Paper code : ARD 201	L	P	Credits
Subject : Essential Mathematics for Artificial Intelligence	4	0	4

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- There should be 9 questions in the end term examination question paper
- Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Ability of students to understand, apply and analyze the basic concepts of linear algebra, vector addition, scalar multiplication, inner product space, norms, orthogonal vectors, linear independence, spanning sets. **[K1, K2, K3, K4]**
CO2: Ability of students to understand numerical linear algebra, and to apply these techniques to real world problems **[K1, K2, K4]**
CO3: Ability of students to understand linear programming problems and solve large scale linear models **[K1,K2,K3]**
CO4: Ability of students to solve nonlinear optimization problems through various numerical techniques **[K1,K2, K3, K4]**

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	2
CO2	3	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	1	3
CO4	3	3	3	3	3	-	-	-	-	-	2	3

Course Content	No of lectures
Unit I **Linear Algebra:** Vector space and subspaces with examples, linear dependence and independence of vectors, basis and dimensions, linear transformations, Null spaces, Range space, rank-nullity theorem (without proof) with applications, Eigenvalues and eigenvectors of linear operators, Definition and examples of inner product spaces and normed space, Gram Schmidt orthogonalization process.	**[12]**
Unit II **Numerical Linear Algebra:** LU factorisation, Cholesky factorisation, Spectral Decomposition, Singular value decomposition (SVD), SVD in image processing, Solving least squares using SVD	**[12]**

Unit III **Linear programming:** Convex sets and functions, Graphical method, Feasible region, Basic feasible solutions, Degenerate and non-degenerate solutions, Simplex method as an algebraic version of graphical method, Simplex method, Method of artificial variables: Two phase and Big-M Method, Alternate Optima, Duality of Linear programming models	**[12]**
Unit IV **Unconstrained Optimization:** Necessary and Sufficient conditions for optimality, Line search method for unimodal functions: Golden Section Rule and Fibonacci search method, Steepest descent method with application in linear regression **Constrained Optimization:** Penalty function method	**[12]**

Text Books:

[T1] Friedberg, Stephen H., Arnold J. Insel, and Lawrence E. Spence. Linear Algebra: Pearson New International Edition. Pearson Higher Ed, 2013

[T2] Datta, Biswa N. Numerical linear algebra and applications. SIAM, 2010

[T3] Chandra, Suresh, Jayadeva, and Mehra, Aparna. Numerical optimization with applications. Alpha Science International, 2009

Reference Books:

[R1] Lay, David C. Linear algebra and its applications. Pearson Education India, 2003

[R2] Bazaraa, Mokhtar S., Hanif D. Sherali, and Chitharanjan M. Shetty. Nonlinear programming: theory and algorithms. John Wiley & Sons, 2013

[R3] Nocedal, Jorge, and Stephen J. Wright, eds. Numerical optimization. New York, NY: Springer New York, 1999