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

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) Basics of Mathematics in Real Life (Minor III)	
II)	
III)	
From the Academic Year	**2024-25**

Name of the Course: Basics of Mathematics in Real Life (Minor III)
(Sem II)

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This course gives introduction to basic concepts of mathematics, highlighting practical aspects with concrete examples. In this course, students from various science streams will recognize the importance of mathematics and learn.
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 gives introduction to basic concepts of mathematics, highlighting practical aspects with concrete examples. In this course, students from various science streams will recognize the importance of mathematics and learn. CO1: To develop matrix based techniques for solving linear system of equations. CO2: To identify underlying principles for balancing chemical equations. CO3: To associate geometrical objects for understanding maximization and minimization problems. CO4: To recognize the role of matrices in solving real life problems.	
8	**Course Outcomes (OC):** (List the course outcomes) At the end of the course, the students will be able OC1: to derive the formulae for simple curves passing through given set of points. OC2: to perform various useful operations on matrices like computing inverse, adjoint, determinant etc. OC3: to predict when two matrices commute. OC4: to outline basic linear programming problem and steps for its solution. OC5: to evaluate the polar form of complex numbers. OC6: to illustrate the use of reflection and rotation matrices in computer graphics.	
9	**Modules** **Module 1: Matrices and systems of linear Equations (15 Hours)**	
	1. Drawing curve through given set of points: formula and simple curves. 2. Kepler's law and equation of the orbit of an asteroid around the sun. 3. Two by two matrices: traces, determinant, commutation and anticommutation, $[X\ Y] = XY - YX$, $[X\ Y] = XY + YX$.	

	4. Equation of line passing through two points, parallel line, intersecting lines, point of intersection. 5. Two by two matrices: traces, determinant, inverse of a matrix and its calculation (without proof). Criterion for invertibility in terms of the determinant. 6. Formula for matrix multiplication (without proof) and examples. 7. Balancing chemical equations-I, Motivation and examples using system of linear equations. 8. System of linear equations in at most three variables and their visualization 9. Three by three matrices: traces, determinant, addition, further properties like symmetric, antisymmetric. 10. Inverse of three by three matrix and solution to a system of three equations in three unknowns (only statement). 11. Balancing chemical equations-II (using three by three matrices and their properties). 12. Basics of complex numbers-I: introduction of the complex plane, modulus of a complex number, complex conjugate. 13. Examples of Pauli matrices (named after Nobel prize winner Wolfgang Pauli) and their properties related to commutation and anticommutation. 14. Magic card trick based on linear system of equations: examples and explanation 15. Variation of card trick based on linear system of equations: Further examples and variations.
	Module 2: Geometry of Linear Equations and Matrices in Action. (15 Hours)
	1. Basics of linear programming-I: set up equations, feasible region, theorem on existence of solution. 2. Basics of linear programming-II: plotting the feasible region and checking its boundedness or unboundedness. 3. Maximization or minimization in industry-I: Objective function, Mathematical formulation (only two variables) examples. 4. Maximization or minimization in industry-II: Optimal solution, Geometrical solution (only two variables) examples. 5. Maximization or minimization in industry-III: exceptional cases: Unbounded solution, feasible region being a line segment. 6. Computer graphics-I: three by n matrices, visualization and introduction of xyz coordinates. Scaling and translation: formula using matrices and its visualization. 7. Introduction to basic trigonometric functions: sine, cosine definition and tabulation of certain standard values. 8. Formulae for sine of a sum of two angles and cosine of two angles and examples. Properties like points of vanishing, graphs of sine and cosine function and periodicity. 9. Basics of complex numbers-II: Polar form, DeMoivre's formula (without proof) and applications, Plotting roots of unity (upto degree four). 10. Computer graphics-II: rotation matrices, formula and

visualization. Product of two rotation matrices is again a rotation, determination of the angle.

11. Computer graphics-III: reflection matrices, formula and visualization. Product of two reflection matrices: formula and properties.
12. Shearing and its formula, visualization, transpose of a matrix, orthogonal matrices: definition and examples, inverse of an orthogonal matrix.
13. Leontief (closed) model in economics (work of Nobel laureate Wassily Leontief): price vector, input-output matrix, Setting up the associated equation using matrices: examples.
14. Statement of the result for existence of solution to the exchange matrix and examples.
15. Linear independence (for columns in 2 by 2 and 3 by 3 matrices), Statement of result related to powers of exchange matrix. Computation of examples.

10 **Text Books:**

1) Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley and Sons.
2) Artin, Algebra, Pearson, Second Edition.

11 **Reference Books:**

1) Contemporary Abstract Algebra, J. A. Gallian, Narosa publishing house.
2) Halliday and Resnick's Principles of Physics, Wiley, Eleventh Edition.

Scheme of the Examination

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.

12 **Internal Continuous Assessment: 40%**
Semester End Examination: 60%

13 **Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)

Sr. No.	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/ group presentation	05

		on any one topic related to the syllabus.	

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)

14 **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.

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
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