Paper code: BS 201	L	P	Credits
Subject: Linear Algebra and Numerical Methods	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. It should be of 15 marks.
- 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. Each question should be 15 marks.
- 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, K3]**
CO3	Ability of students to numerically solve nonlinear equations and system of linear equations. **[K2,K3, K4]**
CO4	Ability of students to learn numerical methods to obtain interpolating polynomials and approximate differentiation and integration. **[K1,K2, K4]**

CO/ PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	-	-	-	1	-	1	3
CO2	3	3	3	3	3	-	-	-	1	-	1	3
CO3	3	3	3	3	3	-	-	-	1	-	1	3
CO4	3	3	3	3	3	-	-	-	1	-	1	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), Eigenvalues and eigen vectors 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, Singular value decomposition (SVD), SVD in image processing, Solving least squares using SVD	[8]
Unit III Numerical Methods for solving nonlinear equations and system of linear equations: Methods for solving nonlinear equations- Bisection method, Method of False position, Secant method, Newton-Raphson method. Methods for system of linear equations: Gauss elimination, iterative methods of Gauss Jacobi and Gauss Seidel.	[10]
Unit IV Interpolation, Numerical Integration and differentiation: Interpolation techniques-Lagrange interpolation, Newton Divided difference interpolation, Newton Forward and Backward difference method. Numerical Integration: Trapezoidal, Simpson's 1/3 rule, Simpson's 3/8 rule. Numerical differentiation: Approximation of derivatives using interpolating polynomials.	[10]

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] Jain, Mahinder Kumar. *Numerical methods for scientific and engineering computation*. New Age International, 2003.

Reference Books:

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

[R2] Sastry, Shankar S. *Introductory methods of numerical analysis*. PHI Learning Pvt. Ltd., 2012.

[R3] Hoffman, Joe D., and Steven Frankel. *Numerical methods for engineers and scientists*. CRC press, 2018.