



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME03065031

Subject Name: Numerical Methods for Civil Engineering Applications

w. e. f. Academic Year:	2024-2025
Semester:	III
Category of the Course:	<b>Open Elective</b>

**Prerequisite:** Engineering Mathematics

<b>Rationale:</b>	To find solution of structural engineering problems, a mathematical model of the problem is formed and then its closed form or numerical solution is obtained using mathematics. Thus, the knowledge of application of various mathematical tools is essential for the solution of structural problems. The course on <i>Numerical Methods</i> equips the students with the applications of numerical and statistical methods to solve problems related to structural engineering
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### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Solve algebraic equations,	U, R
02	Obtain numerical solution for ordinary and partial differential equations,	A
03	Apply integration method/s for structural analysis,	A, N
04	Carry out interpolations and curve fitting,	A, N
05	Obtain solution of eigenvalue problems and fourier series for structural analysis,	E, C
06	Apply iterative and transformation methods in structural engineering	A, E

\*Revised Bloom's Taxonomy (RBT)

### Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
2	0	2	3	70	30	30	20	150



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Error analysis, types of errors, accuracy & precision, stability in numerical analysis	02	05
2	Empirical laws and curve fitting.	02	10
3	Interpolation & extrapolation, general, interpolation formulae, numerical differentiation & integration/ solution of large systems of linear equations, Use of software, solution of banded equations.	06	15
4	Solution of non-linear algebraic and transcendental equations, Newton-Raphson iterative method, numerical solutions of ordinary differential equations and partial differential equations using finite difference technique, its applications to structural engineering problems.	06	20
5	Solution of Eigen value problems, iterative methods & transformation methods. Applications to Structural Dynamic problems, stress problems, Buckling of columns. Application of numerical methods in civil engineering	04	15
6	Laplace transform methods, Laplace equation- Properties of harmonic functions – Fourier transform methods for Laplace equation	04	15
7	Euler's equation- Functional dependent on first and higher order derivatives	02	10
8	Correlation and regression, Principles of least squares.	02	10
	<b>TOTAL</b>	<b>28</b>	<b>100</b>

## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20	15	20	20	20	5

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

## Reference Books:

- 1) Numerical Methods for engineers. S C Chapra and R P Canale . McGraw Hill International Edition
- 2) Numerical Methods for Scientific & Engineering Computation, M. K. Jain, S.R.K.
- 3) Introduction to Numerical Analysis - By S. S. Sastry., PHI .
- 4) Numerical Methods in Science & Engineering Prog.- By Dr. B. S. Grawal, Khanna Pub., New Delhi.
- 5) Computer Oriented Numerical Methods, R. S. Salaria., Khanna Publisher.



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6) Miller & Freund's Probability and Statistics for Engineers – By Richard A Johnson., PHI

## **List of Practical/Tutorials based on:**

1. Algebraic equations
2. Ordinary and partial differential equation
3. Integration methods
4. Curve fitting
5. Eigen value problems
6. Iterative and transformations methods

## **Open source software and website:**

[www.scilab.org](http://www.scilab.org)<http://nptel.ac.in>

<http://ocw.mit.edu/>

<https://nptel.ac.in/courses/105105043>

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