Scheme of Examination for M. Phil./ Ph.D. Coursework (Statistics) (January - December 2017)

The duration of the course of instruction of M.Phil./ Ph.D. Coursework (Statistics) Degree shall be one/ half year (Two semesters/ One Semester). There will be three theory papers in 1st Semester (for both M.Phil. & Ph.D.Coursework) and two theory papers in 2nd Semester (only for M.Phil. course) of 100 marks each (including Internal Assessment of 20 Marks in each paper). The detailed Scheme of the course is given below:

Program Specific Outcomes

B. M.Phil.(Statistics)/ Ph.D. Coursework

PSO1: Enhanced ability to apply Statistical theory for carrying out research in some specialized areas of the subjects Statistics and Operations Research.
PSO2: Able to understand the Research Methodology for preparation and presentation of research reports, research papers, monographs and articles.
PSO3: Acquired knowledge to review the existing literature in the field of Statistics and related areas.
PSO4: Gained skills and experience for oral and written presentation of the research work.
PSO5: Achieved expertise knowledge for Statistical Interpretation and Communication of the results.
PSO6: Acquired a solid base to pursue research work in various fields of subject Statistics and related areas.

M. Phil Semester-I **(Common with Ph.D Course Work)**

Paper Code	Name of Paper	Theory Marks	Internal Assessment Marks	Time (per week)	Credits
17STAMP11	Research Methodology	80	20	4 hrs.	04
Optional Papers (**Any two of the following**)					
17STAMP12	Stochastic Processes	80	20	4 hrs.	04
17STAMP13	Advanced Theory of Sample Surveys	80	20	3 hrs.	04
17STAMP14	Regression Analysis and Bayesian Inference	80	20	3 hrs.	04

M. Phil Semester-II

Paper Code	Name of Paper	Theory Marks	Viva-Voce	Internal Assessment	Time Allowed	Credits
Optional Papers (**Any two of the following from 17STAMP21 TO 17STAMP24**)						
17STAMP21	Reliability Theory and	80	-	20	3 hrs.	04

	Modeling					
17STAMP22	Statistical Genetics	80	-	20	3 hrs.	04
17STAMP23	Information Theory	80	-	20	3 hrs.	04
*17STAMP24	Bio-Statistical Methods	80	-	20	3 hrs.	04
17STAMP25	Dissertation	150	50	-	-	08

* Syllabi will be framed later.

M. Phil Dissertation

The dissertation work for M.Phil. will be carried out under the approved supervisor from amongst the faculty members of the department. The dissertation work will be started in the 2nd Semester of the M.Phil. Course. The evaluation of dissertation will be done by external examiner. The viva-voce will be conducted jointly by the external examiner and the supervisor.

HOD (STATISTICS)

M. Phil./ Ph.D. Coursework (Statistics) Semester-I
17STAMP11 (Research Methodology)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credits: 4

Paper Code: 17STAMP11
Paper: Research Methodology
Course Outcomes:

CO1: Able to understand basic concepts of research and its methodologies.
CO2: Ability to find the scores located on the scale of measurements, validity and reliability.
CO3: Able to understand the methodology for writing a research project proposal.
CO4: Able to understand review of literature.
CO5: Able to use the technique for Random Numbers Generation.

Unit – I

Introduction to Research Methodology. Types and Significance of Research. Research Approaches. Research and Scientific Methods. Research Process and Criteria of Good Research. Research Problem and its Necessity. Features of a Good Research Design. Sampling Design. Characteristics of a Good Sample Design. Random Samples and Determination of Sample Size.

Unit – II

Data Collection. Methods of Data Collection. Case Study Method. Questionnaires and Schedules. Guidelines for Successful Interviewing. Measurement and Scaling Techniques: Measurement Scales, Meaning of Scaling, Test of Second Measurements. Meaning of Scaling, Scale Classification Bases, Important Scaling and Scale Construction Techniques. Reliability and Validity of Measurements.

Unit – III

Data Analysis using Tools like SPSS, Minitab, SAS & MS Excel. Generating Data from Standard Discrete and Continuous Distributions. Exploring Univariate and Multivariate Data Using Tables and Plots (Stem and Leaf Display, Box Plot, Spider Plot, Q-Q Plot and Probability Plot). Graphical Methods of Clustering (Chernoff Faces).

Unit - IV

Documentation and Scientific Writing: Meaning & Techniques of Interpretation, Precautions in Interpretation, Preparation & Presentation of Manuscript of a Research Paper and Thesis Writing. Research Report: Presentation, Structure, Components, Types-Research Papers, Thesis, Research Project Report, Pictures & Graphs, Citation Styles and Bibliography.

Books Suggested:

1. C.R. Kothari : Research Methodology (Methods and Techniques), New Age International Publishers
2. R. Panneerselvam : Research Methodology, Prentice Hall of India, New Delhi
3. J.A. Khan : Research Methodology, APH Publications, New Delhi
4. V.V. Khanzode : Research Methodology (Techniques and Trends), APH Publications, New Delhi
5. B.H. Dursten & : Thesis and Assignment Writing, Wiley Eastern, 1977 M. Poole
6. Sheldon Ross : Probability and Statistics for Engineers and Scientists, Elsevier Academic Press
7. A.M. Goon, M.K. : Fundamentals of Statistics (Vol. I & Vol. II)Gupta and B. Das Gupta
8. J. Tukey : Exploratory Data Analysis. Addison-Wesley Pub Co., USA, 1977.

Note: The examiner is to set the question paper into four units. In each unit, he/she has to set two questions of 16 marks each from sections I, II, III, & IV respectively. The candidate will attempt five questions in all, selecting at least one question from each unit.

17STAMP12 Opt. (i) (Stochastic Processes)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credits: 4

Paper Code: 17STAMP12
Paper: Stochastic Processes
Course Outcomes:

CO1: Able to understand the applications of Markov Chain in research.
CO2: Able to develop Stochastic Models for carrying out research in reliability theory.
CO3: Obtained understanding for the solution of stochastic differential equations.
CO4: Able to understand the use of probability generating functions.
CO5: Acquired knowledge to apply Stochastic Processes in Bio Medical Sciences.

Unit I

Introduction, Examples and Types of Stochastic Processes. Probability Generating Function of Compound Distributions. Random Walk: Definition and Examples. Gambler's Ruin problem: Probability of Ruin, Duration of Game and Generating Function. Ballot Problem and its Applications.

Unit II

Markov Process: Continuous time Discrete State Markov Process, Limiting Behavior and Stability. Poison Process: Postulates, Methods for Probability Generating Function, Decomposition and Related Distributions, Birth and Death Processes. Diffusion Process: Diffusion Limit of Random Walk and Branching Process, Kolmogorov Backward and Forward Diffusion Equations, Solution of the General Diffusion Equation, Application to Population Growth.

Unit-III

Wiener Process: Definition, Differential Equations, Kolmogorov Equations and First Passage Time Distribution. Renewal Processes: Renewal Process in Discrete & Continuous Time, Forward Renewal Equation, Renewal Function and Density, Renewal Theorems, Central Limit Theorem for Renewal Process, Delayed and Equilibrium Renewal Process, Residual and Excess Life Times Renewal Process, Poison Process as a Renewal Process.

Unit IV

Applications of Stochastic Processes: Population Growth Models, Queuing Models, Epidemic Models, Simple & General Epidemic Models and Stochastic Models in Ecological & Biological Sciences.

Books:

1	Baily, NTJ	The Elements of Stochastic Processes
2	Cox, DR & Miller, HD	The Theory of Stochastic Processes
3	Basu AK	Introductions to Stochastic Processes
4	Medhi, J.	Stochastic Processes
5	Bhatt, B.R.	Stochastic Models, Analysis and Application

Note: The examiner will set two questions from each section. The students are required to attempt five questions in all, selecting at least one question from each section.

17STAMP13 Opt. (ii) (Advanced Theory of Sample Surveys)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credit: 4

Paper Code: 17STAMP13
Paper: Advanced Theory of Sample Surveys
Course Outcomes:

CO1: Able to understand appropriate sampling methods.
CO2: Able to propose estimators for population parameters.
CO3: Gained expertise in designing a survey plan.
CO4: Achieved practical knowledge to analyze data from multistage surveys.

Unit –I

Types of Sampling: Simple Random, Stratified Random and systematic sampling, Estimation in Ratio and Regression estimators, (For One and two variables), Double sampling for ration and regression estimators, double Sampling for stratification.

Unit-II

Sampling with varying probabilities, ordered and unordered estimators, Sampling Strategies due to Horvitz Thomson, Yales and Grundy Form Midzuno Sen, Brewerand Durbin Scheme (Sample size two only) Rao-Hartley, cochran Scheme for sample size n with random grouping and PPS systematic sampling, Double sampling for PPS estimation.

Unit-III

Single stage cluster sampling: multi-stage sampling, selection of PSU's with unequal probabilities, Selection of PSU with replacement, stratified multi-stage sampling, Estimation of ratios, choice of sampling and sdub-sampling fraction, Repetitive Surveys, sampling on more than two occasions.

Unit-IV

Non-sampling errors, response errors, response bias, the analysis of data, Estimation of variance components uncorrelated response error, response and sampling variance, the problem of non-response, some example of sources of error. Variance estimation, method Estimation of random groups sub population. The best linear estimator two way stratification with small sample, variance estimation in multistage sampling, sampling inspections.

Books suggested

1.	Chochran, W.G.	Sample Techniques
2	Desrjv and Chandok	Sampling Theory
3	Singh & Chaudhary F.S.	Theory and analysis of sample Survey designs.
4	Mukhopadhyay, Primal	Inter Problems in survey sampling

Note: The examiner will set two questions from each section. The students are required to attempt five questions in all, selecting at least one question from each section.

17STAMP14 Opt.iii (Regression Analysis and Bayesian Inference)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credit: 4

Paper Code: 17STAMP14
Paper: Regression Analysis and Bayesian Inference
Course Outcomes:

CO1: Able to understand the different types of regression.
CO2: Updated knowledge to explain the Bayesian frame work for data analysis.
CO3: Able to demonstrate the role of prior distribution in Bayesian inference.
CO4: Enhanced knowledge to use Bayesian methods for solving real life world problems.
CO5: Able to improve research skills to from a hypothesis, collect and analyze the data and reach appropriate conclusion

Unit I

Matrix Approach to Linear Regression, R^2 and adjusted R^2 , Model Adequacy Checking – Residual Analysis, methods of scaling residuals- Standardized and studentized residuals Press

Residual, Residual Plots, PRESS Statistic, Variance Stabilizing Tranformation, Analytical methods for selecting a transformation.

Unit II

Generalized and Weighted Least Squares. Diagnostics for Leverage and Influence, Variable Selection and Model Building, Computational Techniques for Model Selection- Mallow's C_p , Stepwise Regression, Forward Selection, Backward Elimination. Elementary Ideas of Logistic and Poisson regression

Unit III

Concepts of Prior and Posterior distributions and Non – Informative and Improper priors. Baye's theorem and computation of posterior distributions, Standard Loss functions, and concept of Baye's estimation,Mixture Distributions, Sufficient Statistics, Exponential Family of distributions.

Unit IV

Natural conjugate family of priors for a model, Conjugate families for exponential family models, Jeffrey's Prior, Asymptotically Locally invariant prior. Maximum entropy priors and associated Bayes Estimation.

Books Recommended

1. Montgomery, D.C, Peck and Vining, G.G. (2002). Introduction to Linear Regression Analysis (John Wiley & Sons.)
2. Draper, N.R. and Smith, H. (1981) Applied Regression Analysis (John Wiley & Sons)
3. Robert, C.P. (2001): The Bayesian Choice: A Decision Theoretic Motivation (Springer Verlag New York)
4. Sinha , S.K. (2004) Bayesian Estimation
5. Berger, J.O. (1985) Statistical Decision Theory and Bayesian Analysis (Springer)

Note: The examiner will set two questions from each section. The students are required to attempt five questions in all, selecting at least one question from each section.

M.Phil. Semester-II
17STAMP21 (Reliability Theory and Modeling)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credit: 4

Paper Code: 17STAMP21
Paper: Reliability Theory and Modeling
Course Outcomes:

CO1: Able to understand the techniques of Reliability Prediction.
CO2: Acquired knowledge to analyze Statistical Experiments leading to reliability modeling.
CO3: Able to apply Reliability Theory to assessment of reliability in Engineering Design.
CO4: Acquainted with the applications of Stochastic Processes in Reliability Theory.

Unit I

Reliability: Types and Its Importance. Failures and Failure Modes. Causes of Failures. Failure Rate. Hazard Function. Reliability in Terms of Hazard Rate and Failure Density Functions. Hazard Models: Constant, Linear & Non-Linear, Weibull, Gamma and Normal Models. Markov Model. Estimation of Reliability and Failure Density Functions of Hazard and Markov Models. Mean Time to System Failure (MTSF).Relation Between MTSF and Reliability.

Unit- II

System and System Structures. Evaluation of MTSF and Reliability of The Systems: Series, Parallel, Series-Parallel, Parallel-Series, Non-Series- Parallel, Mixed Mode and K-out-of-n. Reliability Evaluation of Systems by Decomposition, Cut-Set, Event Space, Path Tracing and Boolean Function Methods.

Unit- III

Reliability Estimation Using Redundancy and Maintenance Techniques. Repairable and Non-Repairable Systems. Availability Function and its types. Parametric and Non- Parametric Renewal Function Estimation. Renewal Theoretical Approach for Availability Evaluation of a System. Economics of Reliability Engineering: Manufactures & Customers Costs, Reliability Achievement, Utility and Depreciation Cost Models. Availability Cost Model for a Parallel System.

Unit- IV

Evaluation of Reliability and Availability of Parallel-Unit System with Repair Using Markovian Approach. Reliability and Availability Analysis of Single Unit, Two-Unit Cold Standby and Parallel-Unit Systems with Constant Failure Rate, Arbitrary Repair Rates and a Single Server using Semi-Markov Process and Regenerative Point Technique. Idea of Supplementary Variable Technique.

Parameters Estimation of Exponential, Gamma, Weibule, Normal and Lognormal Distributions (Two and Three Parameters) with Complete , Truncated and Censored Samples. Estimation by Components of Order Statistics: K-out-of-n Reliability Estimation.

Books Suggested:-

1. Balagurusamy,E. : Reliability Engineering
2. Srinath,L.S. : Reliability Engineering
3. Elsayed A. Elsayed : Reliability Engineering(Addison Wesley Longman.Inc. Publication.
4. Sinha,S.K. : Reliability and Life Testing.
5. Birolini,A. : Reliability Engg.(Theory and Practice).

Note: The examiner is to set the question paper into four units. In each unit, he/she has to set two questions of 16 marks each from sections I, II, III, & IV respectively. The candidate will attempt five questions in all, selecting at least one question from each unit.

17STAMP22 (Statistical Genetics)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credit: 4

Paper Code: 17STAMP22
Paper: Statistical Genetics
Course Outcomes:

CO1: Detailed and comprehensive understanding of the basis of heredity.
CO2: Understanding of genetic methodology and quantification of heritable traits in families and populations.
CO3: Acquired knowledge to design, execute, and analyze the results of genetic experimentation in animal and plant model systems.
CO4: Get insight into mathematical, statistical and computational basis of genetical analyses and to evaluate conclusions.

Unit-I

Basic terms and definition in genetics, Concepts of gene frequencies and their estimation, Mendal's Laws Linkage and crossing over. Statistical analysis for segregation: single factor segregation, two factors segregation, Heterogeneity chi-square, Detection and estimation of linkage for qualitative characters, Sex linked inheritance, gene action interaction, Multiple alleles, Pleiotropic action, lethal action, Mutation.

Unit-II

Random mating: Hardy- Weinberg equilibrium, Panmixia Population, Single locus, sex linked genes, Fisher's fundamental theorem of natural selection, forces affecting gene frequencies, selection, mutation and migration, equilibrium between forces in large population.

Unit-III

Polygenic system for quantitative characters: Polygenes, Major genes, Characterization of phenotypic value, Additive and genetic effects, Characterization of genotypic value, breeding value and dominance deviation, Determination of parameters of additive – dominance model.

Unit-IV

Components of variance and Genotypic variance, Components of Covariance, Correlations between relatives, Genetic parameters; Heritability, Repeatability and Genetic correlation, Relationship between them.

Books suggested:

Falconer, D.S.	Introduction to quantitative Genetics (Longman Group Ltd.)
Kempthorne, O (1953)	An Introduction to Genetical Statistics, Wiley Eastern
Prem Narain	Statistical Genetics, Wiley Eastern
Li, C.C.	Population Genetics, University of Chicago Press Cchieage & London
Jain, J.P.	Statistical Technique in Quantitative Genetics (Tata Mc Graw, Hill Publication Co. Ltd., New Delhi.

Note: The examiner will set two questions from each section. The students are required to attempt five questions in all, selecting at least one question from each section.

17STAMP23 (Information Theory)

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100
Time: 3 Hours
Credit: 4

Paper Code: 17STAMP23
Paper: Information Theory
Course Outcomes:

CO1: Acquired knowledge of Entropy, Conditional Entropy, Joint Entropy, Information Measures and their properties for both Discrete and Continuous case
CO2: Acquired knowledge to use entropy function in noiseless coding and construction of optimal course
CO3: Acquired knowledge of Channel Capacity and decoding scheme
CO4: Acquired knowledge to use Entropy Function in Statistics

Unit-I

Basic concepts of Information Theory, Measure of uncertainty and its properties, Measure of Information for two dimensional discrete and continuous finite probability scheme, Uniqueness of Entropy function, Joint and Conditional measure of uncertainty, Interpretation of uncertainty measure , Measure of mutual information.

Unit-II

Noiseless Coding, Uniquely decipherable codes, instantaneous codes, condition for uniquely decipherable and instantaneous codes, Noiseless coding Theorem, Optimal Codes, Block Coding, Construction of Optimal Codes, Shannon Fanon encoding, Huffman procedure.

Unit-III

Discrete Memoryless Channel, Channel matrix, Channel Capacity, Classification of Channels, Channel capacity for different types of channel, Fundamental theorem of Information

Theory(without proof), Efficiency and Reduancy, decoding schemes ,the ideal observer, Exponential error bound, Fano inequality.

Unit-IV

Inequalities of Information Theory, Kullback-Leibler measure of information, Mean information for discrimination and divergence and their properties, Fisher information, Information and sufficiency, Minimum discrimination information-sufficient statistics.

Books suggested:

1. Robert Ash — Information Theory
2. Reza, F.M — An Introduction To Information Theory.
3. Mathai,A.M and Rathie, P.N. — Basic Concepts in Information Theory and Statistics.
4. Kullback, S. — Information Theory and Statistics.

Note: The examiner will set two questions from each section. The students are required to attempt five questions in all, selecting at least one question from each section.