

# GUJARAT TECHNOLOGICAL UNIVERSITY

## MECHANICAL (PRODUCTION ENGINEERING) (28)

DESIGN OF EXPERIMENT

SUBJECT CODE: 2732806

M.E. SEM-III

**Type of course:** MAJOR ELECTIVE - IV

**Prerequisite:** NIL

**Rationale:** This course provides the knowledge of Various Techniques used in Experimental Works. This course gives hands on practice regarding Hybrid Designing tools using to solve or Trial and errors for Research work for Optimization. This course gives knowledge about different major industrial application related to modernize Production.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	PA (V) ESE	PA (I)		
3	2	2	5	70	30	30	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment;

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Random Variables</b> Introduction to discrete and continuous random variables, quantify spread and central tendencies of discrete and continuous random variables <b>Important Statistical Distributions</b> Properties and applications of Normal, log-normal and t-distributions, Chi-Square and F distributions	02	6
2	<b>Point and interval estimates of population parameters</b> 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	04	12
3	<b>Hypothesis Testing</b> Formulation of null and alternate hypotheses, errors in hypothesis Tests, power of hypothesis tests, hypothesis tests on population means, variances and ratios of variances	04	12
4	<b>Analyze single factor experiments</b> Introduction to Analysis of Variance (ANOVA), blocking and randomization	04	12
5	<b>Factorial Design of Experiments</b> Need for planned experimentation, factorial design experiments involving	05	15

	two factors, effect of interactions, ANOVA in factorial design, general factorial design, partial factorial designs  Use descriptive statistics and charts to summarize cross-sectional and time series data.		
<b>6</b>	<b>Linear Regression Analysis</b> 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.	<b>05</b>	<b>15</b>
<b>7</b>	<b>Comparison of different experimental design strategies</b> Properties of orthogonal designs, implications of different factorial design models, importance of center runs, scaled prediction variance, central composite design, Box- Behnken design, moments of experimental designs, rotatable of experimental designs, face centered cuboidal designs, comparison of experimental designs	<b>5</b>	<b>15</b>
<b>8</b>	<b>Response Surface Methodology</b> Method of steepest ascent, first and second order models, identification of optimal process conditions	<b>5</b>	<b>15</b>

#### Reference Books:

1. H. Toutenburg and Shalabh: Statistical Analysis of designed experiments, Springer 2009
2. D. C. Montgomery: Design & Analysis of Experiments, 5th Edition, Wiley, 2001

#### Course Outcome:

After learning the course the students should be able to solve the problems in analytical way.also will be able to optimize the existing process parameters.

#### List of Experiments:

1. Theory of linear models
2. General linear hypothesis and analysis of variance
3. One way analysis of variance of fixed effect model
4. Multiple comparison tests
5. Experimental designs and their analysis- completely randomized design, randomized block design and Latin square design

#### Design based Problems (DP)/Open Ended Problem:

1. Write programe/s using MATLAB software of different DOE techniques
2. Analysis using different DOE techniques (using annova,regression analysis)

#### Major Equipments/ Software/learning:

- ANSYS
- MATLAB
- MINITAB STASTASTICAL TOOLS

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first

two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.