Philadelphia University	PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE	**Approval date:**
Faculty of Science		**Issue:**
Department of Math		**Credit hours: 3**
Academic year 2023/2024	**Course Syllabus**	**Bachelor**

Course information

Course#	Course title	Prerequisite
250313	**Number Theory**	**Set Theory 250251**

Course type	Class time	Room #
☐ University Requirement ☐ Faculty Requirement ☒ Major Requirement ☐ Elective ☒ Compulsory	ST 1 14:15-15:30 SM 2 09:45-11:00 SM 3 12:45-14:00	21003 21003 21003

Instructor Information

Name	Office No.	Phone No.	Office Hours	E-mail
Feras Awad	822	2132	SM 11:15–12:30 ST 12:45–14:00	fawad@philadelphia.edu.jo

Course Delivery Method

Course Delivery Method			
☒ **Physical**	☐ **Online**	☐ **Blended**	
Learning Model			
Precentage	**Synchronous**	**Asynchronous**	**Physical**
	0%	**0%**	**100%**

Course Description

This module is an introduction to elementary number theory, covering the basic theory of Divisibility and Primes, The Euclidean Algorithm, Linear Diophantine Equations, Modular Arithmetic.

Course Learning Outcomes

Number	Outcomes	Corresponding Program outcomes
Knowledge		
K1	Demonstrate the ability to construct and understand mathematical proofs related to number theory concepts and theorems.	**K_p2**
K2	Understand the fundamental principles of divisibility, including the definition of prime numbers, composite numbers, and the fundamental theorem of arithmetic.	**K_p1**
K3	Comprehend the Euclidean Algorithm and its applications in finding the greatest common divisor (GCD) of two integers.	**K_p3**

K4	Explain the concept of linear Diophantine equations and the methods for solving them, including the application of the Extended Euclidean Algorithm.	**K_p1**
K5	Gain knowledge of modular arithmetic, including properties of congruence, modular addition, subtraction, multiplication, and division.	**K_p1**
K6	Understand the Chinese Remainder Theorem and its applications in solving systems of modular congruences.	**K_p3**
Skills		
S1	Gain proficiency in algorithmic thinking through the application of algorithms like the Euclidean Algorithm and the Chinese Remainder Theorem.	**S_p2**
S2	Enhance logical reasoning skills in constructing mathematical proofs and making sound mathematical arguments.	**S_p1**
Competencies		
C1	Develop critical thinking and problem-solving skills by working on challenging number theory problems and applications.	**C_p1**
C2	Collaborate with peers to solve problems and engage in group discussions and projects related to number theory.	**C_p2**

Learning Resources

Course textbook	Pommersheim J., Mrks T., Flapan E. (2010) Number Theory: A Lively Introduction with Proofs, Applications, and Stories (1st ed.). Wiley.
Supporting References	• Witno, A. (2017) Theory of Numbers (1st ed.). BookSurge Publishing. • Burton, D. (2017) Elementary Number Theory (7th ed.). McGraw-Hill. • Eynden, C. (2006) Elementary Number Theory (2nd ed.). Waveland Press Inc. • Rosen K. (2010). Elementary Number Theory and Its Applications (6th ed.). Pearson. • Silverman, J. (2019) Friendly Introduction to Number Theory (4th ed.). Pearson.
Supporting websites	• Amin Witno: http://www.witno.com/philadelphia/250313.htm • Student Companion Site: Click here
Teaching Environment	☒**Classroom** ☐ **laboratory** ☐**Learning platform** ☐**Other**

Meetings and Subjects Timetable

Week	Topic	Learning Methods	Tasks	Learning Material
1	Explanation of the study plan for the course, and what is expected to be accomplished by the students. **Divisibility and Primes.** 3.1 Basic Properties of Divisibility.	Lecture		Course Syllabus Chapter 3
2	3.2 Prime and Composite Numbers. 3.3 Patterns in the Primes.	Lecture		Chapter 3
3	3.4 Common Divisors and Common Multiples. 3.5 The Division Theorem.	Lecture	Quiz	Chapter 3

4	**The Euclidean Algorithm.** 4.1 The Euclidean Algorithm. 4.2 Finding the Greatest Common Divisor.	Lecture		Chapter 4
5	**Linear Diophantine Equations.** 5.1 The Equation $aX + bY = 1$. 5.2 Using the Euclidean Algorithm to Find a Solution.	Lecture	Quiz	Chapter 5
6	5.3 The Diophantine Equation $aX + bY = n$.	Lecture		Chapter 5
7	5.4 Finding All Solutions to a Linear Diophantine Equation.	Lecture		Chapter 5
8	**The Fundamental Theorem of Arithmetic.** 6.1 The Fundamental Theorem. 6.2 Consequences of the Fundamental Theorem.	Lecture	Midterm Exam	Chapter 6
9	**Modular Arithmetic.** 7.1 Congruence modulo n.	Lecture		Chapter 7
10	7.2 Arithmetic with Congruences. 7.3 Check Digit Schemes.	Lecture		Chapter 7
11	7.4 The Chinese Remainder Theorem.	Lecture		Chapter 7
12	**Modular Number Systems.** 8.1 The Number System $\mathbb{Z}_n$: an Informal View. 8.2 The Number System $\mathbb{Z}_n$: Definition and Basic Properties.	Lecture	Quiz	Chapter 8
13	Multiplicative Inverses in $\mathbb{Z}_n$.	Lecture		Chapter 8
14	**Exponents Modulo n.** 9.1 Fermat's Little Theorem. 9.2 Reduced Residues and the Euler ϕ-function.	Lecture		Chapter 9
15	9.3 Euler's Theorem.	Lecture		Chapter 9
16	Final Exam	Lecture		

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

Course Contributing to Learner Skill Development

Using Technology
• Encourage students to use mathematical software (e.g., GeoGebra) to perform numerical calculations, simulate number theory concepts, and visualize results. • Guide students in utilizing online resources, digital libraries, and academic databases to access relevant research articles, papers, and additional learning materials related to number theory.
Communication Skills
• Encourage students to engage in peer discussions, group work, and online forums to exchange ideas, collaborate, and articulate mathematical solutions effectively.
Application of Concepts Learnt
• Assign problem-solving projects that require students to apply number theory concepts to novel problems and situations, helping them develop problem-solving and critical thinking skills.

Assessment Methods and Grade Distribution

Assessment Methods	Grade Weight	Assessment Time (Week No.)	Link to Course Outcomes
Mid Term Exam	**30%**	**8**	**K1, K2, K3, K4**
Various Assessments *	**30%**	**Continuous**	**S1, S2, C1, C2**
Final Exam	**40%**	**16**	**K1, K2, K3, K4, K5, K6**
Total	**100%**		

* Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Alignment of Course Outcomes with Learning and Assessment Methods

Number	Learning Outcomes	Learning Method*	Assessment Method**
Knowledge			
K1	Demonstrate the ability to construct and understand mathematical proofs related to number theory concepts and theorems.	Lecture	**Exam**
K2	Understand the fundamental principles of divisibility, including the definition of prime numbers, composite numbers, and the fundamental theorem of arithmetic.	Lecture	**Exam**
K3	Comprehend the Euclidean Algorithm and its applications in finding the greatest common divisor (GCD) of two integers.	Lecture	**Exam**
K4	Explain the concept of linear Diophantine equations and the methods for solving them, including the application of the Extended Euclidean Algorithm.	Lecture	**Exam**
K5	Gain knowledge of modular arithmetic, including properties of congruence, modular addition, subtraction, multiplication, and division.	Lecture	**Exam**
K6	Understand the Chinese Remainder Theorem and its applications in solving systems of modular congruences.	Lecture	**Exam**
Skills			
S1	Gain proficiency in algorithmic thinking through the application of algorithms like the Euclidean Algorithm and the Chinese Remainder Theorem.	Project	**Homework**
S2	Enhance logical reasoning skills in constructing mathematical proofs and making sound mathematical arguments.	Problem Solving	**Homework**
Competencies			
C1	Develop critical thinking and problem-solving skills by working on challenging number theory problems and applications.	Problem Solving	**Homework**
C2	Collaborate with peers to solve problems and engage in group discussions and projects related to number theory.	Project	**Group Project**

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

** Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Course Polices

Policy	Policy Requirements
Passing Grade	The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%).
Missing Exams	• Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment. • A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from an exam or assessment due date. • A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date.
Attendance	The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and seven lectures (S, T, T). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive excuse accepted by the dean of the college, then withdrawal grade will be recorded.
Academic Honesty	Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights.

Program Learning Outcomes to be Assessed in this Course

Number	Learning Outcome	Course Title	Assessment Method	Target Performance level
K_p2	The ability to write proofs in logical sequence and mastery of different methods of proofs.	Number Theory	Quiz	100% of the students get 80% or more on the rubric

Description of Program Learning Outcome Assessment Method

Number	Detailed Description of Assessment
K_p2	Each student will choose one proposition or theorem from a list of predefined statements related to number theory. The list will include propositions of varying complexity to accommodate students of different skill levels.

Assessment Rubric of the Program Learning Outcome

	Excellent (4 pts**)** Student understands the concept perfectly.	**Good (**3 pts**)** Student is almost perfect in their understanding of the topic, with some minor confusion or mistakes.	**Fair (**2 pts**)** Student has a decent grasp of the process but makes some major mistakes.	**Poor (**1 pt.**)** Student is very confused and does not understand the topic, nor is able to clearly grasp how to apply it or when to use it.
Logical Structure and Organization	Demonstrates a highly logical and well-organized proof with a clear and effective sequence.	Provides a logically structured proof with a mostly clear sequence.	Offers a somewhat organized proof with occasional lapses in logical sequence.	Presents a disorganized or disjointed proof.
Correct Application of Proof Methods	Correctly and skillfully applies various proof methods relevant to the chosen proposition.	Accurately applies proof methods with some minor errors.	Demonstrates limited mastery of proof methods, leading to noticeable errors.	Inadequately applies proof methods, resulting in significant errors.
Clarity of Explanations and Justifications	Offers exceptionally clear and concise explanations and justifications throughout the proof.	Provides clear explanations and justifications with minor clarity issues.	Presents somewhat unclear explanations and justifications, making parts of the proof challenging to follow.	Lacks clear explanations and justifications, making the proof difficult to understand.
Mathematical Writing	Demonstrates impeccable mathematical writing, free from errors, and adheres to conventions consistently.	Displays proficient mathematical writing with only minor errors or occasional deviations from conventions.	Exhibits some issues with mathematical writing, including errors and deviations from conventions.	Contains numerous errors and significant deviations from mathematical writing conventions.
Justification of Method Selection	Justifies the choice of proof method for the proposition thoroughly and convincingly.	Adequately justifies the choice of proof method for the proposition.	Provides a partial or somewhat weak justification for the chosen proof method.	Offers inadequate or no justification for the chosen proof method.