AC – 20/04/2024
Item No. – 6.7 Sem. II (1b)

As Per NEP 2020

University of Mumbai

Syllabus for Basket of Minor	
Board of Studies in Mathematics	
UG First Year Programme	
Semester	**II**
Title of Paper	**Credits 2/ 4**
I) Number Theory and Basics of Matrices (Minor II)	
II)	
III)	
From the Academic Year	**2024-25**

Name of the Course: Number Theory and Basics of Matrices
(Minor II)
(Sem II)

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This course includes functions, integers, divisibility of integers and types and basic properties of matrices. This course introduces basic concepts of Algebra with rigour and prepares students to study further courses in linear and abstract algebra. Formal proofs are emphasized which also enhance understanding of the subject of Mathematics as a whole.
2	**Vertical:**	Minor
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** (List the course objectives) This course introduces basic concepts of Algebra with rigour and prepares students to study further courses in linear and abstract algebra. Formal proofs are emphasized which also enhance understanding of the subject of Mathematics as a whole. CO1. To give sufficient knowledge of fundamental principles, methods, and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving and interpreting. CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. CO3. To enhance students' overall development, problem-solving skills, creative talent and power of communication are necessary for various kinds of employment. CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** (List the course outcomes) After completion of the course, students will be able to OC1: understand the integer and rational number system and illustrate examples of polynomials in $F[x]$, where $F = \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}$. OC2: explain the properties of integers and matrices with suitable examples. OC3: verify the statements of theorems by applying them in problem-solving. OC4: analyze the problem and apply the theorems accordingly. OC5: generalize statements of theorems and interpret the proof.	

	OC6: develop skills to note the minute and relevant details in the concepts and develop an understanding of the abstract part of algebra required for higher-order thinking in pure mathematics in the higher classes.
9	**Modules: -** **Module 1: Functions, Integers and Divisibility (15 Hours)**
	(1) Review of functions, domains, codomains, range of functions, injective, surjective and bijective functions, inverse of function, examples of functions like constant, identity, projection, inclusion, polynomial, binary. (2) Well ordering principle of non-negative integers, principles of finite induction (without proof), Pascal's identity (without proof), Pascal's triangle, Binomial theorem (without proof). (3) Divisibility of integers, Division algorithm (without proof), greatest common divisors, least common multiple. (4) Definition and elementary properties of congruence, Euler's ϕ function, Euler's theorem (without proof), Fermat's theorem (without proof), Wilson's theorem (without proof) and examples.
	Module 2: Matrices (15 Hours)
	(a) Systems of homogeneous and non-homogeneous linear equations, Simple examples of finding solutions of such systems. Geometric and algebraic understanding of the solutions. Matrices (with real entries), Matrix representation of system of homogeneous and non-homogeneous linear equations. Algebra of solutions of systems of homogeneous linear equations. A system of homogeneous linear equations with number of unknowns more than the number of equations has infinitely many solutions. (b) Elementary row and column operations. Row equivalent matrices. Row reduction (of a matrix to its row echelon form). Gaussian elimination. Applications to solving systems of linear equations. Examples. (c) Elementary matrices. Relation of elementary row operations with elementary matrices. Invertibility of elementary matrices. Consequences such as (i) a square matrix is invertible if and only if its row echelon form is invertible. (ii) invertible matrices are products of elementary matrices. Examples of the computation of the inverse of a matrix using Gauss elimination method.
10	**Text Books:** 1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd. 2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989. 3. Serge Lang, Introduction to Linear Algebra, Springer.
11	**Reference Books** 1. I. Niven and S. Zuckerman, Introduction to the theory of numbers, Third Edition, Wiley Eastern, New Delhi, 1972. 2. Kenneth Rosen, Discrete Mathematics and its applications, Mc-Graw Hill, International Edition, Mathematics Series. 3. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition).

<table>
<tr><td></td><td colspan="2">4. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers.
5. S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning.</td></tr>
<tr><td></td><td colspan="2"><u>Scheme of the Examination</u></td></tr>
<tr><td></td><td colspan="2">The performance of the learners shall be evaluated in two parts.
• Internal Continuous Assessment of 20 marks.
• Semester End Examination of 30 marks.
• A separate head of passing is required for internal and semester-end examinations.</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%
Semester End Examination: 60%</td><td></td></tr>
<tr><td>13</td><td>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)
<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<tr><td>1</td><td>A class test of 10 marks is to be conducted during each semester in an Offline mode.</td><td>10</td></tr>
<tr><td>2</td><td>Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.</td><td>05</td></tr>
<tr><td>3</td><td>Seminar/ group presentation on any one topic related to the syllabus.</td><td>05</td></tr>
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Paper pattern of the Test (Offline Mode with One hour duration):
Q1: Definitions/Fill in the blanks/ True or False with Justification.
(04 Marks: 4 x 1).
Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 × 3)</td><td></td></tr>
<tr><td>14</td><td colspan="2">Format of Question Paper:
The semester-end examination will be of 30 marks of one hour duration covering the entiresyllabus of the semester. All questions are Compulsory.</td></tr>
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	Q.No.1	Module 1	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
	Q.No.2	Module 2	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
	Q.No.3	Module 1 and 2	Attempt any TWO out of FOUR.(10 marks) (Problems) (OC 5 & OC 6)	10 Marks

Sign of the BOS Chairman
Dr. Bhausaheb S Desale
The Chairman, Board of Studies in Mathematics

Sign of the Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology