College of Engineering Pune
(An Autonomous Institute of Government of Maharashtra, Pune-411005)
Department of Mathematics
(MA-19002) Linear Algebra

F.Y. B.Tech. Semester I (All Branches)

Teaching Scheme
Lectures : 2 hrs / week
Tutorial : 1 hr / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Unit I : Matrices and linear equations: basic properties of matrices, row operations and Gauss elimination, Determinants and their basic properties. Basic concepts in linear algebra: vector spaces, subspaces, linear independence and dependence of vectors, bases, dimensions. Row and Column spaces, rank. Applications to systems of linear equations. **[10 Hrs]**

Unit II : Linear mappings, representation by matrices, rank-nullity theorem, Eigen values, Eigen vectors and their basic properties. **[08 Hrs]**

Unit III : Inner product spaces, orthogonality, Gram-Schmidt process, Diagonalization of special matrices, Geometric applications of Linear transformation, quadratic forms: positive definiteness. **[08 Hrs]**

Text Book :

- Introduction to Linear Algebra (2^{nd} edition) by Serge Lang, Springer.

Reference Books :

- Linear Algebra (3^{rd} edition) by Serge Lang, Springer.
- Elementary Linear Algebra (10^{th} edition) by Howard Anton and Chris Rorres, John Wiley and sons.
- Schaum's outlines of Linear Algebra (5^{th} edition) by Seymour Lipschutz, Marc Lipson, McGraw-Hill Education (India) Private Limited, New Delhi.
- Linear Algebra by Hoffman and Kunze, (2^{nd} edition) Prentice Hall Publication, New Delhi.
- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley eastern Ltd.
- Linear Algebra and its applications (4^{th} edition) by Gilbert Strang, Cengage Learning (RS).

- Advanced Engineering Mathematics by Chandrika Prasad and Reena Garg, Khanna Publishing Company Private Limited, New Delhi.

Outcomes : Students will be able to

1. **define** matrices, linear equations, and determinants, **recall** basic vector algebra.
2. **understand** basic concepts such as vector spaces, linear dependence / independence of vectors, basis and linear maps.
3. **analyze** and **calculate** eigen values, eigen vectors, rank nullity of a matrix / linear map.
4. **prove** theorems, **apply** Gram-Schmidt process on inner product spaces, diagonalize special matrices.
5. **apply** concepts of linear algebra to various applications including real life problems.

Note 1 :

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

Note 2 :

All the Course outcomes 1 to 3 will be judged by 75% of the questions and outcomes 4 and 5 will be judged by 25 % of questions.