



Shanghai Jiao Tong University

MA197 Algebra and Number Theory (Online)

<b>Instructor Information</b>	Wanchunzi Yu Home Institution: Bridgewater State University Email: wyu@bridgew.edu		
<b>Term</b>	June 28, 2021 - July 27, 2021	<b>Credits</b>	4 units
<b>Course Delivery</b>	The class will be delivered in the format of online. Other than recorded lecture videos, the instructor will arrange 3 hours' real-time interactions with students per week (via discussion forum, zoom meeting, and WeChat). The workload students are expected to complete to properly pass this course is about 15 hours per week.		
<b>Required Texts (with ISBN)</b>	Unit information, summary lecture notes, assignments, exercises, marks, all handouts and all announcements are made available during class. A Book of Abstract Algebra, 2nd edition, by Charles C Pinter. Elements of Number Theory, by John Stillwell		
<b>Prerequisite</b>	N/A		



## Course Overview

This course introduces students to a rigorous study of algebra and number theory. During the first part of the course we will study natural numbers and integers, the Euclidean algorithm, congruence arithmetic, the RSA cryptosystem, quadratic integers, and quadratic reciprocity from the textbook of the Elements of Number Theory. We will learn operations, groups, subgroups, examples of groups and subgroups, as well as quotient groups from a book of abstract algebra.

## Learning Outcomes

Upon successful completion of this course, students will be conversant with

- understanding concepts of numbers and integers
- the definitions, examples, and applications of groups and subgroups
- developing problem solving skills
- apply concepts and theories to solve problems
- improvements of mathematical thinking skills

## Course Structure

1. Asynchronous Hours: Sunday through Thursday, total 25 hours Pre-recorded videos will be posted on SJTU SCE online learning platform.
2. Synchronous Hours: Beijing Time: Tuesday: 8:30 – 10:00 pm, Thursday: 7:00 – 8:30 pm.



## Grading Policy

Three Assignments	30%
Quizzes/Attendance	20%
Middle Exam	25%
Final Exam	25%

## Grading Scale is as follows

Number grade	Letter grade	GPA
90-100	A	4.0
85-89	A-	3.7
80-84	B+	3.3
75-79	B	3.0
70-74	B-	2.7
67-69	C+	2.3
65-66	C	2.0
62-64	C-	1.7
60-61	D	1.0
≤59	F (Failure)	0



Class Schedule

Date	Lecture	Chapter	Online Teaching Arrangement
Day 1	1.1 Natural Numbers 1.2 Induction 1.3 Integers 1.4 Division with remainder 1.5 Binary notation 1.6 Diophantine equations	Elements of Number Theory Chapter 1	Approximately 80 minutes pre-recorded video lectures
Day 2	1.7 The Diophantus chord method 1.8 Gaussian integers 2.1 The gcd by subtraction 2.2 The gcd by division with remainder 2.3 Linear representation of the gcd 2.4 Primes and factorization	Elements of Number Theory Chapter 1 & Chapter 2	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 3	2.5 Consequences of unique prime factorization 2.6 Linear Diophantine equations 3.1 Congruence mod n 3.2 Congruence classes and their arithmetic	Elements of Number Theory Chapter 2 & 3	Approximately 80 minutes pre-recorded video lectures
Day 4	3.3 Inverses mod p 3.4 Fermat's little theorem 3.5 Congruence theorems of Wilson and Lagrange 3.6 Inverses mod k	Elements of Number Theory Chapter 3	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 5	3.7 Quadratic Diophantine equations 4.1 Trapdoor functions 4.2 Ingredients of RSA 4.3 Exponentiation mod n	Elements of Number Theory Chapter 3 & 4	Approximately 80 minutes pre-recorded video lectures
Day 6	4.4 RSA encryption and decryption 4.5 Digital signatures 4.6 Other computational issues 6.1 $\mathbb{Z}[i]$ and its norm 6.2 Divisibility and primes in $\mathbb{Z}[i]$ and $\mathbb{Z}$	Elements of Number Theory Chapter 4	Approximately 80 minutes pre-recorded video lectures
Day 7	6.3 Conjugates 6.4 Division in $\mathbb{Z}[i]$ 6.5 Fermat's two square theorem 6.6 Pythagorean triples 6.8 Discussion	Elements of Number Theory Chapter 6	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 8	7.1 The equation $y^3 = x^2 + 2$ 7.2 The division property in $\mathbb{Z}[\sqrt{-2}]$ 7.3 The gcd in $\mathbb{Z}[\sqrt{-2}]$ 7.4 $\mathbb{Z}[\sqrt{-3}]$ and $\mathbb{Z}[\zeta_3]$	Elements of Number Theory Chapter 7	Approximately 80 minutes pre-recorded video lectures
Day 9	9.1 Primes $x^2 + y^2$ , $x^2 + 2y^2$ , and $x^2 + 3y^2$ 9.2 Statement of quadratic reciprocity 9.3 Euler's criterion 9.4 The value of $\left(\frac{2}{q}\right)$	Elements of Number Theory Chapter 9	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom



Day 10	9.6 The Chinese remainder theorem 9.7 The full Chinese remainder theorem	Elements of Number Theory Chapter 9	Approximately 80 minutes pre-recorded video lectures
Day 11	Midterm Exam Review	Elements of Number Theory	Approximately 80 minutes pre-recorded video lectures
Day 12	<b>Midterm Exam</b>	Elements of Number Theory	Exam via Zoom
Day 13	Chapter 1 Why Abstract Algebra? Chapter 2 Operations	A book of Abstract Algebra Chapter 1&2	Approximately 80 minutes pre-recorded video lectures
Day 14	Chapter 3 The Definition of Groups Chapter 4 Elementary Properties of Groups	A book of Abstract Algebra Chapter 3&4	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 15	Chapter 5 Subgroups	A book of Abstract Algebra Chapter 5	Approximately 80 minutes pre-recorded video lectures
Day 16	Chapter 6 Functions	A book of Abstract Algebra Chapter 6	Approximately 80 minutes pre-recorded video lectures
Day 17	Chapter 7 Groups of Permutations	A book of Abstract Algebra Chapter 7	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 18	Chapter 8 Permutations of a Finite Set	A book of Abstract Algebra Chapter 8	Approximately 80 minutes pre-recorded video lectures
Day 19	Final Exam Review	A book of Abstract Algebra	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 20	<b>Final Exam</b>	A book of Abstract Algebra	Exam via Zoom