

**SECOND SEMESTER, 2022 - 2023**

**Course Handout Part II**

Date: 16.01.2023

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further

specific details regarding the course.

**Course Number: MATH F231**

**Course Title: Number Theory**

**Instructor In-charge: Debopam Chakraborty**

**Scope and Objective of the Course:**

In this course we cover the basic mathematical notation and methods, properties of divisors, prime numbers, integer functions, equations in integers and the applications of some of the concepts. The main objective of this course is to understand the divisibility properties of integers and other related topics as a basis for studying more advanced topics in Number Theory, Modern Algebra, and the number theoretic cryptography algorithms.

**Text Book:**

Thomas Koshy: Elementary Number Theory with Applications, Second Edition, Academic Press,

2007.

**Reference Books:**

**(i)** Tom M. Apostol: Introduction to Analytic Number theory, Springer, 1976.

**(ii)** Kenneth H. Rosen: Elementary Number Theory and its Applications, Addison – Wesley

publishing Company, 1986.

**(iii)** Neal Koblitz: A Course in Number Theory and Cryptography, 2nd edition, Springer, 1994.

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | To explain the fundamental properties of integers | Fundamental properties, the  summation and product notations,  mathematical induction, recursion, the  binomial theorem | 1.1 – 1.5 |
| 2 – 3 | To examine the correctness of a division problem | The division algorithm | 2.1 |
| 4 – 6 | To classify the various classes of positive integers | Prime numbers, composite numbers,  Fibonacci numbers, Lucas numbers,  Fermat numbers | 2.5 – 2.7 |
| 7 | To list the fundamental operations on integers | Greatest common divisor | 3.1 |
| 8 – 9 | To know how to find the greatest common divisor of two numbers having  prime factorizations. | The Euclidean algorithm | 3.2 |
| 10 | To know how to factorize any positive integer | The fundamental theorem of arithmetic | 3.3 |
| 11 – 13 | To learn linear Diophantine equations | Least common multiple, linear  Diophantine equations | 3.4 – 3.5 |
| 14-16 | To define what is congruence and explain their fundamental properties | congruence, linear congruence, the Pollard Rho factoring method | 4.1 – 4.3 |
| 17 – 18 | To explain the applications of congruence | Divisibility tests, check digits,  round - robin tournaments | 5.1 – 5.3, 5.5 |
| 19 – 24 | To explain the four classical mile stone  theorems in number theory | Chinese remainder theorem, Wilson’s theorem, Fermat’s little theorem, Euler’s theorem | 6.1 – 6.3, 7.1, 7.2, 7.4 |
| 25 – 28 | To define the multiplicative functions and to explain their properties | Euler’s phi function, the tau and sigma  functions, the Mobius function | 8.1 – 8.2, 8.5 |
| 29 – 31 | To explain perfect numbers | Perfect numbers, Mersenne primes | 8.3 – 8.4 |
| 32 – 35 | To define the order of an integer and primitive roots | The order of a positive integer, primality tests, primitive roots for primes | 10.1 – 10.3 |
| 36 – 38 | To define quadratic residues and to explain the  famous law of quadratic reciprocity | Quadratic residues, the Legendre  symbol, quadratic reciprocity, the  Jacobi symbol, | 11.1 – 11.4 |
| 39 – 40 | To explain the continued fractions | Finite continued fractions, infinite  continued fractions | 12.1 – 12.2 |

6. **Evaluation Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Quiz 1 | 30 minutes | 20 | To be announced in class | Closed Book |
| Assignment |  | 10 | To be announced in class | Open Book |
| Mid-Semester Test | 90 minutes | 20 | 13/03 9.30 - 11.00AM | Open Book |
| Quiz 2 | 30 minutes | 20 | To be announced in class | Closed book |
| Comprehensive Examination | 180 minutes | 30 | 08/05 FN | Closed book |

Total marks: 200

7. **Chamber consultation hour:** Will be announced in the class

8. **Notices:** The notices concerning this course will be displayed in CMS only.

9. **Make-up Policy**: Make-up for tests will be given only for very genuine cases and prior permission

has to be obtained from Instructor In-charge.

**10. Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor In-charge**

**MATH F231**