PROBABILITY AND STATISTICS
ENSH 304

Lecture	: 3	**Year : III**
Tutorial	: 1	**Part : I**
Practical	: 0	

Course Objectives:

The objective of this course is to equip students with foundational knowledge in probability and statistics, focusing on core concepts essential for engineering applications. Students will develop essential skills in statistical data analysis, enabling them to apply various statistical techniques to address real-world engineering challenges. Additionally, the course emphasizes the interpretation and effective communication of statistical results, preparing students to make informed, data-driven decisions in their professional practice.

1   Descriptive Statistics and Basic Probability   (6 hours)

    1.1   Introduction to statistics and its importance in engineering
    1.2   Measure of central tendency and measure of variation
    1.3   Graphical representation of data: Histograms, box plots and scatter plots
    1.4   Basic probability concepts, additive law, multiplicative law
    1.5   Conditional probability and Bayes' theorem

2   Probability Distributions and Sampling Distribution   (14 hours)

    2.1   Random variables: Discrete and continuous
    2.2   Expectation and variance of discrete and continuous random variables
    2.3   Discrete probability distributions: Binomial, Poisson, negative Binomial
    2.4   Continuous probability distributions: Normal, Gamma, Chi-Square
    2.5   Population and sample
    2.6   Sampling distribution of mean and proportion
    2.7   Central limit theorem

3   Statistical Inference   (14 hours)

    3.1   Point estimations and properties of estimators
    3.2   Confidence intervals for mean and proportions
    3.3   Hypothesis testing, parametric and non-parametric tests, procedure of hypothesis
    3.4   Hypothesis testing of mean (Single mean, two means, paired t-test and one-way)
    3.5   Goodness of fit tests and independence of attributes (Chi-square and Kolmogorov–Smirnov test)

4   Correlation and Regression   **(6 hours)**

4.1   Correlation analysis and test of linear correlation
4.2   Simple regression analysis, the concept of explained, unexplained, and total
4.3   Multiple regression analysis

5   Statistical Quality Control   **(5 hours)**

5.1   Quality control and its importance in engineering
5.2   Control charts for variables (X-bar, R-chart, P-chat)
5.3   Six sigma concepts

Tutorial   **(15 hours)**
1.   Visualize data, compute central tendency, and variance in engineering problems using computer software
2.   Solve different engineering problems involving probability
3.   Solve different engineering problems involving discrete probability distribution and its interpretation
4.   Solve different engineering problems involving continuous probability distribution and its interpretation
5.   Analyze numerical engineering datasets, perform normality tests, confidence intervals, significance tests of means, and ANOVA
6.   Analyze categorical engineering datasets, perform crosstabulation, proportion tests, Chi-Square tests, and draw conclusions using computer software
7.   Calculate the correlation coefficient and perform correlation tests on engineering data
8.   Fit and interpret simple/multiple regression models on engineering data using computer software
9.   Use control charts for process monitoring on sample engineering data.
10. Create control charts using computer software

Final Exam
The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	6	10
2	14	15
3	14	20
4	6	10
5	5	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Ronald, E.W., Raymond, H.M., Sharon, L.M. (2012). Probability & Statistics for Engineers & Scientists (9th edition). Boston USA: Prentice Hall.
2. Richard A.J. (2018). Probability and Statistics for Engineers (9th edition). Edinburgh Gate: Pearson Education Limited
3. Sheldon M.R. (2009). Introduction to Probability and Statistics for Engineers and Scientists (4th edition). London: Elsevier Inc.
4. Jay L.D. (2012). Probability and Statistics for Engineering and Sciences. Boston: Thomson Brooks/Cole
5. Brian S.E., Ibrsten H. (2010). A Handbook of Statistical Analyses Using R (2nd edition). London: CRC Press Taylor & Francis Croup
6. Andy F. (2018). Discovering Statistics Using IBM SPSS Statistics (5th edition). London: SAGE Publications.