Syllabus for Entrance Test
For Admission to M. Phil, Ph.D. Courses and for the University Research Scholarship in Statistics

Duration: 90 Minutes
No. of Questions: 100

Maximum Marks: 100


Multivariate Analysis, Data reduction techniques: Principle component analysis, Discriminant analysis, Canonical correlation.


Linear programming problem: Simplex methods, duality.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Eigenvalues and eigenvectors, Quadratic forms, reduction and classification of quadratic forms.


Note: The syllabus for entrance test will be based on the syllabi of M.Sc. (Mathematical Statistics)
**Scheme of Examination for M. Phil (Statistics) 2010-11**

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 in 1st Semester and two theory paper each of 100 marks in 2nd Semester. There will be dissertation of 200 marks to be submitted by the candidate during the course of Study. The detailed Scheme of the course is given below:

**M. Phil 1st Semester**

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

**M. Phil 2nd Semester**

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

The dissertation work for M. Phil will start in the 1st 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 paper.
Unit-I


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, checklist, concept of reliability and validity methods, compilation of data, coding, editing and tabulation of data, various sampling methods.


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
   M.K. and B. Das Gupta
M.Phil- I\textsuperscript{st} Semester
Paper II, III
Opt. (i) Stochastic Processes

Max Marks- 80
Time- Three Hours

Unit I


Unit II


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 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.
M.Phil-Ist Semester  
Paper II, III  
Opt. (ii) Advanced Theory of Sample Surveys

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, cochrans 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 sub-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.
Unit I
Simple Linear Regression, Estimation of parameters, Matrix Approach to Linear Regression, $R^2$ and adjusted $R^2$, Weighted Least Squares. Model Adequacy Checking – Residual Analysis, methods of scaling residuals- Standardized and studentized residuals Press Residual, Residual Plots, PRESS Statistic

Unit II
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
Mixture Distributions, Exponential Family of distributions, Prior and Posterior distributions, Baye’s theorem and computation of posterior distribution, Natural conjugate family of priors for a model, Conjugate families for exponential family models

Unit IV
Non – Informative and Improper priors, Jeffrey’s Prior, Asymptotically Locally invariant prior. Maximum entropy priors, Bayes estimation.

Books Recommended

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-2\textsuperscript{nd} Semester
Paper IV & V
Opt. (i) Reliability Theory And Modeling

Maximum Marks-80
Time:-03 Hours

\textbf{Unit–I}

Reliability and Quality. Types of Reliability. Failures Data Analysis: Failure, Types of Failures, Causes of Failures, Failure Rate, Mean Time To Failure (MTTF), Mean Time Between Failures (MTBF), MTTF in terms of failure density. Hazard rate reliability


of hazard models and Markov model.

\textbf{Unit-II}

System structures. Evaluation of mean time to system failure (MTSF) and reliability for various structures such as series, parallel, series parallel, parallel series, non-series parallel, mixed-mode and k-out-of-n structures. Methods of reliability improvement: Redundancy And Maintenance. Reliability analysis using redundancy and maintenance. Availability function.

\textbf{Unit- III}


\textbf{Unit-IV}

Reliability and availability analysis of single-unit and two–unit cold standby systems with constant failure rate and repair using Regenerative Point and Supplementary Variable Techniques. Evaluation of reliability by the Methods-Decomposition method, Cut-set method, Event space method and Boolean function 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.

\textbf{Books Suggested:-}

1. Balagurusamy,E. : Reliability Engineering
5. Birolini,A : Reliability Engg.(Theory And Practice )

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 & 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

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 Chicago & London

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.
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.

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.