Name of the Course: PM-4B Linear Algebra (Minor II)

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<tr><td>Sr. No.</td><td>Heading</td><td>Particulars</td></tr>
<tr><td>1</td><td>Description of the course: Including but not limited to:</td><td>The system of linear equations arises naturally in other science courses. This course provides a sound knowledge of Matrix theory, starting with the basic requirement of its study in the form of solving a system of equations. Also, it advances the discussion of vector space dealing with linear transformations, developing its connection with matrix theory.</td></tr>
<tr><td>2</td><td>Vertical:</td><td>Minor</td></tr>
<tr><td>3</td><td>Type:</td><td>Practical</td></tr>
<tr><td>4</td><td>Credits:</td><td>2 credits
(1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)</td></tr>
<tr><td>5</td><td>Hours Allotted:</td><td>30 Hours</td></tr>
<tr><td>6</td><td>Marks Allotted:</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives (CO):
This course deepens the understanding of system of linear equations with an understanding of the geometry of its solutions. Also, it covers a brief amount of matrix theory and the theory of linear transformations.
CO1. To give sufficient knowledge of fundamental principles and methods, as well as 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 the 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.</td></tr>
<tr><td>8</td><td colspan="2">Course Outcomes (OC):
After completion of the course, students will be able to
OC1: Calculate solutions to a system of equations using various methods, and the inverse of matrices
OC2: Analyse the null space and rank space related to the linear transformation.
OC3: Verify the Rank Nullity theorem
OC4: Construct and design counterexamples related to linear transformations</td></tr>
<tr><td>9</td><td colspan="2">Modules: -
Module 1: Practical for Matrices (30 Hours)
<table><tr><td>1.</td><td>System of linear equations with examples.</td></tr><tr><td>2.</td><td>The geometry of solutions of a system of linear equations.</td></tr><tr><td>3.</td><td>Matrix representation of a system of linear equations.</td></tr><tr><td>4.</td><td>Algebra of solutions of a system of homogenous linear equations.</td></tr><tr><td>5.</td><td>Elementary row operations on matrices.</td></tr><tr><td>6.</td><td>Determinants and rank of a matrix.</td></tr><tr><td>7.</td><td>Solving a system of linear equations using determinants.</td></tr><tr><td>8.</td><td>Elementary matrices and their relations with elementary operations on matrices.</td></tr></table></td></tr>
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	9.	Invertibility of elementary matrices.
	10.	Computing the inverse of a matrix by the Gauss elimination method.

Module 2: Practical for Linear Transformation (30 Hours)

1.	Linear transformations and their elementary properties.
2.	Composite of linear transformations.
3.	Determining linear transformation by knowing its action on basis vectors.
4.	Null space and image space of linear transformation.
5.	Rank and nullity of a linear transformation with verification of rank-nullity theorem.
6.	Computing matrix associated with a linear transformation.
7.	Matrix associated with a composite of two linear transformations.
8.	Effect on change of basis on linear transformation.
9.	Similar matrices.
10.	Equivalence of rank of a matrix with the associated linear transformation.

10 Text Books:

1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd edition, Pearson.
2. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition.
3. Serge Lang, Introduction to Linear Algebra, Springer.
4. S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning.
5. Sheldon Axler, Linear Algebra done right, Springer.
6. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers.
7. David W. Lewis, Matrix theory.

11 Reference Books

1. Matrix Analysis and its Applications, Carl D. Mayor, SIAM publications.
2. Linear Algebra, Kenneth Hoffman & Ray Kunze, Prentice-Hall Inc.

Scheme of the Examination

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	Objective question test	10
2	Overall performance	05
3	Viva	05

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple-

	choice questions. (10 marks: 5 × 2) **Duration: 1Hrs** **While setting the question paper, four MCQs on module 1 and four MCQs on module 2.**	
14	**Format of Question Paper:** **Scheme of examination:** At the end of Semester IV, Practical examinations of three hours duration and 30 marks shall be conducted based on both modules. Paper pattern: The question paper shall have two questions. **Marks for Journals:** For both Module 1 and Module 2 1. Journal: 5 marks (2.5 marks for each module 1 & module 2) The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.	

Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)