Scheme of Examinations for M.Phil. Program/Ph.D. Coursework-Statistics
(w.e.f. 2020-21)

The duration of M.Phil. Program/Ph.D. Coursework (Statistics) will be one year (two semesters)/half year (one semester). The credit requirement for M.Phil. Program including credits for the Coursework shall be of 28 credits in all (1 credit equals to 25 marks). The 1st semester comprises 14 credits (03 courses of 4 credits each and one course of 2 credits) with one course on Research Methodology of 4 credits and another on Research and Publication Ethics of 2 credits. The 2nd semester comprises one course of 4 credits and the other of 2 credits along with the M.Phil. dissertation of 8 credits.

The detailed Scheme of examinations for the M.Phil Program/Ph.D Coursework as follows:

Program Outcomes

PO1 : Recognize and think critically towards the subject Statistics curricula with sound knowledge and theoretical skills by questioning and plausible explanations.

PO2 : Motivate themselves and develop an interest in planning and implementation of research

PO3 : Apply the scientific context to develop innovative ideas, products and methods for the benefits of biosphere

PO4 : Adopt changes in the environment with high integrity and transpire ethical professionals

PO5 : Recognize and integrate life-long learning skills to become pro-active in personal and professional live

Program Specific Outcomes

PSO1 : Able to understand the Research Methodology for preparation and presentation of research reports, research papers, monographs and articles.

PSO2 : Enhanced ability to apply Statistical theory for carrying out research in some specialized areas of the subject Statistics.

PSO3 : Acquired knowledge to review the existing literature in the field of Statistics and related areas.

PSO4 : Achieved expertise knowledge for Statistical Interpretation and Communication of the results.

PSO5 : Acquainted with skills and experience for oral and written presentation of the research work.

M.Phil. Semester – 1 (Common with Ph.D. Course Work)

Course Code	Nomenclature of Course	Theory Marks	Internal Assessments Marks	Maximum Marks	Hours /Week	Credits
20STAMP11C1	Research Methodology	80	20	100	4 hrs	04
20MPCC1	Research and Publication Ethics	40	10	50	2 hrs	02
Optional Papers (Any two of the following)						
20STAMP11C3	Reliability Theory and Modelling	80	20	100	4 hrs	04
20STAMP11C4	Information Theory	80	20	100	4 hrs	04
20STAMP11C5	Regression Analysis and Bayesian Inference	80	20	100	4 hrs	04
20STAMP11C6	Statistical Genetics	80	20	100	4 hrs	04
Total Marks/Credits				**350**		**14**

M.Phil. Semester – 2

Course Code	Nomenclature of Course	Theory Marks	Internal Assessments Marks	Maximum Marks	Hours /Week	Credits
Optional Papers (Any one of the following)						
20STAMP12C1	Advanced Theory of Sample Surveys	80	20	100	4 hrs	04
20STAMP12C2	Advanced Design of Experiments	80	20	100	4 hrs	04
Optional Papers (Any one of 20STAMP12C3& 20STAMP12C4)						
20STAMP12C3	Advanced Stochastic Processes	40	10	50	2 hrs	02
20STAMP12C4	Fuzzy Set Theory	40	10	50	2 hrs	02
20STAMP12C5	Dissertation	150 (Evaluation)	50 (Viva-Voce)	200	16	08
Total Marks/Credits				**350**		**14**

M.Phil. Dissertation

The Dissertation work for M.Phil. Program will be carried out under the approved supervisor from among the faculty members of the department. The dissertation work will be started in the 2nd semester of the M.Phil. Program. The evaluation of the dissertation will be done by an external examiner. The Viva-Voce will be conducted jointly by the external examiner and the supervisor.

(HOD Statistics)

Semester – I

20STAMP11C1 (Research Methodology)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP11C1
Paper: Research Methodology
Course Objectives:

1 To Understand Some Basic Concepts of Research and its Methodologies
2 To Identify Appropriate Research Topics
3 To Select and Define Appropriate Research Problem and Parameters
4 To Understand the Review of Literature
5 To Provide Skills for Writing a Research Report and Thesis

Course Outcomes:

1 Able to Understand Basic Concepts of Research and Its Methodologies.
2 Ability to Find the Scores Located on the Scale of Measurements, Validity and Reliability.
3 Able to Understand the Methodology for Writing a Research Project Proposal.
4 Able to Understand Review of Literature.
5 Able to Use the Technique for Random Numbers Generation.

Unit – I (2 Questions)

Research Methodology: Introduction, Types and Significance of Research. Research Approaches. Research and Scientific Methods, Research Process, Research Problem and Criteria of Good Research, Features of a Good Research Design. Sampling Design: Characteristics of a Good Sample Design and Determination of Sample Size.

Unit – II (2 Questions)

Data Collection: Methods of Data Collection, Case Study Method, Questionnaires and Schedules, Interviewing. Measurement and Scaling Techniques: Meaning of Scaling, Measurement Scales, Test of Second Measurements. Scale Classification Bases, Important Scaling and Scale Construction Techniques, Reliability and Validity of Measurements. Generating Data from Standard Discrete and Continuous Distributions. Exploring Univariate and Multivariate Data Using Tables and Plots. Graphical Methods of Clustering (Chernoff Faces).

Unit – III (2 Questions)

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.

Unit – IV (2 Questions)

Databases: indexing databases, Citation databases – Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. Metrics – h-index, g-index, i10 Index, Altmetrics.

Books Suggested:

1. Kothari, C.R. (2004).Research Methodology (Methods and Techniques). New Age International.
2. Panneerselvam, R. (2013). Research Methodology. Prentice Hall India Learning Private Limited.
3. Anderson, J., Dursten, B.H. & Poole, M. (1989).Thesis and Assignment Writing. John Wiley & Sons.
4. Khanzode, V.V. (2003).Research Methodology (Techniques and Trends). Aph Publishing Corporation.
5. Goon, A.M., Gupta, M.K., & Gupta B.D. (2016). Fundamentals of Statistics (Vol-I & II). World Press.
6. Tukey, J. (1977).Exploratory Data Analysis. Pearson.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20MPCC1 (Research and Publication Ethics)

Maximum Marks – 40
Internal Assessments Marks – 10
Teaching hours – 02 hrs per week
Credits – 02

Paper Code: 20MPCC1

Paper: Research and Publication Ethics

Course Objectives:

1 To Study the Philosophy of Ethics
2 To Study the Scientific Conduct of Research
3 To Study the Publication Ethics
4 To Know about Various Journal Citation Databases
5 To Know the Importance of Quality Publications

Course Outcomes:

1 Acquired the Fundamental Knowledge of Basics of Philosophy of Science and Ethics, Research Integrity, Publication Ethics.
2 Ability to Identify Research Misconduct and Predatory Publications.
3 Able to Use Indexing and Citation Databases, Open Access Publications, Research Metrics.
4 Acquainted with Plagiarism Tools for a Valid and Ethical Research Report.
5 Able to Write Research and Review Articles.

Unit – I (2 Questions)

Introduction to Philosophy: Definition, Nature and Scope, Concept, Branches. Ethics: Definition, Moral Philosophy, Nature of Moral Judgments and Reactions, Ethics w.r.t. Science and Research, Intellectual Honesty and Research Integrity. Science Misconducts: Falsification, Fabrication and Plagiarism (FFP).

Unit – II (2 Questions)

Redundant Publications: Duplicate and Overlapping Publications, Salami Slicing. Selective Reporting and Misrepresentation of Data.Publication Ethics: Definition, Introduction and Importance. Best Practices/Standard Setting Initiatives and Guidelines: COPE, WAME, etc. Conflict of Interest

Unit – III (2 Questions)

Publication Misconduct: Definition, Concept, Problems that lead to Unethical Behavior and vice versa, Types. Violation of Publication Ethics, Authorship and Contributorship. Identification of Publication Misconduct, Complaints and Appeals. Predatory Publishers and Journals.

Unit – IV (2 Questions)

Open Access Publishing: Open Access Publications and Initiatives, SHERPA/RoMEO Online Resource to Check Publisher Copyright & Self-archiving Policies, Software Tool to Identify Predatory Publications Developed by SPPU, Journal Finder/Journal Suggestion Tool viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. Use of Plagiarism Software like Turnitin, Urkund and other Open Source Software Tools.

Books Suggested:

1. Bird, A. (1998). Philosophy of Science. Routledge.
2. MacIntyre, A. (1998). A Short History of Ethics. University of Notre Dame Press.
3. Chaddah, P. (2018).Ethics in Competitive Research - Do not get scooped; Do not get plagiarized. Self Published.
4. D.B. Resnik (2015). What is ethics in research & why is it important, National Institute of Environmental Health Sciences, 1-10.
5. Muralidhar, K., Ghosh, A. & Singhvi A.K. (2019). Ethics in Science, Research and Governance. Indian National Science Academy.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 08 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 08 consisting of 04 short answer type questions (each of marks 02), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP11C3 (Reliability Theory and Modelling)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP11C3

Paper: Reliability Theory and Modelling

Course Objectives:

1 To Understand the System Reliability Problems
2 To Know about the Different Hazard Models
3 To Understand the Procedure for Evaluating Reliability Measures
4 To Acquire Knowledge about Different Systems Structures
5 To Study System Reliability Models Using Markov Process Approaches

Course Outcomes:

1 Able to Understand the Techniques of Reliability Prediction.
2 Acquired Knowledge to Analyze Statistical Experiments Leading to Reliability Modelling.
3 Able to Apply Reliability Theory for the Assessment of Reliability in Engineering Design.
4 Acquainted with the Applications of Stochastic Processes in Reliability Theory.
5 Gained Knowledge to Develop System Reliability Models.

Unit – I (2 Questions)

Reliability: Origin and Development of Reliability, Importance of Reliability and its Types. 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 (2 Questions)

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

Unit – III (2 Questions)

Estimation of Reliability using Redundancy and Maintenance Techniques. Repairable and Non- Repairable Systems. Availability Functions. Estimation of Parametric and Non-Parametric Renewal Function. 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 (2 Questions)

Markovian Approach for estimation of Reliability and Availability of a Parallel-Unit System with Repair. Reliability and Availability Analysis: Single Unit System, Cold & Warm Standby Systems (Two-units) and Parallel-Unit Systems with arbitrary distributions for Failure & Repair Rates and a Single Server using Semi-Markov Process and Regenerative Point Technique. The Idea of Supplementary Variable Technique.

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

Books Suggested:

1. Balagurusamy, E. (2017). Reliability Engineering. McGraw Hill Education.
2. Srinath, L.S. (2005). Reliability Engineering. East West.
3. Elsayed, E.A. (2012). Reliability Engineering. Wiley.
4. Sinha, S.K. (1987). Reliability and Life Testing. Wiley–Blackwell.
5. Birolini, A. (2007). Reliability Engg.(Theory and Practice). Springer.
6. Ebeling, C. (2017). An Introduction to Reliability and Maintainability Engineering. McGraw Hill Education.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP11C4 (Information Theory)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP11C4
Paper: Information Theory
Course Objectives:

1 To Learn the Principles and Applications of Information Theory in Communication System.
2 To Define and Apply the Basic Concepts of Information Theory.
3 To Learn the Construction of Optimal Codes and Various Encoding Procedure.
4 To Learn Channel Capacity and Decoding Schemes in Communication System.
5 To Learn Applications of Entropy Function in Statistics.

Course Outcomes:

1 Acquired Knowledge of Information Theory in Communication System.
2 Acquired Knowledge of Entropy, Conditional Entropy, Joint Entropy, Information Measures and their Properties for both Discrete and Continuous case.
3 Acquired Knowledge to use Entropy Function in Noiseless Coding and Construction of Optimal Course.
4 Acquired Knowledge of Channel Capacity and Decoding Scheme.
5 Acquired Knowledge to use Entropy Function in Statistics

Unit – I (2 Questions)

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 (2 Questions)

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 Fano encoding, Huffman Procedure.

Unit – III (2 Questions)

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 (2 Questions)

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. Ash, R.B. (2012). Information Theory. Dover Publications.
2. Reza, F.M. (2003). An Introduction to Information Theory. Dover Publications Inc.
3. Mathai, A.M. & Rathie, P.N. (1975). Basic Concepts in Information Theory and Statistics. Wiley Eastern Pvt.Ltd.
4. Kullback, S. (1997). Information Theory and Statistics. Dover Publications Inc.
5. Stone, J.V. (2015) Information Theory : A Tutorial Introduction, Sebtel Press.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP11C5 (Regression Analysis and Bayesian Inference)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP11C5
Paper: Regression Analysis and Bayesian Inference
Course Objectives:

1 To Teach Students About Different Types of Regressions.
2 To Aware the Students About the Use of Bayes' Rule to Transform Prior Probabilities into Posterior Probabilities
3 To Acquire Knowledge to Explain the Bayesian FrameWork for Data Analysis.
4 To Demonstrate the Role of Prior Distribution in Bayesian Inference.
5 To Enhance Knowledge to use Bayesian Methods for Solving Real Life World Problems.

Course Outcomes:

1 Able to Understand the Different Types of Regression.
2 Gained Knowledge to Explain the Bayesian Frame Work for Data Analysis.
3 Able to Demonstrate the Role of Prior Distribution in Bayesian inference.
4 Enhanced Knowledge to use Bayesian Methods for Solving Real Life World Problems.
5 Acquired Knowledge for Solving Real Life Problems Using Bayesian Approaches.

Unit – I (2 Questions)

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 (2 Questions)

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

Unit – III (2 Questions)

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 (2 Questions)

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 Suggested:

1. Montgomery, D. C., Peck, E. A. & Vining, G.G. (2012).Introduction to Linear Regression Analysis. Wiley.
2. Draper, N.R. & Smith, H. (1998). Applied Regression Analysis. Wiley-Interscience.
3. Robert, C.P. (1997).The Bayesian Choice: A Decision Theoretic Motivation. Springer.
4. Berger, J.O. (1993).Statistical Decision Theory and Bayesian Analysis. Springer.
5. Dobson, A.J. (2001), An Introduction to Generalized Linear Models, Chapman and Hall/CRC.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP11C6 (Statistical Genetics)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP11C6
Paper: Statistical Genetics
Course Objectives:

1 To Understand the Basic Concepts of Genetics
2 To Know the Inheritance of Genes In Families and Populations
3 To Design, And Analyze the Genetic Experimentation in Animal and Plant Breeding Experiments.
4 To Analyse the Statistical Models to Obtain the Breeding Value and Genotypic Value
5 To Conclude and Interpret the Statistical Significance of the Different Genetic Parameters

Course Outcomes:

1 Detailed and Comprehensive Understanding of the Basis of Heredity.
2 Understanding of Genetic Methodology and Quantification of Heritable Traits in Families and Populations.
3 Acquired Knowledge to Design, Execute, and Analyze the Results of Genetic Experimentation in Animal and Plant Model Systems.
4 Get Insight into Mathematical, Statistical and Computational Basis of Genetic Analyses and to Evaluate Conclusions.
5 Understand the Statistical Significance of Different Genetic Parameters

Unit – I (2 Questions)

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 (2 Questions)

Random Mating: Hardy- Weinberg Equilibrium, Panmixia Population for Single Locus, Sex Linked Genes. Forces affecting Gene Frequencies; Selection, Mutation and Migration, Equilibrium between Forces in Large Random Mating Population. Fisher's Fundamental Theorem of Natural Selection.

Unit – III (2 Questions)

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 (2 Questions)

Components of Additive Variance and Genotypic Variance, Components of Covariance, Assortative and Dissortative Mating, Correlations between Relatives, Genetic Parameters; Heritability in Narrow Sense and in Broad Sense, Repeatability and Genetic Correlation, Relationship between them.

Books Suggested:

1. Mackay, T.F.C. & Falconer, D.S. (1995). Introduction to quantitative Genetics. Longman.
2. Kempthorne, O. (1969). An Introduction to Genetic Statistics. Iowa State University Press.
3. Narain, P. (1990). Statistical Genetics. New Age International Pvt Ltd.
4. Li, C.C. (1978). Population Genetics. Boxwood Press.
5. Jain, J.P. (2017). Statistical Technique in Quantitative Genetics. Hindustan Publishing Corporation.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

M.Phil. Semester – II

20STAMP12C1 (Advanced Theory of Sample Surveys)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP12C1

Paper: Advanced Theory of Sample Surveys

Course Objectives:

1 To Design and Implement Surveys with Different Sampling Designs
2 To Provide Knowledge to Determine Sample Size in Order to Estimate Population Parameters and Testing Null Hypothesis
3 To Explain and Apply Intraclass Correlation and Design-Effects (DEFF) for Complex Surveys
4 To Estimate Design Weights and Adjust for Non-Response Errors
5 To Acquire Knowledge for Determining Best Estimators

Course Outcomes:

1 Able to Understand Appropriate Sampling Methods.
2 Able to Propose Estimators for Population Parameters.
3 Gained Expertise in Designing a Survey Plan.
4 Achieved Practical Knowledge to Analyze Data from Multistage Surveys.
5 Acquired Knowledge to Minimize Sampling Errors.

Unit – I (2 Questions)

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 (2 Questions)

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 (2 Questions)

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 (2 Questions)

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. Singh, D. & Chaudhary, F.S. (2018). Theory & Analysis of Sample Survey Designs. New Age International Private Limited.
2. Mukhopadhyay, P. (2008). Theory and Methods of Survey Sampling. PHI.
3. Goon, A.M., Gupta, M.K., & Gupta B.D. (2016). Fundamentals of Statistics, Vol-II. World Press.
4. Chochran, W.G. (1977).Sample Techniques. Wiley.
5. Raj, D. & Chandhok, P. (2013).Sample Survey Theory. Createspace Independent Pub.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP12C2 (Advanced Design of Experiments)

Maximum Marks – 80
Internal Assessments Marks – 20
Teaching hours – 04 hrs per week
Credits – 04

Paper Code: 20STAMP12C2
Paper: Advanced Design of Experiments
Course Objectives:

1 To Know about the Basic Statistics that Underlie DOE i.e., MOLS, PBIBD
2 To Understand the Parametric Relations and Association Class & Scheme
3 Construction of BIBD and PBIBD through MOLS
4 To Identify the Factors with Levels/Combination of Factors with Levels which have an effect on Response with Confounding in Experiments
5 To Construct Orthogonal Arrays using Galois Field and to Construct Response Surface Designs

Course Outcomes:

1 Able to Learn the Issues and Principles for Orthogonal Latin Square (OLS).
2 Able to Layout and Analyze the Balanced Incomplete Block designs (BIBD).
3 Able to Layout and Analyze the Partially Balanced Incomplete Block designs (PBIBD).
4 Acquainted with Confounding in Different Experiments.
5 Acquired Knowledge of Designs for Fitting Response Surfaces.

Unit – I (2 Questions)

General Block Designs: C- Matrix and its Properties 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 – II (2 Questions)

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 – III (2 Questions)

Concept of Confounding. Confounding in 2^n Experiments. Complete and Partial Confounding in Symmetric Factorial Experiments.

Unit – IV (2 Questions)

Galois Fields, Quadratic Residues, Hadamard Matrices, Plackett Burman Designs and their Properties, Orthogonal Arrays and their Constructions, Designs for Fitting Response Surfaces, Design Criterion Involving Bias and Variance.

Books Suggested:

1. Dey, A. (1987). Theory of Block Designs. Wiley–Blackwell.
2. Raghavrao, D. (2002). Construction and combinatorial problems in design of experiments. Dover Publications Inc.
3. Dass, M.N. & Giri, N.C. (2017). Design and analysis of Experiments. New Age International.
4. Hedayat, A.S., Sloane, N.J.A. & Stufken, J. (1999). Orthogonal Arrays: Theory and Applications. Springer.
5. Lin, D.K.J. & Draper, D.R. (1992). Projection Properties of Plackett and Burman Designs. Technometrics, Vol. 3 (4).
6. Myers, R.H., Montgomery, D.C. & Anderson-Cook, C.M. (2009). Response Surface Methodology: Process and Product Optimization using Designed Experiments. Wiley–Blackwell.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 16 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 16 consisting of 04 short answer type questions (each of marks 04), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP12C3 (Advanced Stochastic Processes)

Maximum Marks – 40
Internal Assessments Marks – 10
Teaching hours – 02 hrs per week
Credits – 02

Paper Code: 20STAMP12C3
Paper: Advanced Stochastic Processes
Course Objectives:

1 To Explain in Detail The Fundamental Concepts of Stochastic Processes
2 To Aware the Students About the Applications of Markov Chain in Research.
3 To Provide Methodology for Developing Stochastic Models for Carrying Out Research on Social Aspects.
4 To Train About the Methods for the Solution of Stochastic Differential Equations.
5 To Provide Knowledge to apply Stochastic Processes in Epidemic Models.

Course Outcomes:

1 Able to Understand the Applications of Markov Chain in Research.
2 Able to Develop Stochastic Models for Carrying Out Research on Social Aspects.
3 Obtained Understanding for the Solution of Stochastic Differential Equations.
4 Acquired Knowledge to Apply Stochastic Processes in Epidemic Models.
5 Acquainted with Techniques to Simulate Different Stochastic Processes.

Unit – I (2 Questions)

Introduction to Stochastic Process. Markov Process: Markov Chains, Determination of Higher Transition Probabilities, Limiting Behavior and Stability of Markov Chain, Statistical Inference for Markov Chains, Non-Homogeneous Chains. Poisson Process: Decomposition and related distributions, Birth and Death Processes, .

Unit – II (2 Questions)

Erlang Process. Time Series Processes: Moving Average (MA) Process, Autoregressive Process, Auto-regressive Process of Order Two (Yule Process), Autoregressive Moving Average Process Wiener Process: Definition, Differential Equations, Kolmogorov Equations and First Passage Time Distribution.

Unit – III (2 Questions)

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. Simulation of Stochastic Process: Markov Chain, Poisson Process, Non-Homogeneous Poisson Process and Renewal Process.

Unit – IV (2 Questions)

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

Books Suggested:

1. Baily, N.T.J. (1990). The Elements of Stochastic Processes with Applications to the Natural Sciences. Wiley-Interscience.
2. Medhi, J. (2009). Stochastic Processes. New Age Science.
3. Bhatt, B.R. (2000). Stochastic Models, Analysis and Application. New Age International Pvt. Ltd.
4. Basu, A.K. (2002). Introductions to Stochastic Processes. Alpha Science International Ltd.
5. Cox, D.R. & Miller, H.D. (1977). The Theory of Stochastic Processes. Chapman and Hall/CRC.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 08 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 08 consisting of 04 short answer type questions (each of marks 02), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.

20STAMP12C4 (Fuzzy Set Theory)

Maximum Marks – 40
Internal Assessments Marks – 10
Teaching hours – 02 hrs per week
Credits – 02

Paper Code: 20STAMP12C4
Paper: Fuzzy Set Theory
Course Objectives:

1 To Introduce the Theory of Fuzzy Sets and Fuzzy Relations.
2 To Discuss Theoretical Differences between Fuzzy Sets and Classical Sets.
3 To Study Arithmetic Operations on Fuzzy Sets.
4 To Introduce Generalized Fuzzy Sets and their Properties.
5 To Learn the Applications of Fuzzy Sets in Decision Making.

Course Outcomes:

1 Able to Understand the Basic Knowledge of Fussy Sets and Generalized Fuzzy Sets.
2 Acquired Knowledge about Fuzzy Relation.
3 Acquired Knowledge to Apply Fuzzy Information in Decision Making.
4 Acquired Knowledge to Deal with Vague, Imprecise and Uncertain Problem Taking Processes.
5 Able to Apply Arithmetic Operations on Fuzzy Sets.

Unit – I (2 Questions)

Fuzzy Sets and Uncertainty: Certainty versus Uncertainty, Fuzzy Sets and Membership Functions, Properties of Fuzzy Sets, Operations on Fuzzy Set: Union, Intersection, Algebraic Sum, Bounded Sum and Bounded Difference, Algebraic Product.

Unit – II (2 Questions)

Convex Combination, Extension Principle, t-norm and t-Conorm Operation. Operations on Intervals, Fuzzy Numbers and Operations. Fuzzy Equations, Fuzzy Relations: Fuzzy Relation on Crisp Set, Fuzzy Relation on Fuzzy Set, Composition of Fuzzy Relations:

Unit – III (2 Questions)

Max-min, Max-product, Max-average. Fuzzy Equivalence Relations, Fuzzy Antisymmetric Relation, Similarity Relation, Fuzzy Ordering Relation and Fuzzy Compatibility Relation, Fuzzy Morphism, Fuzzy Relation Equation.

Unit – IV (2 Questions)

Generalized Fuzzy Sets: Intutionistic Fuzzy Sets, Linguistic Fuzzy Sets, Interval Valued Fuzzy Sets, Interval Valued Intutionistic Fuzzy Sets, Hesitant Fuzzy Set, Fuzzy Rough Sets, Fuzzy Soft Sets and their Properties. Application of Fuzzy Set in Multicriteria Decision Making.

Books Suggested:

1. Zimmerman, H.J. (1996). Fuzzy Set theory and its application. Springer.
2. Mohan, C. (2019). An Introduction to Fuzzy Set Theory and Fuzzy Logics. MV Learning.
3. Klir, G. J. & Yuan, B. (1995). Fuzzy Set and Fuzzy Logic: Theory and Applications. Pearson.
4. Klir, G.J. & Fegler, T.A. (1987). Fuzzy Sets, Uncertainty and Information. Pearson Education (US).
5. Bhargav, A.K. (2013). Fuzzy Set Theory Fuzzy Logic and their Applications. S. Chand
6. Ross, T.J. (2011). Fuzzy Logic with Engineering Applications. Wiley.

Note: The examiner is to set nine (09) questions in all into five sections A,B,C,D and E of the question paper from all the four units- I, II, III and IV. In each section A,B,C and D, there will be two questions of 08 marks each from Units I, II, III, &IV respectively. In section E, there will be a compulsory question of marks 08 consisting of 04 short answer type questions (each of marks 02), one from each unit I,II,III and IV. The candidate will be required to attempt five questions in all selecting at least one question from each section.