Math 301-DL1 Number Theory

George Mason University

Fall 2021 Syllabus

Course Description

Learning Objectives: To understand and make use of the concepts of prime numbers, congruences, multiplicative functions, and cryptology, and to develop general mathematical skills.

Prerequisite: Completion of 6 hours of MATH.

Textbook: Rosen, *Elementary Number Theory and its Applications*, 6th Edition, Pearson, 2010

Course Modalities: All online, half asynchronous, and half synchronous.

Course Meetings:

- Synchronous classes: Thursdays, 1:30-2:45pm, Zoom
- Asynchronous learning and course home page: Blackboard, `https://mymasonportal.gmu.edu/`

Instructor Information

Name: Dr. Kirsch (she/her/hers)

Student Office Hours: Tuesdays 1:30-2:45pm, or by appointment, on Zoom

Email Address: rkirsch4 @ gmu.edu

Grading and Course Requirements

The grading rubric for each problem is

3 Demonstrates full achievement of the learning objective

2 Demonstrates significant progress toward the learning objective

1 Demonstrates some progress toward the learning objective

0 Does not demonstrate progress toward the learning objective

Letter grades in the course will be determined by the percentage of points you have earned and the following table.

A+	A	A-	B+	B	B-	C+	C	C-	D	F
97-100	93-96	90-92	87-89	83-86	80-82	77-79	73-76	70-72	60-69	0-59

Course components and point values: Subject to change, but only to your advantage.

Syllabus and Course Policies Quiz	6
Community and Collaboration Portfolio	18
Preparation, Participation, and Practice Portfolio	18
Reflection Homework	14
Chapters 1, 3:	
Weeks 1-4 Quizzes	24
Exam 1	24
Chapters 4, 6:	
Weeks 6-9 Quizzes	24
Exam 2	24
Chapters 7, 8:	
Weeks 11-14 Quizzes	24
Exam 3	24
Total points in course	200

Retake opportunities: You may complete at most one retake problem each week to replace your score on a quiz or exam problem corresponding to the same learning objective.

Course Calendar

Week	Course Topics	Relevant Problems
Week 1 August 24-30	1.3 Mathematical Induction 1.5 Divisibility	1.3 #2, 3, 4, 6, 7, 8, 9, 10, 12, 13, 14, 20, 21, 24, 26, 27, 36 1.5 #1-22, 26, 27, 28, 30, 31, 36-43
Week 2 August 31-September 5 Labor Day September 6	3.1 Prime Numbers 3.2 The Distribution of Primes 3.3 Greatest Common Divisors and their Properties	3.1 #1, 3, 6, 7, 8, 9, 12, 14, 15, 16, 17, 18, 19, 26, 27, 28 3.2 #1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 18 3.3 #1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 25, 27, 31
Week 3 September 7-13	3.4 The Euclidean Algorithm 3.5 The Fundamental Theorem of Arithmetic, Proof	3.4 #1-10, 14 3.5 Understand and be able to explain each step of the proof.
Week 4 September 14-20	3.5 The Fundamental Theorem of Arithmetic, Applications 3.6 Factorization Methods and Fermat Numbers 3.7 Linear Diophantine Equations	3.5 #1-5, 6, 7, 8, 9, 10, 11, 28, 29, 30, 31, 34, 35, 36 3.6 #1-4 3.7 #1-10 odd, 13-18 odd
Week 5 September 21-27	Chapter 1: The Integers and Chapter 3: Primes and Greatest Common Divisors Catch-Up, Review, and Exam 1	See Weeks 1-4
Week 6 September 28-October 4	4.1 Introduction to Congruences 4.2 Linear Congruences	4.1 #1-4, 6, 7, 8, 9, 10-14, 16, 17, 20-23, 25, 27, 29, 31, 32, 34, 41, 42 4.2 #1-15 odd, 19
Week 7 October 5-10	4.3 Sun Zi's Remainder Theorem 6.1.1 Wilson's Theorem	4.3 #1-12, 16, 17, 20, 21 6.1 #1-22 odd, 27, 29, 34, 41
Week 8 October 13-18	6.1.2 Fermat's Little Theorem	6.1 #1-22 odd, 27, 29, 34, 41
Week 9 October 19-25	6.2 Pseudoprimes 6.3 Euler's Theorem	6.2 #1-19 odd 6.3 #1-12 odd, 17, 19
Week 10 October 26-November 1	Chapter 4: Congruences and Chapter 6: Some Special Congruences Catch-Up, Review, and Exam 2	See Weeks 6-9
Week 11 November 2-8	7.1 The Euler Phi-Function 7.2 The Sum and Number of Divisors	7.1 #1-8, 12, 13, 14, 17, 19 7.2 #1-4, 7-14, 20, 21
Week 12 November 9-15	7.3 Perfect Numbers and Mersenne Primes 7.4 Mobius Inversion	7.3 #1-14, 15 7.4 #1-6, 10, 13, 14, 19, 21
Week 13 November 16-22	8.1 Character Ciphers 8.3 Exponentiation Ciphers	8.1 #1-14 8.3 #1-6
Week 14 November 23, 29	8.4 Public Key Cryptography	8.4 #1-8, 11-15
Week 15 November 30-December 5	Chapter 7: Multiplicative Functions and Chapter 8: Cryptology Catch-Up and Review	See Weeks 11-14
December 8-13	Exam 3	See Weeks 11-14