GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Course : Structural Engineering

Subject Code : ME01000081

Course / Subject Name : Numerical Methods in Structural Engineering

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

Prerequisite:	Mathematics
Rationale:	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 Analytical and Numerical Methods for Structural Engineering equips the students with the applications of numerical and statistical methods to solve problems related to structural engineering.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
1	. Solve algebraic equations,
2	Obtain numerical solution of ordinary and partial differential equations,
3	Apply integration method/s for structural analysis,
4	Carry out interpolations and curve fitting,
5	Obtain solution of eigen value problems and fourier series for structural analysis,
6	Apply iterative and transformation methods in structural engineering

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Errors: Error analysis, types of errors, accuracy & precision, stability in numerical analysis	03	05
2.	Interpolation and Curve Fitting: Empirical laws for curve fitting, general interpolation formulae.	06	10
3.	Solution of Non-linear Algebraic and Transcendental Equations: Solution by graphical method, bisection method, Newton Raphson iterative method, Regula-Falsi method.	07	15
4.	Elements of Matrix Algebra: Solution of systems of linear equations, Eigen value problems. Applications to Structural Dynamic problems, stress problems, buckling of columns	08	20
5.	Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations, Euler's equation and other methods. Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation. Numerical Integration.	10	20
6	Finite difference method: Finite difference technique, its applications to structural engineering problems.	06	20
7	Computer Algorithms: Numerical solutions for different structural problems	05	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	20	20	20	15	5

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 in Engineering - Salvadori & Baron
2. Numerical methods – B S Grewal
3. Numerical Methods in Finite Element Analysis - Bathe & Wilson
4. Numerical methods for scientific and engineering computations – S R K Iyengar, R K Jain and Mahinder

(b) Open source software and website:

1. **www.scilab.org/**
2. **http://nptel.ac.in/**
3. **http://ocw.mit.edu/**

Suggested Course Practical/Tutorial List: If any

Minimum 20 problems from above topics out of which half of the problems shall be also solved using self developed computer programs in any language.

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