



GUJARAT TECHNOLOGICAL UNIVERSITY
Master of Engineering, Chemical (Computer Aided Process Design)
Subject Code - 3721615
Semester II
Subject Name: Design of Experiments and Parameter Estimation

Type of course: Program Elective – III

Prerequisite: Fundamentals of probability and statistics

Rationale: Optimum condition for the experiments involved in chemical engineering depends on number of variables. To achieve these optimized set of condition is iterative, laborious and uneconomical task. This course enables how to design experiments in order to overcome aforementioned drawbacks. This course also enables students to analyze data yielded by experiments and estimation of parameters involved in models.

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)		
3	0	0	3	70	30	0	0	100

Syllabus Content:

Sr. No.	Content	Total Hrs
1	Random Variables: Introduction to discrete and continuous random variables, quantify spread and central tendencies of discrete and continuous random variables.	4
2	Important Statistical Distributions: Properties and applications of Normal, log-normal and t-distributions, Chi-Square and F distributions.	6
3	Point and interval estimates of population parameters: Point Estimation of the population mean, distribution of the sample means, central Limit theorem, confidence Intervals on the population mean, optimal sample size to obtain precision and confidence in interval estimates of mean, maximum likelihood parameter estimation	8
4	Hypothesis Testing: Formulation of null and alternate hypotheses, errors in hypothesis Tests, power of hypothesis tests, hypothesis tests on population means, variances and ratios of variances.	6
5	Analyze single factor experiments: Introduction to Analysis of Variance (ANOVA), blocking and randomization.	4
6	Factorial Design of Experiments: Need for planned experimentation, factorial design experiments involving two factors, effect of interactions, ANOVA in factorial design, general factorial design, partial factorial designs.	7
7	Linear Regression Analysis: Matrix approach to linear regression, 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
8	Comparison of different experimental design strategies: Properties of orthogonal designs, implications of different factorial design models, importance of center runs, scaled prediction variance, central composite design, BoxBehnken design, moments of	6



GUJARAT TECHNOLOGICAL UNIVERSITY
Master of Engineering, Chemical (Computer Aided Process Design)
Subject Code - 3721615

	experimental designs, rotatable of experimental designs, face centered cuboidal designs, comparison of experimental designs.	
9	Response Surface Methodology: Method of steepest ascent, first and second order models, identification of optimal process conditions.	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	16	18	12	14	-

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 slightly from above table.

Reference Books:

1. Design and Analysis of Experiments - Douglas C. Montgomery – Eighth edition.
2. Applied Statistics and Probability for Engineers - Douglas C. Montgomery, George C. Runger – Fifth edition.
3. Design and Analysis of Experiments – M. N. Das, N. C. Giri - Second edition.

Course Outcomes: After successful completion of the course, students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe importance of statistical distribution terms.	15 %
CO-2	Select appropriate experimental design method.	10 %
CO-3	Design experiments with systematic approach and appropriate technique.	45 %
CO-4	Estimate parameter using regression techniques.	30 %

List of Open Source Software/learning website:

- Students can refer to video lectures available on NPTEL.