GUJARAT TECHNOLOGICAL UNIVERSITY

PACKAGING TECHNOLOGY (58)
NUMERICAL METHODS AND DESIGN OF EXPERIMENTS
SUBJECT CODE: 715801
SEMESTER: I

Type of Course: Numerical Methods and Design of Experiments

Prerequisite: Nil

Rationale:
This course will enable students to find approximate solutions where closed form solution not easy to find. Most simulators of physical phenomena we see are using numerical methods rather than closed-form solutions. Moreover, students will learn some distributions of statistics and design of experiments.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2	0	4	70	30	30	0	10	10	150

Sr. No.	Contents	Total Hrs.	% Weightage
1.	**Error Analysis:** Significant figures, Accuracy and Precision, Absolute Error, True Relative Error, Approximate Relative Error, Types of Error	**03**	**5**
2.	**Roots of Equations:** Bracketing Methods: Bisection Method, False Position Method Open Methods: Newton-Raphson Method, Secant Method Case Studies: Pipe Friction	**05**	**15**
3.	**Linear Algebraic Equations:** Solving small number of equations, Naïve Gauss Elimination Method, Pitfalls of Elimination methods, Techniques for improving solutions, Gauss Jordan Method, Matrix inverse, Gauss Seidel Method, Case Studies: Spring-Mass Systems	**06**	**15**
4.	**Curve Fitting:** Linear Regression, Polynomial Regression, Multiple Linear Regression Interpolation: Newton's forward and backward difference methods, Newton's divided difference method, Lagrange's interpolation method, Inverse interpolation by Lagrange's method Case Studies: Analysis of Experimental Data	**05**	**15**
5.	**Ordinary Differentiation and Integration:** Newton's forward difference and backward difference formula, Trapezoidal rule, Simpson's one-third and three-eighth rules, Gauss quadrature Case Studies: Computation of Work	**06**	**15**

6.	**Discrete Distributions:** Random Variables, Standard probability distribution- Binomial, Poisson as an approximation to binomial and Poisson processes. The mean and the variance of a probability distribution. **Continuous Distribution:** Normal Distribution, Standard normal distribution	**08**	**15**
7.	**Design of Experiments:** Completely Randomized Design, Randomized Block design, Latin square design-2 Factorial Design, Fundamental Assumptions of analysis of variance, Single factor experiments- Fixed/random effects model- Model adequacy checking- Multiple comparisons –Design of experiments with several factors- Two factor factorial experiments, Taguchi Approach to Design of Experiments	**11**	**20**

Note: Only examples will be asked especially in case of Case Studies. Mathematical formulation or derivation of any theory is not to be discussed.

Reference Books:

1. Steven Chapra and Raymond Canale, "Numerical Methods for Engineers", 6th Edition, Tata McGraw-Hill.
2. E. Balagurusamy, "Numerical Methods", Prentice Hall of India.
3. Sastry S. S., "Introductory Methods of Numerical Analysis", 5th edition, Prentice Hall of India.
4. Erwyn Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, 2008.
5. Dr.B.S.Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 2014.
6. Probability and Statistics for Engineers, Richard A. Johnson, Irwin Miller, John Freund, 7th Edition, Pearson
7. K. Krishnaiah, P. Shahabudeen, "Applied Design of Experiments and Taguchi Methods", PHI Learning Pvt Ltd, 1st Edition, 2012

Course Outcome:

After learning this course the student must demonstrate the knowledge and ability to:

1. To understand the use of numerical methods in modern scientific computing way.
2. Be familiar with numerical solutions of nonlinear equations in a single variable
3. Be familiar with numerical interpolation and approximation of functions
4. Be familiar with numerical integration and differentiation
5. Be familiar with statistics and experiments of design