Scheme of Examination for M. Phil (Statistics) 2012-13.

The duration of the course of instruction of M. Phil (Statistics) Degree shall be one year (Two semesters). There will be three theory paper each of 100 marks (including Internal Assessment o f 20 Marks) in 1st Semester and two theory paper each of 100 marks in 2nd Semester. There will be dissertation of 200 marks (including Internal Assessment o f 20 Marks) to be submitted by the candidate during the course of Study. The detailed Scheme of the course is given below:

M. Phil Ist Semester   Common with course work of Ph.D.

Name of Paper	Theory	Internal Assessment	Time Allowed	Teaching Hrs. per week
Paper-I Research Methodology	80	20	3 hrs.	04
Paper-II & III Any two of the following:				
Opt. (i) Stochastic Processes	80	20	3 hrs.	04
Opt. (ii) Advanced Theory of Sample Surveys	80	20	3 hrs.	04
Opt. (iii) Regression Analysis and Bayesian Inference	80	20	3 hrs.	04

M. Phil IInd Semester

	Theory	Internal Assessment	Time Allowed	Teaching Hrs. per week
Paper-IV, V Any two of the following:				
Opt. (i) Reliability Theory and Modeling	80	20	3 hrs.	04
Opt. (ii) Statistical Genetics	80	20	3 hrs.	04
Opt. (iii) Information Theory	80	20	3 hrs.	04

The dissertation work for M. Phil will start in the Ist Semester under the approved supervisor from amongst the members of the staff. The evaluation will be done by external examiner out of 150 marks. The viva-voce will be of 50 marks and will be conducted and evaluated by external examiner and supervisor. There will be internal assessment of 20 marks in each theory.

M. Phil (Statistics) I[st] Semester

Paper-I
Research Methodology

Maximum Marks: 80
Time Allowed: 3 hrs.

Unit-I

Introduction: Meaning, objectives, types and significance of Research. Research Methods versus Methodology. Process of Research: Steps involved in research process, Research problem and its selection, Necessity of defining the problem, techniques involved in defining a problem with example.
Research Design: Meaning, Need, Feature and Importance of Research Design, various research designs.

Unit-II

Types of data and various methods of data collection, framing of questionnaire, check-list, concept of reliability and validity methods, compilation of data, coding, editing and tabulation of data, various sampling methods.
Random Number Generation, Mid-square method of Generating Pseudo-Random Numbers, Simulation techniques: Monte-Carlo Simulation and Applications.
Use of data analysis tools like SPSS, Minitab and MS Excel.

Unit-III

Statistical techniques for analyzing data: Measures of Central tendency measures of Dispersion, Importance of sampling distributions. Testing of Hypothesis: Parametric and Non-Parametric tests. Application of analysis of variable (ANOVA) and Covariance (ANCOVA).

Unit-IV

Preparation of Dissertation: Types and layout of Research, Precautions in preparing the research dissertation, Bibliography, reference and annexure, discussion of results, draurg conclusions given suggestions and recommendations to the concerned persons.

Books suggested:

1. C.R. Kothari : Research Methodology (Wiley Eastern Publication)
2. J.K. Sharma : Operations Research
3. Goon, A.M., Gupta, : Fundamentals of Statistics (Vol. I and II)
   M.K. and B. Das Gupta

M.Phil- Ist Semester
Paper II, III
Opt. (i) Stochastic Processes

Max Marks- 80
Time- Three Hours

Unit I

Stochastic Processes, Random Walk model, Gambler's Ruin problem, Ballot Problem, Applications of Ballot problem, Generalized Random Walk.

Unit II

Continuous time Discrete State Markov Process, Population Models, Poison Process, Continuous Time and Continuous State Markov Process, Differention process, Kolmograow backward and forward difference equation, Wiener Process, First passage Time distribution

Unit-III

Renewal theory, renewal equation, renewal theorems, Central limit theorem for renewal theory, Delayed and equilibrium renewal process, residual and excess life times renewal, renewal process.

Unit IV

Applications to population growth, Queuing models, Epidemic processes, simple epidemic, General epidemic, application in ecology, biology and sociology.

Books:

1	Baily, NTJ	the Elements of Stochast6ic 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.

Max Marks- 80
Time- Three Hours

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.

Max Marks- 80
Time- Three Hours

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

Montgomery, D.C, Peck and Vining, G.G. (2002). Introduction to Linear Regression
        Analysis (John Wiley & Sons.)
Draper, N.R. and Smith, H. (1981) Applied Regression Analysis (John Wiley & Sons)
Robert, C.P. (2001): The Bayesian Choice: A Decision Theoretic Motivation (Springer
        Verlag New York)
Sinha , S.K. (2004) Bayesian Estimation
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. 2nd Semester
Paper IV and V
Opt.(1): Reliability Theory And Modeling

Maximum Marks-80

Section I

Reliability, Importance of Reliability, Types of Reliability, Failures and Failure Modes. Causes of Failures. Failure Rate.. Hazard Function. Reliability In Terms of Hazard Rate and Failure Density Functions. Hazard Models: Constant Hazard Model, Linear and Non-Linear Hazard Models, Weibull Model, Gamma Model and Normal Model. 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. Mean Time Between Failure (MTBF).

Section II

System and System Structures. Evaluation of Mean Time To System Failure (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.

Section III

Reliability Improvement Techniques: Redundancy and Maintenance. Reliability Estimation Using Redundancy and Maintenance. Repairable and Non-Repairable Systems. Availability Function. Types of Availability. Parametric and Non- Parametric Renewal Function Estimation. Renewal Theoretical Approach for Availability Evaluation of A System. Economics of Reliability Engineering: Manufactures Cost, Customers Cost, Reliability Achievement And Utility Cost Models, Depreciation Cost Models And Availability Cost Model For A Parallel System.

Section 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, Arbitrary Repair Rates and Waiting Time of the Server Using semi-Markov Process and Regenerative Point Technique. 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 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-2nd Semester

Paper IV &V

Opt. (ii) Statistical Genetics

Max Marks- 80
Time- Three Hours

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.

Max Marks- 80
Time- Three Hours

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.