Course Code: MAT2001	**Course Title:** Numerical Methods for Engineers	**TPC**	2	2	3
Version No.	**1.0**				
Course Pre-requisites/ Co-requisites/ anti-requisites (if any).					
Objectives:	1. The aim of this course is to cover certain basic, important computer oriented numerical methods for analysing problems that arise in engineering and physical sciences. 2. The students are expected to use MATLAB as the primary computer language to obtain solutions to a few assigned problems.				
Expected Outcome:	On completion of this course the students will be able 1. to appreciate the power of numerical methods and use them to analyse the problems connected with data analysis, and solution of ordinary and partial differential equations that arise in their respective engineering courses. 2. To understand the processes of numerical simulation, modeling, optimization, identification, and visualization of engineering systems				
Module No. 1	**Algebraic and Transcendental Equations**	**5 Hours**			
Computer arithmetic & errors, General iterative method- rates of convergence- Secant method - Newton – Raphson method-System of non-linear equations by Newton's method					
Module No. 2	**System of Linear Equations and Eigen Value Problems**	**4 Hours**			
Gauss –Seidel iteration method. Convergence analysis of iterative methods - LU Decomposition -Tri diagonal system of equations-Thomas algorithm- Eigen values of a matrix by Power and Jacobi methods.					
Module No. 3	**Interpolation**	**5 Hours**			
Finite difference operators - Newton's Forward-Newton's Backward interpolation formulae- Central differences-Stirling's interpolation - Lagrange's interpolation – Inverse Interpolation-Newton's divided difference - Interpolation with cubic splines.					
Module No. 4	**Numerical Differentiation and Integration**	**4 Hours**			
Numerical differentiation with interpolation polynomials-maxima and minima for tabulated Values-Trapezoidal rule, Simpsons 1/3rd and 3/8th rules. Two and Three point Gaussian quadrature formula.					
Module No. 5	**Numerical Solution of Ordinary Differential Equations**	**6 Hours**			
Picard's method -Taylor series method - Fourth order Runge-Kutta method. Finite difference solution for the second order ordinary differential equations.					
Module No. 6	**Numerical Solution Partial Differential Equations**	**6 Hours**			
Finite Difference Method partial differential equations - Laplace equation - Libman's Method - One dimensional heat equation - Schmidt explicit method - Crank-Nicolson implicit method - One dimensional wave equation - Explicit method					

Text Book

1. Steven C. Chapra and Ra P. Canale, Numerical Methods for Engineers with Programming and Software Applications, 7th Edition, Tata McGraw Hill, 2014.

References

1. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering, New Age International Ltd., 5th Edition, 2010.

2. G. D. Smith, Numerical Solution of Partial Differential Equations: Finite Difference Methods, Third Edition, Oxford University Press, 1985.
3. C. F. Gerald and P.V. Wheatley Applied Numerical Analysis, Addition-Wesley, 7th Edition, 2004.
4. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Pvt. Ltd., 5th Edition, New Delhi, 2009.
5. W.Y. Yang, W. Cao, T.S. Chung and J. Morris, Applied Numerical Methods Using MATLAB, Wiley India Edition., 2007.
6. R. L. Burden and J. D. Faires, Numerical Analysis, 4th Edition, Brooks Cole, 2012.

Laboratory exercises using MATLAB

Understanding of the concepts through mathematics lab - 10 experiments such as

1. Root Finding using Bracket Methods: Finding the mass of the bungee jumper.
2. Root Finding using Open methods: Determining fluid flow through pipes and tubes
3. Applications of Root Finding Methods: Velocity of a Rocket
4. Implementing Gauss Elimination to solve physical Problems.
5. Solution of diffusion equation.
6. Implementing the power method to evaluate the largest and smallest eigenvalues and their respective eigenvectors
7. Applications of Eigenvalues in stability analysis/earthquakes etc.
8. Implementing polynomial interpolation techniques: Applications to Truncated signals, Growth Rate of Bacteria, Pollutant Uptake etc.
9. Numerical Integration and Differentiation: Applications on Rate of Change, Area, Volume, Work
10. Numerical Integration on Mass-Density etc.
11. Numerical Solutions to Ordinary Differential Equations and Applications: Electrical Circuits, Mass Spring Systems etc.
12. Numerical Solutions to Ordinary Differential Equations and Applications: Diffusion–Reaction Problem, Heat Transfer in a Rod, etc.
13. Other applications related to Computer Science in domains such as computer vision, graphics, image processing and machine learning.

Mode of Evaluation

Continuous Assessment (Quizzes, CATs, Assignments etc.).

CAT-1	Weightage (in %)	20
CAT-2	Weightage (in %)	20
CAT-3	Weightage (in %)	20
Lab	Weightage (in %)	25
Assignment	Weightage (in %)	5
Quiz-1	Weightage (in %)	5
Quiz-2	Weightage (in %)	5
	Total	**100**

Recommended by the Board of Studies on

1st July 2018

Date of Approval by the Academic Council

21st July 2018