Course Specification

(Postgraduate Programs)

Course Title:	Theory of Numbers
Course Code:	MAT 7123
Program:	Doctor of Philosophy in Mathematics .
Department:	Mathematics and Statistics
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	2024 – V1
Last Revision Date:	None

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A. General information about the course:

1. Course Identification:

1. Credit hours:					
4 (4 Lectures, 0 Lab, 0 Tutorial)					
2. Course type					
A.	☐ University	☐ College	☒ Program	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 3/Year 2					
4. Course General Description:					
The target of this course is three-fold: the reduction of an integer modulo a prime number which is one of the main methods to solve a diophantine equation is first studied. The second step is to give conditions which ensure that a positive integer is the sum of squared integers. This leads to the arithmetic theory of quadratic forms. The last part of the course concerns the notion of continued fractions which is defined for any positive real number. This notion allows one to detect some arithmetic properties such as rationality, algebraicity in a very efficient way. It also prepares the theory of Diophantine approximation. However, the focus will be on concrete examples and applications to cryptography.					
5. Pre-requirements for this course (if any)**:**					
None					
6. Pre-requirements for this course (if any)**:**					
None					
7. Course Main Objective(s):					
The objective of this course is to initiate the student to some aspects of number theory and related problems. This background of this course can serve for more advanced topics such as Analytic and Algebraic Theory, but also to Coding Theory and Cryptography.					

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**60**	**100%**
2	E-learning	**0**	**0%**
3	Hybrid • Traditional classroom • E-learning	**0**	**0%**

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning	0	0%

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	60
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
	Total	60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	To record some methods specific to Number Theory.	K1, K2	4 lecture hours\week	Direct: Regular Exams
1.2	To outline different kinds of mathematical proofs in number theory	K1,K2	• 4 lecture hours\week • Self-study	Direct: Short Quizzes and Homework
2.0	Skills			
2.1	To develop techniques of proof in Diophantine Equations.	S1, S2	Self-study	Direct: • Participations • Short Quizzes
2.2	To develop oral communication and technical writing skills through representation of	S3	Self-study	Direct: Homework and Mini projects

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	integers and sums of squares.			
2.3	To use Internet in searching for continued fractions.	S4	Self-study	Direct: Short Quizzes
3.0	Values, autonomy, and responsibility			
3.1	To work with independence and responsibility.	V1, V2	Personal questions	Direct: Participation
3.2	To join and participate in team works.	V1, V3	Teamwork and class discussions.	Direct: Homework and Mini projects

C. Course Content:

No	List of Topics	Contact Hours
1.	Linear and Quadratic Diophantine Equations: Review of congruences, Linear congruences, Linear Diophantine equations, Quadratic Diophantine Equations, RSA Public Key Cryptosystem, Quadratic Residues: Reduction modulo a prime number, Legendre Symbol, Gauss Lemma, Quadratic Reciprocity Law, Jacobi Symbol.	20
2.	Quadratic forms: Basic Properties, Equivalences of Quadratic Forms, Reduced Quadratic Forms, Quadratic Representations of integers. Representations as Sums of Squares: Two Squares Sums Representation, Four Squares Sum Representations, Lagrange's Theorem.	15
3	Continued Fractions: Definitions and Basic Properties, Uniqueness of the Representation of Real Number, Convergence. Finite Continued Fractions and Rationality. Application of Continued Fractions: Characterization of Algebraic Numbers, and Periodic Continued Fractions. Particular solutions of Linear Congruence Equation, Approximation of a real number by rational numbers, Pell's Equation.	25
Total		60

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini projects	During the	30%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
		semester	
2.	Midterm	Week 9-10	30%
3.	Final Exam	Week 15-16	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	Stewart and D. Tall, *Algebraic Number Theory and Fermat's Last Theorem*, 3rd Ed., Peters Natick 2002.. (Main Reference)
Supportive References	I. Niven and Others, *An Introduction to The Theory of Numbers*, 5thEd., Wiley, 1991.
Electronic Materials	None
Other Learning Materials	None

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ Each class room should be equipped with a whiteboard and a projector. ▪ Laboratories should be equipped with computers and an internet connection.
Technology equipment (projector, smart board, software)	The rooms should be equipped with data show and Smart Board.
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	During the semester and at the end of the course each student will complete two evaluation forms.
Effectiveness of Students assessment	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Quality of learning resources	Students	During the semester and at the

Assessment Areas/Issues	Assessor	Assessment Methods
		end of the course each student will complete two evaluation forms.
The extent to which CLOs have been achieved	**Instructor**	**At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.**
Other	**None**	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL**
REFERENCE NO.	**8/1446**
DATE	**05/04/1446 (08/10/2024)**