University of Gdańsk

Subject card

Subject name and code	Number Theory, PG_00174490						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	Master's studies		Subject group	Optional subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish the course could be given in English			
Semester of study	4		ECTS credits	6.0			
Learning profile	academic		Assessment form	exam			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Ewa Kozłowska-Walania				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		10.0		80.0	150
Subject objectives	The goal of the course is to get the students acquainted with the basic notions, theorems and methods of elementary number theory						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	Student is able to independently search for answers to questions in the literature on elementary number theory, also in foreign languages.	[SK1] oral statement/conversation/ discussion [SK6] demonstration of practical skills [SK8] observation of student's independent or team work
[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	Student gives the opinion on the basic problems in elementary number theory	[SK1] oral statement/conversation/ discussion [SK6] demonstration of practical skills
[MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics	Student is able to, in speech and writing, propose definitions and independently present correct mathematical reasoning concerning the topics of the lecture, for example study the properties of an object, construct an example or counterexample.	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work [SU4] test/exam - oral or written
[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	Student knows how to use theorems and proof methods learned during the lecture, knows how to use ideas and techniques presented during the lecture and can give applications for theorems presented during the lecture	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work [SU4] test/exam - oral or written [SU5] implementation of a problem task [SU6] demonstration of practical skills
[MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	Student is able to use techniques and notions of elementary number theory in other branches of mathmatics.	[SU3] text preparation/written work [SU5] implementation of a problem task
[MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics	Student knows and understands connections between the topics of the lecture and familiar notions from the courses of calculus and linear algebra, for example	[SW4] test/exam - oral or written [SW3] text preparation/written work [SW5] implementation of a problem task
[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	Student precisely formulates questions concerning elementary number theory and aims to deepen the knowledge by filling the gaps in incomplete reasoning.	[SK1] oral statement/conversation/ discussion [SK3] text preparation/written work [SK4] test/exam - oral or written [SK6] demonstration of practical skills [SK8] observation of student's independent or team work
[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	Student knows and understands basics of number theory, i. e. theorems concerning the lecture, regarding for example congruences, prime numbers, diophantic equations together with the proper definitions, examples and the most important proofs or their sketches.	[SW4] test/exam - oral or written [SW3] text preparation/written work [SW5] implementation of a problem task
[MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics	Student is able to contruct a medium difficulty proofs, concerning topics from the lecture, while using the tools familiar from the courses of calculus and linear algebra.	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work [SU4] test/exam - oral or written [SU6] demonstration of practical skills
[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	Student feels the need to enhance the knowledge got during the lecture, on their own.	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work
[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	Student acts honestly and ethically in all aspects relating to passing the subject.	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work
[MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians	Student selects the issues that interest him or her the most, is able to formulate questions about them, and actively participates in events for young mathematicians.	[SU1] oral statement/conversation/ discussion [SU8] observation of student's independent or team work

Course outcome	Subject outcome	Method of verification
[MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics	Student can actively use the literature concerning elementary number theory	[SU3] text preparation/written work [SU4] test/exam - oral or written [SU5] implementation of a problem task
[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	Student knows and understands proofs, or sketches of proofs, of the most inportant results presented during the lecture	[SW4] test/exam - oral or written [SW3] text preparation/written work [SW5] implementation of a problem task

Subject contents

1. Properties of divisibility relation defined on the set of integers.
2. Euclidean algorithm.
3. Prime numbers.
4. Congruences and their properties.
5. Quadratic reciprocity law.
6. Basic Diophantine equations.
7. Continued fractions and their properties.
8. Approximating real numbers by rational numbers.
9. Arithmetic functions - algebraic properties and analytic properties.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Observation of the student's attitude	51.0%	0.0%
Activity points	51.0%	5.0%
Written or oral exam	51.0%	50.0%
Test	51.0%	45.0%

Recommended reading

Basic literature	1. W. Marzantowicz, P. Zarzycki, *Elementarna teoria liczb*, PWN, Warszawa 2006 2. W. Narkiewicz, *Teoria liczb*, PWN, Warszawa 1990 3. J. Rutkowski, *Teoria liczb w zadaniach,* PWN, *2018*
Supplementary literature	1. L. K. Hua, *Introduction to Number Theory*, Springer, 1982 2. H. Davenport, *The Higher Arithmetic*, Cambridge University Press, 2008 3. Yan Song Y., *Teoria liczb w informatyce*, PWN, 2006
eResources addresses	

Example issues/ example questions/ tasks being completed

State and prove Euler's theorem.

State and prove Binet's formula.

Give a necessary and sufficient condition on the existence of a solution of a diophantic equation of the form nx+my=k. Knowing, that the pair (5,-11) is a solution to the equation 18x+7y=13, give a formula for all the integer solutions of this equation

State the definition of Euler's function and prove its multiplicativity. Compute (624).

Using the numbers a=12378 and b=3054 as an example, demonstrate the Euclid\s algorithm and determine the integers n,m such that na+mb=(n,m)

Work placement

Not applicable

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