



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033021

Course / Subject Name: Numerical Methods In Civil Engineering

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PEC

Prerequisite:	Engineering Mathematics
Rationale:	The course 'Numerical Methods for Civil Engineering' is meticulously designed to gear up postgraduate students with the vital numerical skills and methodologies required to tackle complex civil engineering problems. This course aligns with the objectives of India's National Education Policy (NEP) 2020, which emphasizes multidisciplinary learning, critical thinking, practical applications, and the integration of technology and innovation in education. This comprehensive and innovative approach ensures that the course not only meets academic and industry standards but also prepares students to be leaders and innovators in their field.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Implement iterative and transformation methods to optimize and innovate engineering solutions.	A,N
02	Formulate and implement numerical methods to solve ordinary and Partial differential equations in civil engineering contexts.	U,A,N
03	Perform data interpolation and curve fitting to interpret and analyse engineering data accurately along with numerical modelling.	A,N,E
04	Analyse and solve eigenvalue problems and apply Fourier series for civil engineering projects.	A,N,E
05	Integrate software tools, programming languages, and interdisciplinary knowledge to enhance efficiency and accuracy in civil engineering.	U,A,N
06	Foster ethical, sustainable practices through real-world projects.	A,N

**Revised Bloom's Taxonomy (RBT)*



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033021

Course / Subject Name: Numerical Methods In Civil Engineering

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)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Numerical Methods for Civil Engineering: Importance and applications in real-world scenarios. Numerical Techniques for Solving Algebraic Equations: Introduction to errors in numerical methods (round-off errors, truncation errors), Bisection method, Newton-Raphson method, Secant method, error analysis, and applications in structural analysis. Iterative and Transformation Methods: Gauss-Seidel method, Jacobi method, applications in solving large systems of equations in civil engineering projects.	11	24
2.	INumerical Methods for Ordinary Differential Equations (ODEs): Euler's method, Runge-Kutta methods, applications in civil engineering dynamics. Numerical Methods for Partial Differential Equations (PDEs): Finite difference method, Finite element method, applications in heat transfer and groundwater flow.	11	30
3.	Numerical Integration Methods: Trapezoidal rule, Simpson's rule, Gaussian quadrature, applications in areas such as area and volume calculations in civil projects.	05	11
4.	Data Interpolation and Curve Fitting: Lagrange interpolation, Newton's divided difference, least squares method, applications in material property analysis and geotechnical data.	05	09
5.	Eigenvalue Problems and Fourier Series: Power method, Jacobi method, Fourier series analysis, applications in structural vibration analysis and stability.	05	11
6.	Software Tools and Programming Languages: Introduction to MATLAB, Python, and specialized civil engineering software, implementation of numerical methods.	04	07



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033021

Course / Subject Name: Numerical Methods In Civil Engineering

7.	Critical Thinking and Problem-Solving Skills: Practical applications, real-world project-based learning, case studies. Interdisciplinary Learning: Integration of mathematics, computer science, and engineering principles, collaborative projects, Ethical Practices and Sustainability: Discussion on ethical implications, sustainability considerations in civil engineering projects.	04	08
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	20	20	10

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

References/Suggested Learning Resources:

(a) Books:

1. Numerical Methods for Engineers - Steven C. Chapra & Raymond P. Canale
2. Applied Numerical Methods with MATLAB for Engineers and Scientists - Steven C. Chapra
3. Numerical Methods in Engineering and Science: With Programs in C and C++ - B.S. Grewal
4. Introductory Methods of Numerical Analysis - S.S. Sastry
5. Numerical Methods for Engineers and Scientists - Joe D. Hoffman
6. An Introduction to Numerical Methods and Analysis - James F. Epperson
7. Numerical Methods: Principles, Analyses, and Algorithms - Srimanta Pal & Subodh Chandra Bhattacharya
8. Numerical Methods in Engineering with Python - Jaan Kiusalaas
9. Numerical Methods for Engineers and Scientists: A Practical Approach with Applications Using MATLAB - Amos Gilat & Vish Subramaniam
10. Advanced Engineering Mathematics - Erwin Kreyszig



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033021

Course / Subject Name: Numerical Methods In Civil Engineering

(b) Open source software and website:

- NPTEL: <https://nptel.ac.in/>
- NPTEL IITM YouTube Channel: <https://www.youtube.com/user/nptelhrd>
- MIT Open Course Ware: <https://ocw.mit.edu/>
- Scilab: <https://www.scilab.org/>
- Python: <https://www.python.org/>
- Matplotlib: <https://matplotlib.org/>
- FreeFem++: <http://www.freefem.org/>
- OpenFOAM: <https://www.openfoam.com/>

Sr. No.	Details of Contents	Teaching Hours	Percentage Weightage
1	Practical Sessions on Solving Algebraic Equations Using Numerical Techniques	5	17%
2	Implementation of Numerical Methods for ODEs and PDEs	8	33%
3	Numerical Integration and Curve Fitting Practices	6	20%
4	Application of Eigenvalue Problems and Fourier Series in Software	5	17%
5	Use of Iterative and Transformation Methods in Civil Engineering Software	4	13%

PO1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program .
PO4	An ability to apply advanced knowledge and skills appropriate to civil engineering.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil (Water Resource Engineering)

Course / Subject Code: ME01033021

Course / Subject Name: Numerical Methods In Civil Engineering

PO5	An ability to think critically and apply appropriate logic, analysis, judgment and decision making and to function as an effective member or leader of engineering teams to achieve common goals.
PO6	An ability to use appropriate techniques, skills, and modern engineering tools necessary for engineering practice and commit to professional ethics and responsibilities.

* * * * *