

Syllabus for Master of Science
Mathematics
Subject Code: 02MA0504
Subject Name: Linear Algebra
M.Sc. Year-II (Sem-3)

Objective: The objective of this course is to study the fundamental concepts of linear algebra culminating in abstract vector spaces and linear transformations.

Credits Earned: 5 Credits

Course Outcomes: After completion of this course, student will be able to

- Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces.
- Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt orthogonalization.
- Use the definition and properties of linear transformations and matrices of linear transformations.
- Understand structure of various canonical forms.
- Recognize different properties of trace, transpose and determinants.
- Learn basic concepts of real quadratic forms and bilinear forms.

Pre-requisite of course: Students must be familiar with undergraduate level linear algebra.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Term work (TW)	
4	2	-	5	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	Vector spaces: Vector space, Subspace, Homomorphism, Isomorphism, Quotient space, First isomorphism theorem, Internal direct sum, External direct sum, Linear independence, Span, Bases, Vector space of linear transformations, Linear functional, Dual space, Second dual, Annihilator	15
2	Linear transformations: The algebra of linear transformations, Minimal polynomial, Regular and Singular linear transformations, Range, Rank, Characteristic roots, Characteristic vector, Representation of transformations by matrices, Trace and transpose, Determinants, Cramer's rule, Cayley-Hamilton theorem, Hermitian, Unitary and Normal transformations	15
3	Canonical forms: Similar transformation, Invariant, Triangular forms, Canonical forms of a Nilpotent linear transformation, Decomposition of a finite dimensional vector space: Jordan form, Rational canonical form	15
4	Bilinear forms: Real quadratic forms, Sylvester's law of inertia, Bilinear forms, Symmetric bilinear forms, Skew-symmetric forms, Groups preserving bilinear forms	15
	Total Hours	60

Recommended Textbooks:

1. I. N. Herstein, Topics in Algebra, Willey Eastern Ltd. New Delhi.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Pearson Education (Asia) Pvt. Ltd/ Prentice Hall of India, 2004.
3. S. Roman, Advanced Linear Algebra, 3rd Edition, Springer, 2007
4. J. H. Kwak, S. Hong, Linear Algebra, (Second edition), Birkhauser.
5. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice Hall of India, 2000.
6. S. Lipschutz and M L Lipson, Linear Algebra, 4th Edition, Schaums outlines, 2009.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create

20%	20%	30%	15%	10%	5%
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Instructional Method:

- The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- <http://www.athabascau.ca/courses/math/270/outline.htm>
- <https://www.math.ucdavis.edu/~linear/linear-guest.pdf>
- <http://nptel.ac.in/courses/111106051/>
- <https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/>
- <http://mathworld.wolfram.com/VectorSpace.html>