

# GUJARAT TECHNOLOGICAL UNIVERSITY

## COMPUTER ENGINEERING (07), INFORMATION TECHNOLOGY (16) & INFORMATION & COMMUNICATION TECHNOLOGY (32)

NUMERICAL AND STATISTICAL METHODS FOR COMPUTER ENGINEERING

SUBJECT CODE: 2140706

B.E. 4<sup>th</sup> SEMESTER

**Type of course:** Foundation

**Prerequisite:** Differentiation, Integration, Matrix operation, Various Mathematical Series, Fundamental Mathematics

**Rationale:** To know about various types of Errors, Calculate the error correction and get actual root of the equation. Understand different methods of solution of the equations and compare them. Student will be made aware of different numerical and statistical methods which are used in engineering field, with emphasis on how to prepare program for different methods.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

### Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Mathematical modeling and engineering problem Solving. Approximations and errors. Significant figures, accuracy and precision, Errors, round-off and truncation errors, error propagation.	4	10
2	Roots of Equations: Mathematical background, Bisection, Regula Falsi, NR method, Secant, Successive approximation method, Budan's Theorem, Barristow's method, case studies.	6	15
3	Systems of linear algebraic equations: Mathematical background, Gauss elimination; pitfalls and techniques for improvement, matrix inversion and Gauss-Seidel methods, ill-conditional Equations, Predictor-Corrector methods, case studies.	8	20
4	Curve Fitting: Mathematical background, Least squares linear and polynomial regression, Lagrange interpolating Polynomials. Spline interpolation, Case studies.	6	15
5	Numerical Integration: Newton-Cotes integration formulas; trapezoidal rule and Simpson's rules: Interpolation, case studies.	5	10
6	Ordinary differential equations: Euler's method, Runge-Kutta methods. General methods for boundary value problems, Case studies.	5	10
7	<b>Statistical Methods:</b> Frequency distributions, Data analysis, Expectations and moments, Correlation and regression, Trend analysis, Seasonal effects, Cyclical Fluctuation, Moving average, MSE, Predictions. Non-parametric statistics. Computer-based resampling techniques. Confidence intervals and statistical significance.	8	20

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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) 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, J B Dixit, Laxmi Publications, New Delhi
- 5) Statistics and Numerical Methods, Dr Manish Goyal, Laxmi Publications, New Delhi
- 6) Numerical Methods in Science & Engineering Prog.- By Dr. B. S. Grawal, Khanna Pub., New Delhi.
- 7) Computer Oriented Numerical Methods, R. S. Salaria.,Khanna Publisher.
- 8) Miller & Freund's Probability and Statistics for Engineers – By Richard A Johnson., PHI

### Course Outcome:

After learning the course the students should be able to:

1. Solve system of linear equations.
2. Understand various methods of modeling.
3. Apply Mathematical Modeling and for Engineering Problem Solving.
4. Solve Mathematical Equations by various methods.
5. Find Best Curve fitting for given data.
6. Apply Numerical Integration.
7. Solve Differential Equations.
8. Understand Statistical Methods for Data Analysis and sampling techniques.
9. Write programs for various numerical and statistical methods

### List of Experiments and Open Ended Problems:

Practicals/Programs based on methods covered in the syllabus. There should be minimum 10 programs, out of which 2 should be from statistical portion.

The student should be encouraged to create a menu driven project consisting of various methods studied in the syllabus.

Practical List:

1. Develop a C program to find a root of a non-linear equation using **Bisection method**.
2. Develop a C program to find a root of a non-linear equation using **False Position method**.
3. Develop a C program to find a root of a non-linear equation using **Secant method**.
4. Develop C program to find a root of a non-linear equation using **Newton-Raphson method**.
5. Develop a C program to find a root of a non-linear equation using **Barirstow's method**
6. Develop a C program to implement Simpsons 1/3rd Rule.
7. Develop a C program to solve linear equation using **Gauss Elimination method**.
8. Develop a C program to solve linear equation using **Gauss Seidel method**.
9. Develop a C program to compute the Gauss Jacobi Interactive methods
10. Develop a C program to compute the interpolation value using **Newton's Forward Difference formula**.

11. Develop a C program to compute the interpolation value using **Newton's Backward Difference formula**.
12. Develop a C program to compute derivatives of a tabulated function at a specified value using the Newton interpolation approach.
13. Develop a C program to implement Simpsons 3/8th Rule.
14. Develop a C program to implement Runge- Kutta 2nd order method.
15. Develop a C program to implement fitting of straight line.
16. Write a program to find mean for direct series.
17. Write a program to find median for direct series.
18. Write a program to calculate different percentiles.
19. Write a program to calculate mode for discrete distribution.
20. Write a program to calculate harmonic and geometric means for any distribution.
21. Write a program to calculate probability using binomial distribution and Poisson distribution.

**Assignment** – It should consist of minimum 10 different problems to be solved covering the whole syllabus.

**Major Equipments: Desktop, Laptop**

**List of Open Source Software/learning website:**

- 1) [www.nptel.ac.in](http://www.nptel.ac.in)

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.