



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3162424

NUMERICAL METHODS FOR ENGINEERS

6th SEMESTER

Type of Course: Open Elective

Prerequisite: Mathematics related subjects up to semester 4

Rationale: Digital Processing of data has become integral part of any working system in our life. In various fields like financial system, weather forecasting, engineering systems, astronomy etc., the information available is in numerical form. From the available data, one must extract some useful information like trend, characteristics and many more. All these requires understanding of various numerical methods. Also, processing the large data requires use of computers (super computers in some case like weather forecasting). In addition to this, for controlling various processes and machines, these methods are useful. So, various numerical methods that can be used to fulfil different data processing requirements are required to be understood. This subject deals with such numerical methods meant for processing numerical data for extracting required information that can be used for taking some decision or control action. This subject is one of the important subjects about which every engineer should be aware.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Teaching Hours	% Weightage
1.	Introduction: <ul style="list-style-type: none"> Mathematical modelling and problem solving Approximations and errors, significant figure, accuracy, precision, error definition, round off error etc. Taylor's series, error propagation, total numerical error, Truncation error, blunders, formulation errors, and data uncertainty 	4	10
2.	Roots of Equations: <ul style="list-style-type: none"> Introduction bracketing methods like bisection method, false position method, incremental searches and determining initial guesses Open methods like simple fixed-point iteration, Newton-Raphson method, Secant method, Brent's method, multiple roots Roots of polynomials, polynomials in engineering, computing with polynomials, methods for finding roots of polynomials like Muller's method, Bairstow's method etc. Preparing algorithms for finding roots of equations. 	8	15
3.	Linear Algebraic Equations: <ul style="list-style-type: none"> Introduction, Linear equations, solving set of linear equations using Gauss Elimination method, pitfalls of elimination method and improving solution, LU Decomposition, matrix inversion, error analysis, Special matrices, Gauss-Seidel method etc. Preparing algorithms for solution of linear algebraic equations. 	6	15
4.	Nonlinear Equations: <ul style="list-style-type: none"> Introduction, solution of nonlinear equations, methods like Bisection method, regula falsie method, Secant method etc. 	4	10



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Sr. No.	Content	Teaching Hours	% Weightage
5.	Optimization: <ul style="list-style-type: none"> • Introduction, non-computer methods, optimization, and engineering practices • One dimensional unconstrained optimization, Golden section search, parabolic interpolation, Newton's method, Brent's method • Multi-dimensional unconstrained optimization, direct methods, Gradient methods • Constrained optimization, Linear programming, nonlinear constrained optimization 	5	10
6.	Curve Fitting: <ul style="list-style-type: none"> • Introduction, noncomputer methods, curve fitting and engineering practice. • Least Square regressions, linear regression, polynomial regression, multiple linear regression, general linear least squares, nonlinear regressions • Interpolation, different methods used for interpolation, Fourier Approximation etc. • Preparing algorithms for curve fitting problems. 	5	10
7	Numerical differentiation and integration: <ul style="list-style-type: none"> • Introduction • Numerical differentiation, definition, high accuracy differentiation formula, Richardson Extrapolation, derivatives of unequally spaced data, • integration methods like Trapezoidal rule, Simpson's rule etc., Concept of integration of equations. • Derivatives and integrals of data with errors, Partial derivatives • Preparing algorithms for integration and differentiation 	6	15
8	Differential Equations: <ul style="list-style-type: none"> • Ordinary Differential Equations • Euler's methods, Runge Kutta Methods, Systems of equations • Preparing algorithms for solution of differential equations. 	6	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (Revised Bloom's Taxonomy)				
Remembrance R Level	Understanding U Level	Application A Level	Analyze N Level	Evaluate E Level
10	40	20	15	5

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Mc Graw Hill
2. Joe D. Hoffman, "Numerical Methods for Engineers and Scientists", Marcel Dekker, Inc.
3. William H. press, William T. Vetterling, Saul A. Teukolaky, Brian P. Flannery, "Numerical Recipes in C", Cambridge University Press
4. R. W. Hamming, "Numerical methods for Scientists and Engineers", Dower Publications

Course Outcome:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire



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different learning outcomes in cognitive, psychomotor, and affective domain to demonstrate following course outcomes.

Sr. No.	CO statement At the end of this course, students will demonstrate the ability to	CO-Topic Mapping	Marks % weightage
CO-1	solve various equations like polynomials, linear and nonlinear algebraic equations etc.	2,3,4	35
CO-2	apply optimization methods and curve fitting methods in engineering problems.	1,5,6	25
CO-3	solve differential equations through numerical methods.	7,8	25
CO-4	prepare algorithms for implementing numerical methods.	1,2,3,4,5,6, 7,8	20

List of Learning Resources :

Web-based tools for design:

Open source Math Tools: -

<http://maxima.sourceforge.net/>

<http://www.sagemath.org/>

<http://www.scilab.org/>

<http://www.gnu.org/software/octave/>

List of Open Source Software/learning website:

<https://nptel.ac.in/courses/111/107/111107105/>

<https://nptel.ac.in/courses/127/106/127106019/>

<https://nptel.ac.in/courses/115/103/115103114/>