



FIRST SEMESTER, 2022 - 2023
Course Handout Part II

29-08-2022

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

Course No. : MATH F231
Course Title: Number Theory
Instructor In-charge: Rohit Gupta

Scope and Objective of the Course:

In this course we cover the basic mathematical notation and methods which include mathematical induction, 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.

1. Text Book:

Thomas Koshy: Elementary Number Theory with Applications, Second Edition, Academic Press, 2007.

2. Reference Books:

- (i) Kenneth H. Rosen: Elementary Number Theory and its Applications, Addison – Wesley publishing Company, 1986.
- (ii) Neal Koblitz: A Course in Number Theory and Cryptography, 2nd Edition, Springer, 1994.
- (iii) Tom M. Apostol: Introduction to Analytic Number theory, Springer, 1976.

3. Course Plan:

| 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 | The division algorithm | 2.1 |



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|---------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------|
| | correctness of a division problem | | |
| 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 – 22 | 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 |
| 23 – 26 | 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 |
| 27 – 29 | To explain perfect numbers | Perfect numbers, Mersenne primes | 8.3 – 8.4 |
| 30 – 33 | 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 |
| 34 – 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 |

4. Evaluation Scheme:



| ECNo. | Evaluation Component | Duration | Weightage (%) | Date | Nature of Component |
|-------|----------------------|-----------------------|---------------|-----------------------|---------------------|
| 1. | Quiz-I | To be announced later | 10 | To be announced later | Open Book |
| 2. | Mid Semester Exam | 90 min. | 35 | 02/11 9.00 - 10.30AM | Closed Book |
| 3. | Quiz-II | To be announced later | 10 | To be announced later | Open Book |
| 4. | Comprehensive Exam | 180 min. | 45 | 22/12 FN | Closed Book |

Total marks: 200

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

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

7. **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.

8. **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

