Course No	Course Name	L-T-P-Credits
MA 536	**Numerical Linear Algebra**	**3-0-2: 4**

Prerequisite: Linear Algebra

Course Objectives: The objective of the course is to introduce classical algorithms for solving numerical problems in linear algebra and estimate stability of numerical solutions of the problems.

Course Outcomes: After successful completion of the course, students will be able to:

1. Derive and use the numerical techniques needed for a professional solution of a given linear algebra problem.
2. Understand the theoretical basis for direct and iterative methods for solving linear systems of equations.
3. Demonstrate the priciples of SVD and QR algorithm and use them for solving linear least square problems and eigenvalue problems .
4. Describe the principles of Krylov subspace methods, like the Arnoldi iteration, GMRES, Lanczos iteration and conjugate gradients.
5. Analyze rate of convergence and stability of numerical algorithms.
6. Implement numerical methods in Matlab

SYLLABUS

Module	Contents	Hours
I	Review of vector spaces, bases, vector and matrix norms, condition number and stability. IEEE floating point arithmetic, analysis of round-off errors, stability and ill-conditioning	04
II	Direct methods for solving linear equations: Gaussian elimination, LU decomposition, Cholesky method, stability and sensitivity analysis.	08
III	Linear least-squares: Gram-Schmidt orthonormal process, rotators and reflectors, QR factorization, stability of QR factorization, QR method linear least-squares problems, rank deficient least-squares problems, sensitivity analysis..	10
IV	Eigenvalues and singular values-symmetric eigenvalue problem, non-symmetric eigenvalue problem, power method, inverse power method, QR-algorithm, SVD, Krylov subspace method, Lanczos algorithm, sensitivity analysis of eigenvalues.	14

Software Support: MATLAB

Essential Readings:

1. D. S. Watkins, "*Fundamentals of Matrix Computation*", Wiley, 3rd edition, 2010.
2. G. H. Golub and C. F. Van Loan, "*Matrix Computation*", Hindustan Book Agency; 4th edition, 2015.

Supplementary Readings:

1. L. N. Trefethen and D. Bau, "*Numerical Linear Algebra*", SIAM, 1997.
2. J. W. Demmel, "*Applied Numerical Linear Algebra*", SIAM, 1st edition, 1997.
3. B. N. Datta, "*Numerical Linear Algebra and Applications*", Prentice Hall India Learning Private Limited, 2nd edition, 2010.