

**Choice Based Credit System (CBCS) Syllabus for M.A./M.Sc.4th Statistics wef 2017
onwards BOS held on 08/08/2017**

General Instructions for the Candidates

1. The **two** years (4 semester) PG Programmes is of **96** credit weightage i.e. **24** credits/semester (**24×4 = 96**).
2. Out of 24 credits in a semester a candidate has to obtain **12** credits compulsorily from the **Core Courses**, while the remaining 12 credits can be obtained from the **Electives(DCE, GE &OE)** in the following manner:
 - A candidate can obtain a maximum of **8** credits within his /her own Department out of specialization offered by the Department as **Discipline Centric Electives**.
 - **4** credits shall be obtained by the candidate from the **Electives (GE , OE)** offered by the Department other than his/her own. The candidate shall be free to obtain these **4** credits from the **General** or **Open Elective** or **A Combination of Both**.

SEMESTER IV			
Course Type	Course Code	Title of the Course	No. of Credits
Core (CR)	ST17401CR	Statistical Inference-II	04
	ST17402CR	Industrial Statistics & Reliability Theory	04
	ST17403CR	Design and Analysis of Experiments	04
Discipline Centric Elective (DCE)	ST17404DCE	Information Theory	04
	ST17405DCE	Bayesian Analysis	02
	ST17406DCE	Operations Research-II	02
	ST17407DCE	Practical based on ST17402CR	02
	ST17408DCE	Practical based on ST17403CR	02
Generic Elective (GE)	ST17409GE	Data Analysis Using R Software	02
	ST17410GE	Standard Probability Distributions-II	02
Open Elective (OE)	ST17411OE	Medical Statistics	02

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STATISTICAL INFERENCE –II

COURSE NO: ST17401CR

No. of Credits-4

UNIT-I

Testing of Hypothesis: Concepts of critical regions, test functions, two kinds of errors, size function, power function, level of significance, Most Powerful (MP) and Uniformly most powerful (UMP) test, in class of size tests. Neyman Pearson Lemma, MP tests for simple null against simple alternative hypothesis.

UNIT-II

UMP tests for simple null hypothesis against one-sided alternatives and for one-sided null against one-sided alternatives in one parameter exponential family. Extension of these results to distributions with Monotone Likelihood ratio property.

UNIT-III

Likelihood ratio tests: Large sample properties, derivation of common likelihood ratio tests, asymptotic distribution of likelihood ratio test, Consistency of tests.

Uniformly Most Powerful Unbiased Tests, similar tests with Newman structure locally best unbiased tests, type A and A1 critical regions for the exponential family. Randomized test.

UNIT-IV

Sequential Analysis: Definition of Sequential Probability Ratio Test (SPRT). Fundamental relations among α , β , A and B. Determination of A and B in practice. Wald's fundamental identity and the derivation of O.C and ASN functions. Proof of the ultimate termination of SPRT for simple hypothesis. Examples based on Normal, Poisson, Binomial and Exponential conditions.

TEXT BOOKS:

- Kale, B.K. (1999): A First Course on Parametric Inference, Narosa Publishing House.
- Rohatgi, V. (1988): An Introduction to Probability and Mathematical Statistics. Wiley Eastern Ltd. New Delhi (Student Edition)

REFERENCES:

- Lehman, E.L. (1986): Theory of Point Estimation (Student Edition)
- Lehman, E.L. (1986): Testing Statistical Hypothesis (Student Edition)
- Rao, C.R. (1973): Linear Statistical Inference
- Dudewicz, E.J. and Mishap, S.N. (1988): Modern Mathematical Statistics. Wiley Series in Prob. Math. Stat., John Wiley and Sons, New York (International Student Edition)
- Ferguson, T.S. (1967): Mathematical Statistics, Academic.
- Zacks, S (1971). Theory of Statistical Inference, John Wiley and Sons, New York.
- Berger, J, O.; Statistical Decision Theory and Bayesian Analysis, Springer Verlag.

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INDUSTRIAL STATISTICS & RELIABILITY THEORY

COURSE NO: ST17402CR

No. of Credits-4

UNIT-I:

Meaning and scope of SQC, Stewarts control chart, Statistical basis of a control chart, control chart for variables (\bar{X} , R, & S) charts. Control charts for attributes (np , p & C) charts. Moving average charts. Operating Characteristic function (OC) and Average Run length (ARL) of \bar{X} -bar chart.

UNIT-II:

Consumer and producer's risk, Operating Characteristic curve/function (OC). Corrective Sampling Plan (CSP), Average Sample Number (ASN), Average out-going Quality (AOQ), Graphical method of drawing AOQ, Average out-going Quality Limit (AOQL), Single Sampling Plan, Methods of finding n and c , Double Sampling Inspection Plan and sequential sampling plan.

UNIT-III:

Capability indices C_p , C_{pk} and C_{pm} . estimation, confidence intervals relating to capability indices for normally distributed characteristics.

Reliability concepts, hazard rate, distribution of longevity and moments. Some important theorems based on reliability theory.

UNIT-IV:

Common life time distributions: exponential, Weibull, gamma, Gumbel and normal distributions. Type I and Type II censored samples. Reliability and hazard rate of a system with independent units connected in (a) series and (b) Parallel systems.

TEXT BOOKS:

- Barlow, R.E. and Proschan, F. (1985). Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
- Biswas, S.(1996). Statistical Quality Control, Sampling Inspection and Reliability; New Age International Publishers.
- Montgomery, D.C. (1985) Introduction to Statistical Quality Control; Wiley
- Ott, E.R. (1975) Process Quality Control; McGraw hill
- Phadke, M.S. (1989) Quality Engineering through Robust Design; Prentice Hall
- Wetherill, G.B. (1977) Sampling Inspection and Quality Control; Halsted Press

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DESIGN AND ANALYSIS OF EXPERIMENTS

COURSE NO: ST17403CR

No. of Credits-4

UNIT-I

Planning of experiment: Nomenclature, Introduction to basic designs and their analysis, Principles of experimental design. Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), missing plot techniques for RBD and LSD.

UNIT-II

Analysis of co-variance: Introduction, Analysis of co-variance model, normal equations, assumptions. Analysis of Covariance for Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD). Numerical illustrations.

UNIT-III

Introduction to Incomplete block design intra block analysis (estimability), estimates of estimable linear parametric function; Balanced Incomplete Block Design. Intra block analysis, recovery of inter block information;

UNIT IV

General factorial experiments, factorial effects; best estimates and testing the significance of factorial effects; study of 2 and 3 factorial experiments in randomized blocks; Confounding, complete and partial confounding. Fractional replication for symmetric factorials.

TEXT BOOKS:

- Alokdey (1986): Theory of Block Designs, Willey Eastern
- Angela Dean Daniel Voss (1999): Design and Analysis of Experiments, Springer.
- Das, M.N and Giri, N. (1979): Design and Analysis of Experiments, Willey Eastern
- Giri, N (1986): Analysis of Variance, South Asia Publishers
- John, P.W.M. (1971): Statistical Design and Analysis of Experiments,
- McmillainJoshi.D.D. (1987): Linear estimation and Design of Experiments Willey Eastern
- R. Rangaswamy (2005): A Text book of Agricultural Statistics. New Age International (P) Limited.

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INFORMATION THEORY

COURSE NO: ST17404DCE

No. of Credits -4

UNIT-I

Basic Concepts of Information Theory: Quantitative measure of information, Binary unit of information, measure of uncertainty and its properties, measure of information for two dimensional discrete and continuous finite probability scheme. Measure of mutual information. Shannon's fundamental inequalities. Redundancy, efficiency and channel capacity. Uniqueness of the entropy function, entropy maximization problem.

UNIT-II

Elements of Encoding: Purpose of encoding, separable binary codes, Shannon-Fannon encoding. Condition for noiseless coding. Fundamental theorem of discrete noiseless coding. Huffman's minimum redundancy code. Fundamental theorem of discrete encoding in presence of noise. .

UNIT-III

Entropy under Stochastic Regimes: Finite Markov Chains. Basic theorem on regular Markov chain. Entropy of a simple Markov chain. Entropy of a discrete stationary source. Discrete channels with finite memory. The extension of discrete memoryless noisy channels.

UNIT-IV

Inequalities of Information Theory: Kullback-Leibler measure of information. Mean information for discrimination and divergence and their properties, Some important generalizations of entropy measures and inequalities and their properties.

TEXT BOOKS:

- Reza, F.M(2012).: An Introduction to Information Theory, McGraw Hill
- Mathai, A.M. and Rathie, P. N.: Basic Concepts in Information Theory and Statistics, Wiley Eastern.
- Ash, R.: Information Theory, Wiley Eastern.
- Kullback, S.: Information Theory and Statistics, Dover Publication.
- Yeung, R.W:A, First course of information theory(2004), Kluwer Academics.

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BAYESIAN ANALYSIS

COURSE NO: ST17405DCE

No. of Credits-2

Unit I

Fundamentals of Bayesian Statistics: Conditional probability and its applications in Bayesian analysis, Bayes theorem for events, Bayes factor, Generalized Bayes theorem for events, Bayes theorem for future events, Bayes theorem for random variables, and Sequential nature of Bayes theorem.

Unit II

Prior distribution and types of prior distributions, proper prior, improper prior, conjugate prior, Jeffrey's prior, informative and non-informative priors.

Bayesian method of estimation: Bayes estimation of Binomial, Poisson, exponential, Weibull and normal distributions by using various types of priors.

References:

- Berger, J.O.: Statistical Decision Theory and Bayesian Analysis, Springer Verlag.
- Robert, C.P. and Casella, G.: Monte Carlo Statistical Methods, Springer Verlag.

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OPERATIONS RESEACH -II

COURSE NO.: ST17406DCE

No. of credits -2

UNIT I

Integer Programming: Gomory's Cutting Plane algorithm & branch and bounded method for all integer and mixed integer, Dynamic programming: Single additive constraint; additive separable return, single multiple constraints; additive separable returns, Single additive constraints; multiple separable returns.

UNIT II

Nonlinear programming, Formulation, Lagrange multiplier Technique, Kuhn Tucker necessary and sufficient conditions for optimality of an NLPP, constraint multivariable optimization with inequality constraints. Quadratic Programming problems: Wolfe's and Beale's algorithms for solving quadratic programming problems.

TEXT BOOKS:

- Taha H.A. (1982) Operational Research: An introduction;
- Macmillan. Hadley G.(1964) Nonlinear and Dynamic Programming; Addison Wesley.
- Kabmboj ,Puri,N,C;Mathematical Programming

REFERENCES:

- Bazara and Shetty (1979) Nonlinear Programming Theory And Algorithms; John Wiley
- KantiSwarup, P.K. and Singh,M.M.. (1985) Operation Research; Sultan Chand & Sons.
- Rios's (1989): Optimization Theory and Applications, Wiley Eastern
- Hadley G. and Whitin T.M. (1963) Analysis of Inventory Systems; Prentice Hall.
- Hillier F.S. and Lieberman G.J. (1962) Introduction to Operation Research; Holden Day.Murthy K.G (1976) Linear and Combinatorial Programming; John Wiley.
- Kleinrock L. (1975) Queuing Systems Theory Vol.1, John Wiley.
- Philips D.T., Ravindran A. and Solberg J. Operation Research, Principles and Practice.Saaty T.L.(1961) Elements of Queuing Theory with Applications; McGraw Hill.
- Churchman C.W, Ackoff R.L. and Arnoff E.L. (1957) Introduction to Operations Research.

COURSE NO.: ST17407DCE No. of credits -2

PRACTICAL BASED ON ST17402CR

COURSE NO.: ST17408DCE No. of credits -2

PRACTICAL BASED ON ST17403CR

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DATA ANALYSIS USING R SOFTWARE

COURSE NO: ST17409GE

No. of Credits-2

UNIT-I

Statistical Software R : Reading & Manipulation of data, Commands/Statements in R, different types of functions in R software, Descriptive Statistics, Working with Software package R for graphics, EDA: Histogram, Plot, Box plot, Pi-chart, QQ plot and density plot.

UNIT-II

Using R: Basic operations on matrices. Correlation and regression analysis. t-test for single mean, t-test for significance of difference of means and paired t-test. Chi-Square test for goodness of fit, independence of attributes and Contingency table and F-test.

TEXT BOOKS:

- R.A. Thisted (1988): Elements of Statistical Computing, Chapman and Hall.
- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Wiley, Int'l Students edition.
- Gardner, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.
- Braun W J, Murdoch D J (2007): A First Course in Statistical Programming with R. Cambridge University Press. New York.

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STANDARD PROBABILITY DISTRIBUTION-II

COURSE NO: STM17410GE

No. of Credits-2

UNIT-I

Continuous Random variable, Distribution function, Probability density function, Mathematical expectation and its properties.

UNIT-II

Important Statistical Continuous distributions: uniform, exponential, gamma and normal distributions, their mean, variances and Particular cases.

TEXT BOOKS:

- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.

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MEDICAL STATISTICS

COURSE NO.: ST174110E

No. of credits -2

UNIT-I

Epidemiological method: Evolution of Epidemiology, Causal relationship, establishing a causal relationship, Prevalence, Incidence, Prevalence versus incidence. Types of study design:- Cross-sectional study ; Case-Control study measures of association in case control studies, cohort studies; measures of association.

UNIT- II

Importance of sample size in research design: Diagnostic tests:- Accuracy of a diagnostic test, sensitivity and specificity; predictive values, limitation of predictive values. Bayes theorem, Likelihood ratio. LR of positive tests(LR+) & LR of a negative test(LR-). Post test odds when the test outcome is positive (negative). Tree method for obtaining post test probabilities, Receiver operating characteristics curve.

Books Recommended

- Medical statistics, Principles & Methods, K.R. Sundaram, S.N. Dewidi & Sreenivas, BI publications, pvt. Ltd. New Delhi.
- Bio statistics by Daniel.