SUGGESTED READINGS:

- Box, G.E.P. and Tiao, G.C. (2011). Bayesian Inference in Statistical Analysis, John Wiley & Sons (reprint).
- Lee, P. M. (2012). Bayesian Statistics: An Introduction 4th edition, Wiley.
- O'Hagan, A. and Forster, J. (2010). Kendall's Advanced theory of Statistics, Volume 2B, Bayesian Inference, published by Wiley.
- Robert, C.P. (2007). The Bayesian Choice: A Decision Theoretic Foundations to Computational Implementation, Second Edition, Springer-Verlag, New York (reprint).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch University of Delhi, from time to time.

Discipline Specific Elective for B.Sc.(H) Statistics Semester-VIII

DISCIPLINE SPECIFIC ELECTIVE COURSE – 6 A: NON PARAMETRIC TESTING

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITESOFTHE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Nonparametric Testing	4	3	0	1	Class XII pass with Mathematics	Knowledge of Hypothesis testing

Learning Objectives

The learning objectives include:

- Usefulness of Nonparametric distribution free tests their strength and weaknesses
- Quantile and Empirical distributions and their utility
- Test for randomness, location and scales under nonparametric setup
- Test association of bivariate samples

Learning Outcomes

After completing this course, students should be able to:

- Make distinction between Parametric and Nonparametric test and measurement scales.
- Appreciatetheroleofquantileandempiricaldistributionfunctionandassociated tests.
- Identify suitable nonparametric test for both location and scale and able to apply one/two tests including Kolmogorov- Smirnov one sample and two sample tests, sign test, Wilcoxon signed rank test, run test. Median test, Kruskal-Wallis one-way analysis of variance by ranks, Friedman two-way analysis of variance by ranks.
- Test association of bivariate samples using Kendall tau and Spearman's rank correlation.

UNIT II **(12 Hours)**

Conjugate Prior and Non-Informative Priors

Thumb rule for constructing a conjugate prior; Conjugate families for samples from various standard distributions; Uniform prior; Jeffreys' non-informative priors; Normal approximations to posterior distribution.

UNIT III **(15 Hours)**

Bayes Estimation and Credible Interval

Elements of Bayes Decision Theory; Loss Functions such as Squared error loss function, Bilinear loss function; Bayes risk; Normal and Extensive form of analysis; Duality between loss and prior; Generalized maximum likelihood estimate; Bayesian credible intervals; Difference between Bayesian credible intervals and classical confidence intervals; Application in linear regression model.

UNIT IV **(13 hours)**

Hypothesis Testing

Prior and posterior odds; Bayes factor for simple versus simple hypothesis; Bayes factor for composite versus composite hypothesis; Lindley's procedure for test of significance.

PRACTICAL/LAB WORK–30 Hours

List of Practical:

1. Plotting of Prior and posterior distributions for Binomial distribution case.
2. Plotting of Prior and posterior distributions for Poisson distribution case.
3. Bayes Estimation using Normal distribution and Squared error loss function.
4. Bayes Estimation using Binomial distribution and Absolute error loss function.
5. Construction of credible intervals and their comparison with corresponding classical confidence interval for Normal distribution case.
6. Construction of credible intervals and their comparison with corresponding classical confidence interval for Binomial distribution case.
7. Normal Approximation to Posterior Distribution.
8. Construction of HPD credible interval for Normal case.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS

- Bansal, A.K. (2007). Bayesian Parametric Inference, Narosa Publishing House.
- Barnett, V. (2008). Comparative Statistical Inference, J. Wiley, New York.
- Berger, J.O. (2010-softcover published and 2013- eBook published). Statistical Decision Theory and Bayesian analysis, Second Edition, Springer-Verlag, New York.

SYLLABUS OF DSE-6A
Theory

UNIT I **(15 hours)**

Introduction

Nonparametric Tests: Non-parametric tests-their advantages and disadvantages, comparison with parametric tests. Measurement scale-nominal, ordinal, interval and ratio. The quantile function, the empirical distribution function, Glivenko Cantelli Theorem (without proof), Kolmogorov Goodness of fit test, confidence interval for a population quantile, hypothesis testing for a population quantile.

UNIT II **(15 hours)**

One sample and two sample tests

One-Sample, two-sample problem and Paired-Sample Procedures: the sign test and confidence interval for the median, rank-order statistics, treatment of ties in rank tests, Wilcoxon signed-rank test, confidence interval, Wald-Wolfowitz runs test, Kolmogorov- Smirnov one and two-sample test, median test and the Mann-Whitney U test.

UNIT III **(15 hours)**

K sample tests

Linear Rank Tests for the Location and Scale Problem: Definition of linear rank statistics, Wilcoxon rank-sum test; Tests of the Equality of k Independent Samples: The Kruskal- Wallis one-way ANOVA test and multiple comparisons.; Measures of Association for Bivariate Samples: definition of measures of association in a bivariate population, Kendall's Tau coefficient, Spearman's coefficient of rank correlation.

PRACTICAL/ LABWORK (30hours):

List of Practical:

1. Obtaining quantile and Empirical Distribution
2. Test for randomness
3. Sign test
4. Wilcoxon Signed rank test
5. Wald-Wolfowitz runs test,
6. Kolmogorov-Smirnov one and two-sample test,
7. Median test and the Mann-Whitney U test.
8. Wilcoxon rank-sum test
9. The Kruskal-Wallis one-way ANOVA test
10. Test based on Kendall's Tau coefficient.
11. Spearman's coefficient to rank correlation

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

ESSENTIAL READINGS:

- Gibbons, J.D., and Chakraborti, S. (2020): Nonparametric statistical inference. CRC press.
- Siegel, S. (1988). Nonparametric statistics for the behavioral sciences, 2nd ed. McGraw-Hill.

SUGGESTIVE READINGS:

- Kloke, J., and McKean, J. W. (2024): Nonparametric statistical methods using R, 2nd Edition. CRC Press.
- Hollander, M., Wolfe, D. A., and Chicken, E. (2013): Nonparametric statistical methods (Vol. 751). John Wiley & Sons.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE–6B: RELIABILITY THEORY AND LIFE TESTING

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Reliability Theory And Life Testing	4	3	0	1	Class XII pass with Mathematics	Knowledge of Probability Distribution and Statistical Inference

Learning Objectives

The learning objectives include:

- To understand the reliability and their application area.
- To develop the thinking of students so that they can use the concepts of reliability in real life scenario.
- To determine if the performance of components, equipment, and systems, either under closely controlled and known stress conditions in a testing laboratory or under field use conditions.
- To determine the growth in the mean life and/or the reliability of units during their research, engineering and development phase.

Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- Concept of Reliability and life testing.
- Various estimation procedures of reliability function(s).
- Comparison of various estimates of reliability through simulation study using different software.
- Real data fitting in reliability modelling