Sarvajanik University

Sarvajanik College of Engineering & Technology,Surat

Bachelor of Technology (B. Tech.)

Instrumentation and Control

B.Tech. Year II Semester IV

Subject Name: Numerical Methods and Statistical Analysis **Subject Code: BTAS11401**

Type of course: BSC

Prerequisite: (1) Solution of quadratic equations and conditions for types of roots, matrices
(2) Basic factorization, solution of differential equations and integration.

Rationale: This subject deals with common numerical techniques widely used in engineering applications and some of the statistical methods

Teaching and Examination Scheme:									
TEACHING SCHEME				**Theory Marks**			**Practical Marks**		**Total Marks**
L	**T**	**P**	**C**	**TEE**	**CA1**	**CA2**	**TEP**	**CA3**	
3	**0**	**2**	**4**	**60**	**25**	**15**	**30**	**20**	**150**

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	**Content/Topics**	**Total Hours**	**Module Weightage in %**
1	**Introduction to Basics of Numerical Methods:** Mathematical modeling, computer software, algorithm design, flow chart, approximation and round off errors, accuracy and precision, round off errors. Truncation of errors and Taylor series, using Taylor series to estimate truncation errors, error propagation.	06	13
2	**Bracketing Methods:** Bracketing methods, Graphical methods, bisection method, bisection algorithm, false position method. Numerical examples	06	13
3	**Open Methods:** Introduction, the Newton Raphson method, pitfalls of Newton Raphson method, algorithm, the Secant method, multiple roots, systems of nonlinear equations, roots of polynomials, Muller's method, numerical examples	06	13
4	**Initial value problems for ordinary differential equations:** Single step methods: Taylor series method – Euler and modified Euler Method,– Fourth order Runge-Kutta method for solving first order differential equations, example problems	05	11

5	**Introduction To Statistical Parameters:** Average- Mean, Mode, Median, geometric mean, harmonic mean, root-mean-square and root-sum-squares average, standard deviation, variance, Correlation, examples problems, the normal distribution, regression estimation of confidence interval, curve fitting, examples	08	18
6	**Matrix Equations:** Solution of matrix equations (brief overview), Singular values and Singular Value Decomposition, LU decomposition, the matrix inverse, matrix norm and condition number, Gauss elimination, Gauss-Seidel method, Least square method, linear regression, polynomial regression, multiple linear regression, applications, examples problems	08	18
7	**Numerical differentiation and integration**: Introduction, mathematical background, interpolation, forward and backward difference derivative, Newton's formulae for interpolation, Newton-Cotes integration formulas, Trapezoidal rule, applications, Simpson rules, examples problems	06	14

Suggested Specification table with Marks (Theory): (For B. Tech. only)

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**20**	**20**	**20**	**15**	**10**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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:

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Numerical Methods	Balagurusamy, E	Tata McGraw- Hill Publishing Company, ISBN: 9780074633113	1999	--
2	Introductory Methods for Numerical Analysis	S. S. Sastry	PHI, Eastern Economy Edition, ISBN: 978-81-203-2761-0	2008	4th
3	Numerical Methods for Engineers (with programming and software applications)	Steaven Chapra, Raymond Canale	McGraw Hill Inc. ISBN: 0-07-010938-9	1998	3rd

Course Outcome:

Sr. No.	After learning this subject, students will be able to	Weightage in %
CO-1	choose appropriate methods to find numerical solution of nonlinear equations and system of linear equations.	20
CO-2	find unknown value of given data by using various interpolation methods and evaluate integration with appropriate method.	25
CO-3	solve initial and boundary value problems numerically using appropriate method.	20
CO-4	analyze the experimental data, classify them and draw valid conclusions, provide a probabilistic framework for data.	25
CO-5	make reasonable decisions utilizing maximum information gathered about the population considering minimum effort, cost and time, determine the reliability of the estimates for the population parameters.	10

Mapping CO-POs-PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO 1	PS O2	PSO 3
CO1	1	2		1									2		
CO2	2	2											1		
CO3			2	2	2	1	1							2	
CO4								2	2	2	1	1			3
CO5									1	2	1	1			2

List of open source learning website:

Numerical Methods for Engineers by Prof. Niket Kaisare | IIT Madras

https://onlinecourses.nptel.ac.in/noc19_ge30/preview

List of practical(programming exercises):

1) Implement the bisection method algorithm to find the roots of nonlinear equation using C or Python programming
2) Implement the Newton Raphson method to find the roots of nonlinear equation using C or Python.
3) Implement the secant method to find the roots of nonlinear equation using C or Python.
4) Implement the Gauss Elimination method for solving linear equations.
5) Implement the Gauss Jordon method for solving linear equations.
6) Implement Algorithm To Find Derivatives Using Newton's Forward Difference Formula
7) Implement Algorithm To Find Derivatives Using Newton's backward Difference Formula
8) Implement the trapezoidal algorithm to find integration using C /python programing
9) Implement the Simpsons' 1/3 rule algorithm to find the integration using C/Python programming.
10) Implement the Simpsons' 3/8 rule algorithm to find the integration using C/Python programming.
11) Implement the C program for least square method.
12) Perform the statistical analysis using MATLAB for a given data set.

13) Analyze the trends of data using python. Find correlation of input with output. And apply the reduction using principal component analysis.

Open source software: SCILAB, Code Blocks (for C programming), Python IDLE or equivalent

Major Equipment/software: MATLAB