>
<td></td>
</tr>
<tr>
<td>80-82</td>
<td>B</td>
<td>3.00</td>
<td>The B range denotes good performance.</td>
</tr>
<tr>
<td>77-79</td>
<td>B−</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td>73-76</td>
<td>C+</td>
<td>2.30</td>
<td></td>
</tr>
<tr>
<td>70-72</td>
<td>C</td>
<td>2.00</td>
<td>The C range denotes satisfactory</td>
</tr>
<tr>
<td>67-69</td>
<td>C−</td>
<td>1.70</td>
<td></td>
</tr>
<tr>
<td>63-66</td>
<td>D+</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>60-62</td>
<td>D</td>
<td>1.00</td>
<td>The D range denotes unsatisfactory</td>
</tr>
<tr>
<td>57-59</td>
<td>D−</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Below 57</td>
<td>F</td>
<td>0.00</td>
<td>F denotes failing performance.</td>
</tr>
</tbody>
</table>

**Assignments**

There will be regular written assignments on selected topics, to be determined for 40% of the grade. The performance on all midterm exams will be worth 50% of the grade. The final exam will be worth 10% of the grade. All homework assignments will be selected from the list of problems given below. Not all these problems will be assigned to turn in. Problems for specific assignments and their due dates will be given at a later date.

Chapter 1: 1.1.1, 1.1.2, 1.1.4, 1.2.2, 1.2.3, 1.2.4, 1.2.5, 1.2.7
Chapter 2: 2.1.2, 2.1.4, 2.1.6, 2.1.7, 2.1.8, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4
Chapter 3: 3.2.1, 3.2.2, 3.2.4, 3.2.5, 3.2.6, 3.2.7, 3.2.9, 3.2.11, 3.3.1, 3.3.2, 3.3.4, 3.3.6, 3.3.7,
Chapter 4: Section 4.1 all, 4.2.1, 4.2.2, 4.2.4, 4.2.5, 4.3.2, 4.3.6, 4.3.7, 4.3.10, Section 4.4 all, 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5, 4.5.7, 4.5.9, 4.5.10, 4.5.11, 4.5.13, 4.5.14
Chapter 5: 5.1.1, 5.1.2, 5.1.6, 5.1.7, 5.1.9, 5.1.11, 5.4.2, 5.4.3, 5.4.5, 5.4.7, 5.4.8, 5.4.9, 5.4.10, 5.4.11
Chapter 6: Section 6.1 all, 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.3.1a&c, 6.3.2, 6.3.3, 6.3.4, 6.3.7, 6.3.9
Chapter 7: 7.2.1a&c, 7.2.2b&d, 7.3.1, 7.3.2, 7.3.3, 7.4.1, 7.4.

More problems may be added to this list at a later date.

It should be noted that all exam questions will be from this set of problems or similar problems

**Late Assignments**

Late assignments will not be accepted. There will be no individual make up exams or quizzes given. Exams will be either in-class exams or take-home exams. The Final Exam, which will be a comprehensive examination, will serve as a make up for any and all missed exams and/or quizzes.

**Missed Assignments and Exams**

Missing exams is highly discouraged. Contact me before the exam, if possible, if you are ill or have a personal reason to miss the exam.

**Important Academic Dates**

- The last date to drop a class and receive a W (withdrawn) instead of F (failed) is XXX, XXX. X, 2017. To be determined (has not been published yet)
- There are no classes on March 20-16, 2017 for Spring break.
- The final exam is to be determined. (Schedule not published yet)
Disabilities

If you have a physical, psychiatric/emotional, or learning disability that may impact on your ability to carry out assigned course work, I encourage you to contact the Office of Disability Services (DS). The office is located in Grace Wilkie Annex, room 150, (316) 978-3309 (voice/tty) (316-854-3032 videophone). DS will review your concerns and determine, with you, what academic accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by the instructor or DS without your written permission.

Counseling & Testing

The WSU Counseling & Testing Center provides professional counseling services to students, faculty and staff; administers tests and offers test preparation workshops; and presents programs on topics promoting personal and professional growth. Services are low cost and confidential. They are located in room 320 of Grace Wilkie Hall, and their phone number is (316) 978-3440. The Counseling & Testing Center is open on all days that the University is officially open. If you have a mental health emergency during the times that the Counseling & Testing Center is not open, please call COMCARE Crisis Services at (316) 660-7500.

Diversity and Inclusive

Wichita State University is committed to being an inclusive campus that reflects the evolving diversity of society. To further this goal, WSU does not discriminate in its programs and activities on the basis of race, religion, color, national origin, gender, age, sexual orientation, gender identity, gender expression, marital status, political affiliation, status as a veteran, genetic information or disability. The following person has been designated to handle inquiries regarding nondiscrimination policies: Executive Director, Office of Equal Opportunity, Wichita State University, 1845 Fairmount, Wichita KS 67260-0138; telephone (316) 978-3186.

Intellectual Property

Wichita State University students are subject to Board of Regents and University policies (see [http://webs.wichita.edu/inaudit/ch9_10.htm](http://webs.wichita.edu/inaudit/ch9_10.htm)) regarding intellectual property rights. Any questions regarding these rights and any disputes that arise under these policies will be resolved by the President of the University, or the Presidents designee, and such decision will constitute the final decision.

Shocker1/ Alert System

Get the emergency information you need instantly and effortlessly! With the Shocker Alert System, we will contact you by email the moment there is an emergency or weather alert that affects the campus. Sign up at www.wichita.edu/alert.

Title IX

Title IX of the Educational Amendments of 1972 prohibits discrimination based on sex in any educational institution that receives federal funding. Wichita State University does not tolerate sex discrimination of any kind including: sexual misconduct; sexual harassment; relationship/sexual violence and stalking. These incidents may interfere with or limit an individuals ability to benefit from or participate in the Universitys educational programs or activities. Students are asked to immediately report incidents to the University Police Department, (316) 978-3450 or the Title IX Coordinator (316) 978-5177. Students may also report incidents to an instructor, faculty or staff member, who are required by law to notify the Title IX Coordinator. If a student wishes to keep the information confidential, the student may speak with staff members of the Counseling and Testing Center (316) 978-3440 or Student Health Services (316) 978-3620. For more information about Title IX, go to: [http://www.wichita.edu/thisis/home/?u=titleixf](http://www.wichita.edu/thisis/home/?u=titleixf)

Video and Audio Recording

Video and audio recording of lectures and review sessions without the consent of the instructor is prohibited. Unless explicit permission is obtained from the instructor, recordings of lectures may not be modified and must not be transferred or transmitted to any other person, whether or not that individual is enrolled in the course.
### Tentative Schedule for 15 week class

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics, Readings, Assignments, Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/18</td>
<td>Chap 1 - Preliminaries&lt;br&gt;Homework 1.1, 1.2 assess understanding of preliminary material</td>
</tr>
<tr>
<td>2</td>
<td>1/23, 24</td>
<td>Chap 2 - Divisibility&lt;br&gt;HW 2.1, 2.2 assess division algorithm</td>
</tr>
<tr>
<td>3</td>
<td>1/30, 2/1</td>
<td>Chap 2 - Divisibility&lt;br&gt;HW 2.3 assess Euclidean algorithm</td>
</tr>
<tr>
<td>4</td>
<td>2/6, 8</td>
<td>Chap 3 - Primes&lt;br&gt;HW 3.3 assess Fundamental Theorem of Algebra</td>
</tr>
<tr>
<td>5</td>
<td>2/13, 15</td>
<td>Chap 4 - Congruences&lt;br&gt;HW 4.3 assess Chinese Remainder Theorem</td>
</tr>
<tr>
<td>6</td>
<td>2/20, 22</td>
<td>Chap 4 - cont.&lt;br&gt;HW 4.5 assess theorems of Fermat and Wilson</td>
</tr>
<tr>
<td>7</td>
<td>2/27, 3/1</td>
<td>Exam I - assesses Chaps 1 to 4</td>
</tr>
<tr>
<td>8</td>
<td>3/6, 8</td>
<td>Chap 5 - Number-Theoretic Functions&lt;br&gt;HW 5.1, 5.2 assess divisors and Möbius inversion formula</td>
</tr>
<tr>
<td>9</td>
<td>3/13, 15</td>
<td>Chap 5 - cont.&lt;br&gt;HW 5.3 assess greatest integer function</td>
</tr>
<tr>
<td>10</td>
<td>3/27, 29</td>
<td>Chap 6 - Quadratic Reciprocity&lt;br&gt;HW 6.3 assess quadratic reciprocity law</td>
</tr>
<tr>
<td>11</td>
<td>4/3, 5</td>
<td>Chap 7 - Continued Fractions&lt;br&gt;HW 7.2 assess simple continued fractions</td>
</tr>
<tr>
<td>12</td>
<td>4/10, 12</td>
<td>Chap 7 - cont.&lt;br&gt;HW 7.4, 7.5 assess infinite and periodic continued fractions</td>
</tr>
<tr>
<td>13</td>
<td>4/17, 19</td>
<td>Exam II covering Chaps 5 to 7&lt;br&gt;Chap 8 - Gaussian Integers</td>
</tr>
<tr>
<td>14</td>
<td>4/24, 26</td>
<td>Chap 8 - cont.&lt;br&gt;HW 8.1, 8.2 assess congruences and number-theoretic functions</td>
</tr>
<tr>
<td>15</td>
<td>5/1, 3</td>
<td>Chap 9 - Miscellaneous Topics and Review&lt;br&gt;HW 9.1, 9.2 assess Pythagorean triples and recurrence relations</td>
</tr>
<tr>
<td>Final</td>
<td></td>
<td>covers entire course</td>
</tr>
</tbody>
</table>