

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCHD514	Applied Statistics in Chemical Engineering	3	0	0	3

Course Objective

- To make the students understand the necessity and application of statistics in Chemical Engineering research.
- To impart a holistic view of the distribution of data, sample size, fundamentals of the design of experiments, statistical tests of significance, including non-parametric, data presentation and reduction, and regression analysis, statistical analysis in the multivariate domain, and experimental/simulation data interpretation

Learning Outcomes

- Students will be able to understand the need for statistical analysis in chemical engineering research, understand the fundamentals of the design of experiments such as full-factorial, the significance of hypothesis testing and its application to practical research problems, and other essential statistics required for analyzing experimental and simulation data.

Unit No.	Description of Lectures	Contact Hours	Learning Outcomes
1.	Introduction: Need for data analysis, Design, and analysis of experiments with basic concepts and applications in Chemical Engineering.	5	A comprehensive introduction to the course content will be delivered along with the understanding of the design of experiments and the need for it before conducting the research.
2.	Basic Statistics and Data Presentation: Understanding fundamental terminologies such as mean, sample, population, etc., and data visualization graphs such as Box plots, Distribution plots, Bar plots, and any other plots required for Chemical Engineers.	8	It encompasses the foundation of all basic statistical terminologies that will be useful throughout the course and data presentation using different plots that will be very helpful to understand the terms pictorially and interpret the results of the research problems constructively.
3.	Sampling Distribution and Introduction to Hypothesis Testing: Introduction to the theoretical probability distribution, confidence interval, and statistical inferences using hypothesis testing—comparing means from two samples (Student's T-Test and Z-test).	8	An introduction to well-known probability distributions, hypothesis testing, and statistical tests is required to compare one or two sample means.
4.	Analysis of Variance (ANOVA): Multivariate analysis, Normality tests, F-Test, One-way, Two-way & Three-way ANOVA and its application for Chemical Engineering problems.	8	It includes the well-known hypothesis test called ANOVA, which is essential for comparing more than two samples, F-ratio, interaction effects in ANOVA, and normality tests such as q-q plot, etc.

5	Non-parametric tests: Disadvantages of Parametric Hypothesis tests, Wilcoxon signed-rank test, Kruskal-Wallis test, and Chi-Square test.	8	This section introduces the drawbacks and limitations of parametric statistical significance tests and different non-parametric tests required for analyzing non-normal data.
6	Regression analysis: Introduction to Regression, Linear Regression, the Effect of Sample Size on the regression model, evaluation of the model, and its application for Chemical Engineering related problems.	5	A brief overview of regression analysis will be helpful in having a preliminary idea of the experimental/simulation data that will be analyzed in the future using theoretical or empirical studies.
	Total	42	

Text Books:

1. Montgomery, D. C., & Runger, G. C. (2010). *Applied statistics and probability for engineers*. John Wiley & Sons.
2. Pagano, M., Gauvreau, K., & Mattie, H. (2022). *Principles of biostatistics*. CRC Press (New edition: Third Ed.).

Reference Books:

1. Lavine, M. (2008). *Introduction to statistical thought*. Orange Grove Texts.
2. Urdan, T. C. (2011). *Statistics in plain English*. Routledge (Third Ed.).