GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3733009
Semester – III
Subject Name: Design of experiments and parameter estimation

Type of course: Program Elective 5

Prerequisite: Fundamentals of statistics and mathematics

Rationale: This Subject is essential for Chemical engineering to know the effect of pressure and stress of fluid on different bodies. Further, it is useful for students to know the metering devices for different type of fluids.

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)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Design of experiments. Basic concepts, Bias and confounding, controlling bias, causation, Examples. Random Variables: Introduction to discrete and continuous random variables, quantify spread and central tendencies of discrete and continuous random variables.	9
2	Exploratory Data Analysis Variable types, Displaying the distribution, mean variance and typical spread, quartiles and unusual spread, multivariate data: finding relations. Probability, Definition of a random variable, expectation, percentiles, common distributions such as the binomial, Poisson and normal distributions.	6
3	Linear Regression analysis: The linear regression model, Parameter estimation, accuracy of the coefficient estimates, checking the model, multiple linear regression, confidence and prediction intervals, potential issues, high leverage points, outliers. Matrix approach to linear regression.	10
4	Variance-Covariance matrix, ANOVA in regression analysis, quantifying regression fits of experimental data, Extra sum of squares approach, confidence intervals on regression coefficients, lack of fit analysis.	8
5	**Response Surface Methodology**: Method of steepest ascent, first and second order models, identification of optimal process conditions	12

Reference Books:

1. Hanneman, Robert A., Kposowa, Augustine J., Riddle, Mark D. (2012). Research Methods for the Social Sciences: Basic Statistics for Social Research. John Wiley & Sons.

2. Saunders, Mark, Brown, Reva Berman (2007). Dealing with Statistics: What You Need to Know. McGraw-Hill Education.
3. Cowles, Michael (2000). Statistics in Psychology: An Historical Perspective (2nd Edition). Lawrence Erlb

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Define design of experiments and relate it with random variables.	15
CO-2	Classify different types of variables and explain data analysis.	20
CO-3	Apply linear regression analysis for data analysis.	25
CO-4	Examine lack of fit by ANOVA using different errors calculations.	20
CO-5	Integrate data analysis approaches for optimal process conditions.	20

List of Experiments:

1. Plan experiments for a critical comparison of outputs.
2. Include statistical approach to propose hypothesis from experimental data.
3. Implement factorial and randomized sampling from experiments.
4. Estimate parameters by multi-dimensional optimization.