GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3140510
Semester – IV
Subject Name: Numerical methods in chemical engineering

Type of course: Core Professional course

Prerequisite: Algebra

Rationale: It is necessary for Chemical Engineering students to solve complex problem.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Approximations and Errors:** Types of Errors, Significant figures, Accuracy of Numbers, Precision, Error Propagation, Applications in Chemical Engineering	3
2	**Solution of Algebraic and Transcendental Equations:** Basic Properties of Equations, Relations between Roots and Coefficients, Descartes Rule of Sign, Synthetic Division of a Polynomial by a Linear Expression, Bracketing Methods (Bisection, Secant, Method of False Position or Regula Falsi, etc.), Convergence of Iterative Methods, Newton-Raphson Method, Newton-Raphson Method for Non Linear Equations in Two Variables (Numericals based on application in chemical engineering)	8
3	**Solution of Linear Equations:** Mathematical Background, Matrix inversion, Gauss Elimination, Gauss-Jordan Method, Gauss-Seidel Iteration Method, Jacobi's Method, Gauss-Seidel Method, Eigen Value Problem (Numericals based on application in chemical engineering)	7
4	**Curve Fitting** Method of Least Squares, Fitting a Straight Line and a Polynomial, Fitting a Non-linear Function, Fitting Geometric and Exponential Curves, Fitting a Hyperbola, a Trigonometric Function, etc (Numericals based on application in chemical engineering)	7
5	**Finite Differences & Interpolation:** Finite Differences: Forward, Backward and Divided Differences Table, Central Differences, Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Inverse Interpolation (Numericals based on application in chemical engineering)	6
6	**Numerical Differentiation & Integration:** Differentiation Formula based on Tabulator at Equal and Unequal Intervals, Newton-Cotes	6

	Integration Formulas, Trapezoidal Rule and Simpson's 1/3 and 3/8 Rule (Numericals based on application in chemical engineering)	
7	**Ordinary Differential Equations :** Taylor's Series and Euler's Method, Modifications and Improvements in Euler's Method, Runge-Kutta 2nd Order & 4th Order Methods, Milne's Predictor-Corrector Methods, Boundary Value Problems (Numericals based on application in chemical engineering)	**8**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
17	**18**	**10**	**11**	**7**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy

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. S C Chapra and R P Canale, Numerical Methods for Engineers, McGraw Hill International Edition.
2. S S Shastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.
3. B S Grewal, Numerical Methods in Engineering & Science, Khanna Publishers.
4. M K Jain, S R K Iyengar and R K Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Find accuracy of numbers, errors and propagation of errors.	25
CO-2	Differentiate types of equation based on linearity and order	25
CO-3	Find the root of linear, non-linear and linear algebraic equations	15
CO-4	Analyze and solve finite difference-interpolation and numerical integration problems.	15
CO-5	Arrange the data and find out coefficient of equation for curve fitting	10
CO-6	Compare variety of numerical methods for solving ordinary differential equation	10