<h1 style="text-align:center">Scheme of Examination for M. Phil (Statistics) 2014-15</h1>

The duration of the course of instruction of M.Phil (Statistics) Degree shall be one year (Two semesters). There will be three theory papers in 1st Semester and two theory papers in 2nd Semester each of 100 marks (including Internal Assessment of 20 Marks). There will be a dissertation of 200 marks (including 50 marks of viva-voce) to be submitted by the candidate during the course of Study. The detailed Scheme of the course is given below:

M. Phil Semester-I   **(Common with Pre-Ph.D course work)**

Name of Paper	Theory Marks	Internal Assessment	Time Allowed	Teaching Hrs. Per week
Paper-I MPH101: Research Methodology	80	20	3 hrs.	04
Optional Papers-II & III (MPHE-102 & MPHE-103)				
Any Two of the following:				
option (i) Statistical Genetics	80	20	3 hrs.	04
option (ii) Regression Analysis and Bayesian Inference	80	20	3 hrs.	04
option (iii) Advanced Theory of Sample Surveys	80	20	3 hrs.	04

M. Phil Semester-II

Name of Paper	Theory Marks	Internal Assessment	Time Allowed	Teaching Hrs. Per week
Optional Papers-IV & V (MPHE-201 & MPHE-202)				
Any Two of the following:				
option (i) Reliability Theory and Modeling	80	20	3 hrs.	04
option (ii) Information Theory	80	20	3 hrs.	04
option (iii) Advanced Designs of Experiments	80	20	3 hrs.	04
option (iv) Biostatistical Methods*	80	20	3 hrs.	04

* Syllabus to be framed later on.

Dissertation Work

The dissertation work for M. Phil will start in the Ist Semester under the approved supervisors from amongst the faculty members of the department. 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.

M. Phil (Statistics) Semester-I

MPH-101 (Research Methodology)

Time: 3 Hours   Maximum Marks: 80
Teaching Hours: 4 Hours per week   Internal Assessment Marks: 20
                                                                              Total Marks: 100

Unit – I
Types of Data and Various Methods of Data Collection. Case Study Method. Questionnaires and Schedules. Guidelines for Successful Interviewing. Compilation of Data Coding, Editing and Tabulation of Data. Measurement and Scaling Techniques: Measurement Scales, Tests of Sound Measurement, Meaning of Scaling, Scale Classification Bases, Important Scaling and Scale Construction Techniques. Reliability and Validity of Measurements.

Unit – II
Exploring Univariate and Multivariate Data Using Tables and Plots (Stem and Leaf Display, Box Plots, Median Polish of two way Tables, Root Grams and Bubble Charts, Spider Plots, Scatter & Multiple Scatter Plots: Q-Q Plots and Probability Plots). Graphical Methods of Clustering (Chernoff Faces). Data Analysis using tools like SPSS, MATLAB, SAS and MS Excel.

Unit – III
Generating Data from Standard Discrete and Continuous Distributions, (Binomial, Poission, Normal, Exponential, Gamma, etc.). Variance Reduction Techniques in Simulation, Box Cox Transformations, Resampling, Methods, Permutation Test, Bootstrapping, Jackknifing and Cross Validation.

Unit - IV
Research Methods: Meaning, Objectives, Types and Significance of Research. Research Process and Criteria of Good Research. Research Problem and its Necessity. Research Designs. Sampling Designs. Characteristics of a Good Sample Design. Random Samples and Determination of Sample Size.
Documentation and Scientific Writing: Preparation of Dissertation, Types and Layout of Research, Precautions in Preparation of Research Reports, Bibliography, References and Annexure. Citation Styles.

Books Suggested:
1.   Kothari, C.R.   : Research Methodology (Methods and Techniques)
                                           (New Age International Publishers)
2.   Panneerselvam, R   : Research Methodology (Prentice Hall of India, New Delhi)
3.   Khan, J.A.   : Research Methodology (APH Publications, New Delhi)
4.   Khanzode, V.V.   : Research Methodology (Techniques and Trends)
                                           (APH Publications, New Delhi)
5.   Dursten, B.H. &   : Thesis and Assignment Writing (Wiley Eastern)
        Poole, M
6.   Tukey, J   : Exploratory Data Analysis (Addison-Wesley Pub Co., USA)

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.

MPHE-102 & MPHE-103 Option (i)
(Statistical Genetics)

Time: 3 Hours   Maximum Marks: 80
Teaching Hours: 4 Hours per week   Internal Assessment Marks: 20
                                                  Total Marks: 100

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 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.

MPHE-102 & MPHE-103 Option (ii)
(Regression Analysis and Bayesian Inference)

Time: 3 Hours
Teaching Hours: 4 Hours per week

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100

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 Transformation, 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.	: Introduction to Linear Regression Analysis (John Wiley & Sons)
2.	Draper, N.R. and Smith, H.	: Applied Regression Analysis (John Wiley & Sons)
3.	Robert, C.P.	: The Bayesian Choice: A Decision Theoretic Motivation (Springer Verlag New York)
4.	Sinha , S.K.	: Bayesian Estimation (Inst. of Mathematical Statistics)
5.	Berger, J.O.	: Statistical Decision Theory and Bayesian Analysis (Springer)

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.

MPHE-102 & MPHE-103 Option (iii)
(Advanced Theory of Sample Surveys)

Time: 3 Hours   Maximum Marks: 80
Teaching Hours: 4 Hours per week   Internal Assessment Marks: 20
                                                                                        Total Marks: 100

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 (John Wiley & Sons)
2	Deshraj and Chandok	:	Sampling Theory (Create Space Independent Publishing Platform)
3	Singh & Chaudhary F.S.	:	Theory and Analysis of Sample Survey Designs (Wiley)
4	Mukhopadhyay, Parimal	:	Theory and Methods of Survey Sampling (PHI Learning Private Limited)

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.

M.Phil. Semester-II
MPHE-201 & MPHE-202 Option (i)
(Reliability Theory and Modeling)

Time: 3 Hours
Teaching Hours: 4 Hours per week

Maximum Marks: 80
Internal Assessment Marks: 20
Total Marks: 100

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 Techniques.
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 (Tata McGraw - Hill Education)
2. Srinath,L.S. : Reliability Engineering (East West Press)
3. Elsayed A. Elsayed : Reliability Engineering
   (Addison Wesley Longman.Inc. Publication)
4. Sinha,S.K. : Reliability and Life Testing (John Wiley & Sons Inc)
5. Birolini,A. : Reliability Engg. (Theory and Practice).(Springer)

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.

MPHE-201 & MPHE-202 Option (ii)
(Information Theory)

Time: 3 Hours   Maximum Marks: 80
Teaching Hours: 4 Hours per week   Internal Assessment Marks: 20
                                               Total Marks: 100

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 (Dover Publications)
2. Reza, F.M   : An Introduction to Information Theory (Dover Publications)
3. Mathai,A.M and Rathie, P.N.   : Basic Concepts in Information Theory and Statistics
                                          (Springer)
4. Kullback, S.   : Information Theory and Statistics (Dover Publications)

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.

MPHE-201 & MPHE-202 Option (iii)
(Advance Design of Experiments)

Time: 3 Hours   Maximum Marks: 80
Teaching Hours: 4 Hours per week   Internal Assessment Marks: 20
                                                                            Total Marks: 100

Unit-I
General Block Designs: C- Matrix and its properties. Incomplete Block Designs: its Information Matrix, Estimates of Estimable Linear Parametric Function. Balanced Incomplete Block Design, Intra Block Analysis, Inter block analysis, Recovery of Inter Block Information. Connected and Disconnected Designs. Kronecker- Product Designs, Resolvability and Parametric Relations.

Unit-II
Latin Squares and Orthogonal Latin Square (OLS), Upper bound for the number of OLS. Construction of complete sets of Mutually Orthogonal Latin Square (MOLS). Construction of BIBD using MOLS.

Unit-III
Partially Balanced Incomplete Block designs. Definition and relation between the parameters. Association Matrices, its Algebraic Properties Classification of two Associate Class PBIB Designs. Applications of PBIBD.

Unit-IV
Concept of confounding. Confounding in 2(n) Experiments. Complete and Partial confounding in Symmetric factorial experiments.

BOOK SUGGESTED
1. Dey, Aloke   : Theory of Block Designs (J. Wiley)

2. Raghavrao , D.   : Construction and combinatorial problems in design of
                                               Experiments (John Wiley, New York)
3. Dass, M.N. and Giri, N.C   : Design and analysis of Experiments (John Wiley)

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.