GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electrical/EC

SUBJECT NAME: Probability, Statistics and Numerical Methods

SUBJECT CODE: 2910003

Type of course: Basic Science Course

Prerequisite: Advanced Engineering Mathematics

Rationale: Systematic study of uncertainty by probability - statistics and approximate solutions by numerical methods.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	2	0	5	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
01	Basic Probability: Probability spaces, conditional probability, Bayes' rule, independence, Random variables, Independent random variables, sums of independent random variables; Probability mass function, probability density function, Probability distribution function. Expectation, Moments, Skewness and Kurtosis, Variance, Chebyshev's Inequality, The multinomial distribution, Infinite sequences of Bernoulli trials.	07	16 %
02	Discrete and Continuous Probability Distributions: Discrete Probability distributions: Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these distributions. Continuous random variables and their properties, distribution functions and densities, Normal, Exponential and Gamma densities, Evaluation of statistical parameters for these distributions.	05	16 %
03	Bivariate Distributions: Bivariate random variable, Bivariate distributions and their properties, Distribution of sums and quotients, conditional densities.	02	
04	Basic Statistics: Correlation and regression : Correlation, Rank correlation, Linear regression, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	03	8 %
05	Applied Statistics: Test of significance: Large sample test for single proportion, Difference of proportions, Single mean, Difference of means, and Difference of standard deviations.	04	16 %
06	Small samples: t- Test for single mean, difference of means, paired t-test, t-test for correlation coefficients, F- test for ratio of variances - Chi-square test for	03	

	goodness of fit and independence of attributes.		
07	Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formula. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	10	24 %
08	Ordinary differential equations: Taylor series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicolson methods), Finite difference explicit method for wave equation.	08	20 %

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**14**	**14**	**14**	**14**	**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 from above table.

Reference Books:

(1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
(2) Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
(3) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
(4) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
(5) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley. .
(6) J. N. Kapur, H. C. Saxena, Mathematical Statistics, S. Chand.

Course Outcome:

After learning the course, the students should be able to:

1. Understand the terminologies of Basic Probability, Probability spaces, conditional probability, Bayes' rule, Independence of random variables and their sum, Probability mass function, Probability density function, Probability distributions, Expectation, Moments, Skewness and Kurtosis, Variance, Chebyshev's Inequality, The multinomial distribution, Infinite sequences of Bernoulli trials.
2. Observe and analyze the behavior of various discrete and continuous probability distributions.
3. Recognize the knowledge of Continuous random variables and their properties, distribution functions and densities, Normal, Exponential and Gamma densities, evaluating the statistical parameters for these distributions.
4. Acquire the understanding of bivariate random variable, bivariate distributions and their properties, distribution of sums and quotients, conditional densities.
5. Learn basic idea of statistical terms.
6. Find correlation and correlation coefficient between two variables, rank correlation.

7. Obtain linear regression and fit a straight line, second degree parabola and more general curves by using the method of least squares.
8. Apply the statistics for testing the significance of the given sample data by using t- Test for single mean and difference of means, paired t-test, t-test for correlation coefficients, F- test for ratio of variances, Chi-square test.
9. Solve algebraic and transcendental equations by using Bisection method, Newton-Raphson method and Regula-Falsi method.
10. Use finite differences and their relations in interpolation technique.
11. Obtain an interpolating polynomial from a set of discrete data points by using Newton's forward and backward, Newton's divided difference and Lagrange's interpolation.
12. Use various techniques to find numerical differentiation and integration.
13. Solve ordinary differential equations numerically by Taylor series method, Euler and modified Euler's methods. Runge-Kutta method of fourth order.
14. Apply finite differences to solve two dimensional Laplace equation and Poisson equation.
15. Use implicit and explicit methods for solving one dimensional heat equation (Bender-Schmidt and Crank-Nicolson methods).
16. Solve wave equation by finite difference explicit method.