PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR M.SC. STATISTICS

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2012 – 2013 ONWARDS

MASTER OF SCIENCE

BRANCH – II STATISTICS

(SEMESTER SYSTEM UNDER CBCS)

REGULATIONS

Objectives of the Course:

To transform graduates with sufficient strength in statistics so as to be employed in the Industry, Research and Development unit and Academic Institutions such as colleges, Higher secondary schools and schools. The course is designed to impact professional knowledge and practical skills to the students.

Condition for Admission:

A candidate who have passed B.Sc Statistics / B.Sc Mathematics / B.Sc., Computer Science (with allied Mathematical Statistics) degree of Periyar University or any of the above degree of any other university accepted as per the norms set by the Government of Tamil nadu as equivalent thereto, subject to such condition as may be prescribed thereto are permitted to appear and qualify for the M.Sc Statistics degree examination of this university after a course of study of two academic years, under CBCS.

Duration of the course:

The course for the degree of Master of Science in Statistics shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

Course of study:

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

Course Structure under CBCS

BRANCH - II STATISTICS - Course Title: M. Sc. (Statistics)

(For the candidates admitted from the year 2012-13 onwards)

Semester	Course	Course Title	Credit	Hours	Internal Mark	External Mark	Total Marks
I	Core I	Real Analysis and Linear Algebra	5	6	25	75	100
	Core II	Measure Theory	5	6	25	75	100
	Core III	Distribution Theory	5	6	25	75	100
	Core IV	Sampling Theory and Methods	5	6	25	75	100
	Core Practical CP01	Practical –I	-	3	-	-	-
	Core Practical CP02	Practical –II	-	3	-	-	-
		Total	**20**	**30**	**100**	**300**	**400**
II	Core V	Probability Theory	5	6	25	75	100
	Core VI	Multivariate Analysis	5	6	25	75	100
	Core VII	Demography & Actuarial Statistics	5	6	25	75	100
	Core Practical CP01	Practical-I	4	3	40	60	100
	Core Practical CP02	Practical-II	4	3	40	60	100
	Non-major elective	EDC* : Business Communication	4	4	25	75	100
		Human Rights	2	2	25	75	100
		Total	**29**	**30**	**205**	**495**	**700**
III	Core VIII	Statistical Estimation Theory	5	6	25	75	100
	Core IX	Design and analysis of Experiments	5	6	25	75	100
	Elective-I	Statistical Quality Control & Operations Research	4	6	25	75	100
	Elective-II	Stochastic processes	4	6	25	75	100
	Core Practical CP03	Practical-III	-	3	-	-	-
	Core Practical CP04	Practical-IV	-	3	-	-	-
		Total	**18**	**30**	**100**	**300**	**400**
IV	Core X	Testing Statistical Hypotheses	5	6	25	75	100
	Elective-III	Reliability theory	4	6	25	75	100
	Elective-IV	Applied Regression Analysis	4	6	25	75	100
	Core Practical CP03	Practical – III	4	3	40	60	100
	Core Practical CP04	Practical – IV	4	3	40	60	100
	Core Project	Project & Viva	4	6	40	60	100
		Total	**25**	**30**	**195**	**405**	**600**
		Over all Total	**92**				**2100**

* Extra Disciplinary Course

List of Core/Elective Subjects to be offered

CORE Subjects

1. Real Analysis and Linear Algebra
2. Measure Theory
3. Distribution Theory
4. Sampling Theory and Methods
5. Practical – I
6. Probability Theory
7. Multivariate Analysis
8. Demography and Actuarial statistics
9. Practical – II
10. Statistical Estimation Theory
11. Design and Analysis of Experiments
12. Practical – III
13. Testing Statistical Hypotheses
14. Practical – IV
15. Project & VIVA-VOCE

ELECTIVE Subjects (Only four)

1.Statistical Quality control and Operations Research
2.Stochastic processes.
3.Reliability theory
4.Applied Regression Analysis.
5. Statistical Computing
6. Econometrics.

Extra Disciplinary Course:

1. Statistical Methods
2. Elements of Operations Research

Human rights. Common to all courses. Syllabus will be provided by the University.

Examination:

The examination shall be of three hours duration to each theory paper at the end of each semester. The candidate failing in any paper will be permitted to appear in the subsequent semester.

Practical examinations should be conducted at the end of even semester.

At the end of fourth semester, viva-voce will be conducted on the basis of Project/Dissertation submitted by the student .The viva-voce should be conducted jointly by the guide and the external examiner.

Theory Papers:

Total marks for each course (core/elective) is 100. 25 marks for Internal and 75 marks for University Examination. The components of Internal Assessment are:

1. Test	**=**	**10 Marks**
2. Attendance	**=**	**5 Marks**
3. Seminar	**=**	**5 Marks**
4. Assignment	**=**	**5 Marks**
Total	**=**	**25 Marks**

Practical:

Total marks for each practical course is 100. 40 marks for internal and 60 marks for Written Examination. The components of Internal Assessment are:

1.Record work	**=**	**25 Marks**
2.Test	**=**	**10 Marks**
3.Attendance	**=**	**5 Marks**
Total	**=**	**40 Marks**

Project work:

The Marks for the Project work is 100 and the components are:

Internal Assessment: (For two reviews 20+20 = 40)	**: 40 Marks**
Evaluation : Evaluation of Project report by External Examiner and Guide	**: 40 Marks**
Viva-Voce conducted by External Examiner & Guide	**: 20 Marks**
Total	**: 100 Marks**

Question Paper Pattern:

(a) For Theory

- Total marks for each theory course (University examination) is **75**.
- The Question paper is divided into two parts.
- **PART-A** consists of 5 questions, one from each unit with internal choice. Each question carries 5 marks. All questions should be answered. Total marks for PART-A is **25**.
- **PART-B** consists of 5 questions, one from each unit with internal choice. Each question carries 10 marks. All questions should be answered. Total marks for PART-B is **50**.

(b) For Practical

- Total marks for each practical (university examination) is **60**.
- The candidate should attend 3 questions out of 5 questions each carrying 20 marks.

Classification of Results:

(i) Passing Minimum:

A candidate shall be declare to have passed the examination if the candidate secures not less than 50% of the marks in the Semester Examination and in IA in each course (or) practical. The candidate should get a minimum of 50% marks in SE as well

as a minimum of 50% marks in IA, i.e., a minimum of 38 marks out of 75 in SE and minimum of 12 marks out of 25 in IA in the theory courses.

For practical courses, the distribution of marks will be 40 for IA & 60 for practical examination. The candidate should get a minimum of 20 marks out of 40 in IA and a minimum of 30 out of 60 in practical examination. The submission of record note book is a must in the practical examinations.

For the project work and viva-voce a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in the paper (Project).

Candidates who do not obtain the required minimum marks for a pass in a course or practical or project report shall be required to appear and pass the same at a subsequent appearance.

(ii) Minimum Credits to be earned : 90 credits
For Human Rights : 2 credits
} 92 credits

(iii) Marks and Grades:

The following table gives the marks, grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in a paper / course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0-4.9	U	Re-appear
ABSENT	0.0	AAA	ABSENT

C_i = Credits earned for course *i* in any semester.

G_i = Grade point obtained for course *i* in any semester

n = Refers to the semester in which such courses were credited.

a) Semester:

GRADE POINT AVERAGE (GPA) = $\Sigma_i C_i G_i / \Sigma_i C_i$

$$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

b) The Entire Programme:

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5 - 10.0	O+	First class with Exemplary*
9 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme (Core, Elective, Non-major Electives and Extra-Disciplinary courses alone) are eligible.

Dissertation:

The topic of the dissertation shall be assigned to the candidate before the end of second semester. The student should prepare the plan of work for the dissertation at the end of second semester. In case the student wants to avail the facility from other organisations / university / laboratory, they will undertake the work with the permission of the guide and acknowledge the alien facilities utilized by them. The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners.

Format to be followed:

The format / certificate for dissertation to be submitted by the students are given below.

Format of the preparation of project work

(a) Title page

(b) Bonafide Certificate

(c) Acknowledgement

(d) Table of Contents

Contents

Chapter No.	Title	Page No.
1.	Introduction	
2.	Review of Literature	
3.	Methodology	
4.	Analysis	
5.	Summary of Conclusions	
6.	References	
7.	Tables	

Format of the Title Page:

TITLE OF THE DISSERTATION

Dissertation submitted to the Periyar University
in partial fulfillment of the requirement for the Degree of

Master of Science

in

STATISTICS

By

(Students Name)

(Register Number)

EMBALAM

NAME OF THE INSTITUTION

MONTH & YEAR

SYLLABUS

(For the candidates admitted from 2012-2013 onwards)

Core Course I **REAL ANALYSIS AND LINEAR ALGEBRA**

(I SEMESTER) P.Code :

Unit I

Introduction to real numbers : n-dimensional Euclidian space, open and closed intervals (rectangles). Compact sets. Bolzano-Weierstrass theorem, Heine - Borel theorem.

Unit II

Sequences and series of function. Uniform convergence and its applications (without proof).Real valued function of several variables-Limit, continuity and derivability of function.

Unit III

Characteristic roots and vectors. Cayley-Hamilton theorem. Minimal polynomials-similar matrices-Algebraic and geometric multiplicity of characteristic roots-Spectral decomposition of a real symmetric matrix-reduction of a pair of real symmetric matrices.

Unit IV

Real quadratic forms, reduction and classification of quadraticforms-extrema of quadratic forms-index and signature. Reduction of positive definite matrix.

Unit V

Generalized Inverse of a matrix. Moore and Penrose generalized inverse in the solution of system of equation. Least square properties of Moore and Penrose generalized inverse and simple applications of M-P inverse.

Books for Study and Reference:

1. Goldberg, R. (1970) **Methods of Real Analysis**, Oxford and IBH publishing Co Pvt Ltd.
2. Apostol, T.M. (1985) **Mathematical Analysis**, Narosa publishing, New Delhi.
3. Rudin Walter. (1976) **Principles of Mathematical Analysis**, McGraw Hill.
4. Rao, A.R. and Bhima Sankaran (1992) **Linear Algebra**, Tata McGraw Hill.
5. Rao, C.R. and Mitra, S.K. (1971) **Generalized inverse of matrices and its applications**, John Wiley and Sons Inc.
6. Biswas, S. (1984) **Topics in algebra of Matrices,** Academic Publications.

QP Pattern : Unit wise internal choice with maximum 75 marks

Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course II

MEASURE THEORY

(I SEMESTER) P.Code :

Unit I

Algebra of sets-Countable sets – field –monotonic field-monotonic class-field generated by a class of subsets-Borel sets- Borel field.

Unit II

Set functions – countably additive set functions – finitely additive set functions. Measure functions. Properties of measure functions – Outer measure functions – Extension measure –completion of a measure function (concepts only).

Unit III

Lebesque measure and its properties. Lebesque - Stieltjes measure-examples. Measurable functions- Borel measurable functions –Approximation theorem.

Unit IV

Measure integration – Properties of integrals – sequence of Measurable functions – mode of convergence of measurable functions – monotone and dominated convergence theorems.

Unit V

Product measure –product measure functions-properties – Product measure theorem – Fubini's theorem (concept) and its applications in probability. Radon-Nikodym theorem (concept) and its applications.

Books for Study and Reference:

1. De Barra, G. (1991) **Measure theory and Integration**, Wiley Eastern Ltd.,
2. Basu, A.K. (1999) **Measure theory and Probability,** PHI.
3. Ash, R.B. (2000) **Probability & Measure Theory**, 2nd Edition, Academic Press.
4. Royden, H.L. (1968) **Real Analysis**, 2nd Edition, Macmillan.
5. Burrill.W. (1972) **Measure Integration and Probability,** Academic Press,
6. Gupta, R.P. et al (1999) **Measure theory,** Real Analysis – III, Pragati Prakashan, Meerat.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course III **DISTRIBUTION THEORY**

(I SEMESTER) P.Code :

Unit I

Quick review of the following distributions – Bernoulli, Binomial, Poisson and Normal, Exponential, Gamma and Beta distributions. Study of Hypergeometric, Negative Binomial, Multinomial, Laplace, Lognormal, Cauchy and Dirichlet distributions (Derivation, application and Properties).

Unit II

Bivariate and multivariate distributions; concepts of joint, marginal and conditional distributions. Detailed study of Bivariate Binomial and Bivariate normal distribution. Functions of random variables and their distribution : sum and difference, products and quotients of random variables. concept of truncated distribution and compound distribution (Binomial, Poisson & Normal). Various techniques of finding distribution of functions of random variables.

Unit III

Multivariate normal distribution and its properties; marginal and conditional distribution; characteristic function and its uses. Distribution of linear functions of normal variables. Distribution of sample mean vector.

Unit IV

Sampling distribution of statistics from normal samples leading to Normal, t, chi-square, and F (both central and non-central) - properties of these distribution. Sampling distribution of mean, variance, correlation and regression co-efficient for normal samples.

Unit V

Order statistics and their distribution; single & two order statistics. Distribution of median, range and midrange. Asymptotic distribution of extreme order statistics.

Books for Study and Reference:

1. Hogg, R.V and Craig, A.T. (1972) **An Introduction to Mathematical Statistics**, 3rd Edition, Amerind.
2. Rohatgi, V.K. (1988) **An Introduction to probability theory and Mathematical Statistics**, Wiley Eastern.
3. Anderson.T.W. (1983) **An Introduction to Multivariate Statistical Analysis**, 2nd Edition, John Wiley.
4. Johnson and Kotz. (1970) **Distributions in Statistics**, Vol I, II and III, John Wiley & Sons, New york.
5. Mood, Graybill and Boes. (1974) **Introduction to the theory of statistics,** 3rd Edn. Mc Graw Hill.
6. Parimal Mukhopadhyey. (2006) **Mathematical Statistics,** 3rd edition, New Central Book Agency.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course IV **SAMPLING THEORY AND METHODS**

(I SEMESTER) P.Code :

Unit I

Principal steps in a sample survey– Drafting a questionnaire .Errors in Surveys-Non Response, types of Non-Response, Call -Backs, a mathematical model of the effects of Call-Backs. Interpenetrating sub sample. Randomized response Technique: Warner's model-related and unrelated questionnaire method.

Unit II

Finite population sampling techniques: SRSWR/WOR, stratified and systematic and related results on estimation of population mean and total - Allocation problems in stratified random sampling.

Unit III

Ratio and Regression estimators based on SRSWOR and stratified random sampling. Multivariate ratio estimator (concept only). Cluster sampling – clusters of equal size – Estimation of mean and its variance.

Unit IV

Unequal probability sampling: PPSWR/WOR. Cumulative total and Lahiri's scheme. Methods and related estimators of finite population mean/total. Hurwitz – Thompson estimators – Des Raj ordered estimator and Murthy's unordered estimator.

Unit V

Two stage sampling with equal first stage units – estimation of mean and its variance. Double Sampling: Double sampling for stratification – DS for Ratio estimation – DS for Regression estimation.

Books for Study and Reference:

1. Cochran, W.G. (1977) **Sampling Techniques**, Wiley Limited.
2. Singh, D. and Choudhary F.S.(1986) **Theory and analysis of sample survey Designs**, Wiley Eastern Limited.
3. Parimal Mukhopadhyay. (1988) **Theory and Methods of Survey Sampling**, Prentice Hall of India.
4. Des Raj. (1967) **Sampling Theory**, Tata McGraw Hill, New Delhi.
5. Desraj and Chandek. (1998) **Sample survey theory**, Narosa Publishing House, New Delhi.
6. Hansen, Hurwitz, Madow. (1953) **Sample survey methods and theory**, Vol I & II.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course V

PROBABILITY THEORY
(II SEMESTER) P.Code :

Unit I

Probability measure – properties – Discrete probability space and general probability space, conditional probability space. Functions and inverse functions – Random variables – Induced probability space by random variables.

Unit II

Distribution functions – properties – Decomposition theorem – Correspondence theorem – Distribution function of vector r.v - conditional distribution function – properties – Concept of Independence – Kolmogorov 0-1 Law – Borel Cantelli Lemma.

Unit III

Expectation and moments – properties , conditional expectation – properties. Inequality – Markov, Holder, Jenson , Chebyshev's and Liapounov. Convergence of sequence of random variables – modes of convergence and their relationship.

Unit IV

Characteristic Function of random variables – properties – Inversion theorem – Simple examples – Uniqueness theorem, Levy continuity theorem (statement only). Law of Large numbers – WLLN for independent and i.i.d case – SLLN for independent and i.i.d case.

Unit V

Weak and complete convergence of distribution function – Helly - Bray theorem. Central Limit theorem -generalization of LLN, CLT for independent random variables – Liapounov's form – Lindeberg – Feller CLT for i.i.d random variables – Lindeberg – Levy theorem.

Books for study and Reference:

1. Rohatgi,V.K.(1985) **An Introduction to Probability Theory and Mathematical Statistics,** Wiley Eastern Ltd.
2. Bhat, B.R. (1981) **Modern Probability Theory**, Wiley Eastern Ltd. New Delhi.
3. Feller.W. (1968) **Introduction to Probability and Application,** Wiley Eastern Company.
4. Ash, R.B. (2000) **Probability and Measure Theory**, 2nd Edition, Academic press.
5. Chandra T.K. & D.Chaterjee. (2005) **A first course in Probability,** 3rd Edition, Narosa Publishing House.
6. Billingsley. P. (1985) **Probability and Measure**, Wiley Eastern Ltd.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course VI **MULTIVARIATE ANALYSIS**

(II SEMESTER) P.Code :

Unit I

Estimation of the mean vector and the covariance matrix of a multivariate normal distribution. Partial and multiple correlation coefficients and their null distribution. Concept of path analysis – construction of path diagram and its use in linear regression model.

Unit II

Inference problems concerning the mean vector when the covariance matrix is known (one and two sample problems); likelihood ratio criterion and its application; Mahalanobis D-square and its application. Inference concerning the mean vector (s) when the covariance matrix is unknown (one and two sample problem); Problem of symmetry; Likelihood ratio criterion and its application; Generalised T-square statistics, its distribution and its application; The relationship between T-square and D-square.

Unit III

Wishart distribution (WD) (no derivation) and its properties; characteristic function of WD and its uses; test for covariance matrix. Sphericity test; test for the equality of covariance matrices; testing the independence of sets of variates. Multivariate analysis of variance (one way and two way classification concepts only).

Unit IV

Canonical correlation and variates; Estimation and interpretation. Classification problems, standard of good classifications; procedure of classification with two or more populations with known and unknown distributions. Classification procedures when the parent distribution are normal; Estimation of misclassification probabilities; Fisher's discriminant function and its uses.

Unit V

Principal component analysis; Definitions and maximum likelihood estimators. Computation and interpretation of principal components. Factor analysis - the basic model - common and specific factors – communality - Estimation of factor loadings. Principal factor method, maximum likelihood method - factor rotations. Cluster analysis - similarity and distance measures - clustering techniques; Hierarchical techniques and Agglomerative methods.

Books for study and Reference:

1. Anderson. T.W. (1983) **An introduction to multivariate statistical analysis,** 2nd edition, John wiley.
2. Johnson and Wichern (1996) **Applied multivariate statistical analysis,** 3rd edition, PHI (P) Ltd.
3. Morrison. D.F. (1978) **Multivariate statistical methods,** Academic 2nd edition, McGraw Hill.
4. Agarwal.B.L. (2010) **Theory and Analysis of experimental designs;** CBS Publishers & Distributors Pvt. Ltd.
5. Hair et all (2009) **Multivariate Data analysis,** 6th edition, Pearson Publications.
6. Rao.C.R. (1973) **Introduction to linear statistical Inference and its applications,** Wiley Eastern.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course VII **DEMOGRAPHY AND ACTUARIAL STATISTICS**

(II SEMESTER) P.Code :

Unit I

Demographic data – sources, coverage and content errors in demographic data. Use of balancing equations and Chandrasekaran Deming formula. Vital Registration system – Adjustment of age data - use of whipple, Myer and UN Indices – Smoothing of age data.

Unit II

Measures of fertility, stochastic models for reproduction, distribution of time to first birth, inter-live birth intervals and number of birth for homogenous group of women. Measures of mortality – construction of abridged life table methods by JIA, Reed and Merrel, Grevilles and Kings.

Unit III

Utility theory – Insurance and utility theory. Models for individual claims and their sums – Life tables and its relation with survival function.

Unit IV

Life table function at non-integer age (fractional ages). Analytical laws of mortality – Gompertz's law and Makeham's law. Select and ultimate and aggregate mortality tables.

Unit V

Multiple life function – joint life and lost survivor status – Insurance and annuity benefits through multiple function.

Books for study and Reference

1. Ramkumar. R (1986) **Technical Demography,** Wiley eastern Ltd, New Delhi.
2. Rogers.A. (1975) **Introduction to Mathematical Demography,** Johnwiley, Newyork.
3. Biswas.S. (1988) **Stochastic processes in Demography and applications**, Wiley eastern limited.
4. A Listoris Neill. (1977) **Life contingencies**.
5. Bowers, N.L. Gerber.H.V. Hickman J.C, Jones D.A. and Nesbitt.C.J. (1986): **Actuarial mathematics,** Society of Actuarial, Ithaca, Illinois, USA (Second edition).
6. Dixit et all (2008) **Mathematical basis of life assurance, IC 81,** Insurance Institute of India, Bombay

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Practical CP01	**PRACTICAL –I**	P.Code :

(**Based on Core courses: Sampling and Distribution theory)**

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-I examination should be conducted at the end of II Semester.

Unit I:

(a) Estimation of population mean, total and its variance in SRS.
(b) Ratio estimation for population mean, total and its variance (SRS).
(c) Regression estimation for population mean, total and its variance (SRS).

Unit II:

(a) Estimation of population mean, total and SE in stratified Random Sampling
(b) Comparisons of different allocations in STRS.
(c) Gain due to stratifications.
(d) Estimation of population mean, total and SE in Systematic sampling.
(e) Estimation of mean, total and variance in Cluster sampling.

Unit III:

(a) Estimation of mean, total and variance in two stage cluster sampling with equal size clusters
(b) PPS sampling with replacement.
(c) Double sampling for stratification.
(d) Double sampling for Ratio estimation
(e) Double sampling for Regression estimation.

Unit IV:

(a) Fitting of binomial and Poisson distribution & testing the goodness of fit
(b) Fitting of normal distribution and testing the goodness of fit
(c) Fitting of log normal distribution and testing the goodness of fit

Unit V:

(a) Finding partial, multiple correlation & regression co-efficients from $\sum$ matrix.
(b) Testing for partial, multiple correlation and regression co-efficients.
(c) Testing Ho: $\mu = \mu_0$ when $\sum$ is known.
(d) Testing Ho: $\mu^{(1)} = \mu^{(2)}$ when $\sum$ is known.

(For the candidates admitted from 2012-2013 onwards)

Core Practical CP02	**PRACTICAL – II**	P.Code :

(Based on papers: Demography & Multivariate analysis)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-II examination should be conducted at the end of II Semester.

Unit I

Fitting of Population Growth Models.

(a) Gompertz's Law.
(b) Makeham's Law.
(c) Logistic Law (Method of partial sums).
(d) Logistic Law (Method of three selected points).

Unit II

(a) Computation of Mobility measures.
(b) Probability of living and dying rate of mortality.
(c) Estimation and other measures from mortality table.

Unit III

(a) Construction of Abridged life tables (Reed and Merrell).
(b) Construction of Abridged life tables (JIA).
(c) Construction of Abridged life tables (Greville's).
(d) Finding Fisher's discriminant function (two population case only) and its test.
(e) Test for assigned discriminant function
(f) Use of Discriminant function in classification and probability of misclassification.

Unit IV

(a) MLE's for μ and $\sum$ in a p- variate Normal distribution.
(b) Testing $H_o: \mu = \mu_o$ When $\sum$ is unknown.
(c) Testing $H_o: \mu^{(1)} = \mu^{(2)}$ When $\sum$ is unknown.
(d) Testing $H_o: \Sigma\beta_i\mu^{(i)} = \mu_0$ When $\sum$ is unknown.

Unit V

Test for dispersion matrix of p- variate Normal distribution (All Asymptotic tests)

(a) $H_o: \sum = \sum_0$
(b) $H_o: \sum_1 = \sum_2$
(c) $H_o: \mu = \mu_o$ and $\sum = \sum_0$
(d) First principal component and its variance –Extraction method.

(For the candidates admitted from 2012-2013 onwards)

Core Course - VIII **STATISTICAL ESTIMATION THEORY**

(III SEMESTER) P.Code :

Unit I

Criteria of Point Estimation – Standard parametric models of distributions. Consistent estimation of real valued parameters. Invariance of consistent estimators. Unbiasedness, Sufficiency, Neyman Factorization criterion, Exponential families, distribution admitting sufficient statistics.

Unit II

Completeness, Bounded completeness, Minimal Sufficient statistics, method of constructing minimal sufficient statistics- minimum variance unbiased estimators. Rao - Blackwell theorem, Lehmann- Scheffe theorem.

Unit III

Necessary and sufficient condition for UMVUE-Inequality approach to UMVUE-Fisher measure of Information. Cramer-Rao Inequality. Different forms of Cramer-Rao Inequality. Chapman – Robbins bound. Efficiency of an estimator-Extension of Cramer-Rao Inequality. Bhattacharya bound.

Unit IV

Method of Maximum Likelihood Estimation. Cramer and Huzurbazar theorem Solution of likelihood equations – Method of scoring – Method of minimum variance bound estimation – Method of moments. Interval estimation – confidence level, construction of confidence intervals using pivots, shortest length confidence interval.

Unit V

Bayesian Inference – Bayes theorem – concepts of prior distribution and its classification – Posterior distribution. Bayes estimation – Bayes estimates for Binomial, Poisson and Normal distribution using conjugate priors (Sec 3.4, 4.3, 6.8).

Books for study and reference:

1. Rohatgi. V.K. (1988) **An Introduction to Probability and Mathematical Statistics**, Wiley Eastern Ltd, New Delhi.
2. Kale. B.K. (1999) **A First Course on Parametric Inference**, Narosa publishing House.
3. Lehmann. E.L. (1983) **Theory of Point Estimation**, John Wiley, NewYork.
4. Cassella and Berger. (2002) **Statistical Inference**, Thompson, New Delhi.
5. Radhakrishna Rao.C. (1973) **Introduction to Linear Statistical Inference and its Applications,** Wiley Eastern.
6. Bansal. A.K. (2007) **Bayesian parametric Inference,** Narosa publishing House, New Delhi.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Course–IX **DESIGN AND ANALYSIS OF EXPERIMENTS**

(III SEMESTER) P.Code :

Unit I

Linear models- Estimability of linear parametric functions-Generalized Gauss-Markov theorem on linear estimation (BLUE) –Fixed, mixed and random effect models-ANOVA for one-way and two-way classified data – ANOCOVA for one-way and two-way classification with one concomitant variable.

Unit II

Introduction to designed experiments – Efficiency of CRD,RBD & LSD– Missing plot techniques for RBD and LSD with one (or) two missing observations – Need and scope of Split-plot design, Strip-plot design and their analysis – SPD as main effect confounded design.

Unit III

General factorial experiments-analysis of symmetrical 2^n ($n \leq 5$),3^n ($n \leq 3$), and asymmetrical (p x q) factorial – construction and analysis of confounded (complete and partial) symmetrical factorial – Fractional replication in symmetrical factorial ½ (2^5), ½ (2^6)

Unit IV

General block designs- concepts of connectedness, balancedness and orthogonality. – BIBD and its parametric relations – Information (C) matrix and criteria for connectedness of block designs - Intra and Inter block analysis of BIBD – Youden square design and its intra block analysis.

Unit V

PBIBD with 'm' associate classes – classifications and parametric relations of PBIBD(2) – Intra block analysis of PBIBD(2) – Need and scope of response surface experiments- applications of experimental designs to quality management technique.

Books for study and reference:

1. Joshi. D.D. (1987) **Linear Estimation and design of Experiments**, Wiley Eastern.
2. Das. M.N and Giri.N.O. (1979) **Design and Analysis of Experiments,** Wiley Eastern.
3. Montgomery. D.C.(1994) **Design and Analysis of Experiments,** 3rd edition, John Wiley.
4. Agarwal. B.L. (2010) **Theory and Analysis of experimental Designs,** CBS Publishers,
5. Anderson & Mclean. (1974) **Design of experiments : A realistic approach,** Marcel Dekker, I.C.
6. Cochran & Cox. (1992) **Experimental Designs,** 2nd edn, John Wiley & Sons.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core course X

TESTING STATISTICAL HYPOTHESES

(IV SEMESTER) P.Code:

Unit I

Test of Hypotheses. Concepts of testing hypotheses. Non-Randomized and randomized test- Critical region, Test function, Two types of errors, Level of significance, Size of the test, Power function. MP test - Neyman - Pearson fundamental Lemma.

Unit II

UMP test, MLR property, UMP tests for one sided test in one parameter exponential and MLR family of distributions .Non existence of UMP test for simple hypotheses against two sided alternatives in one parameter exponential family.

Unit III

Generalized Neyman - Pearson fundamental Lemma (statement only).UMP test for two sided alternatives in one parameter exponential family .Unbiased test, UMP unbiased test, Similar test , Neyman Structure test, Likelihood Ratio test (Concepts & properties).

UNIT IV

Sequential Probability Ratio Test- Optimum properties of the SPRT- The Fundamental Identity of Sequential analysis, OC and ASN function of sequential plans. Simple examples

UNIT V

Non-parametric test; Empirical distribution, Kolmogorov – Smirnov goodness of fit for one sample and two sample problems, Sign test, Run test, Wilcoxon Signed- Rank test, Median test, Mann- Whitney U test.

Books for study and reference:

1. Rohatgi.V.K. (1988) **An Introduction to Probability and Mathematical statistics**, Wiley Eastern Ltd, New Delhi.

2. Kale. B.K. (1999) **A First course on parametric inference**, Narosa publishing house.

3.Lehman. E.L. (1986) **Testing Statistical Hypotheses**, John Wiley and sons.

4. Rao.C.R. (1985) **Linear Statistical Inference and its Applications**, Wiley Eastern Ltd.

5. Casella and Berger. (2002) **Statistical inference**, Thompson, New Delhi.

6. Conover. (1980) **Practical Non-parametric statistics,** 2nd edition, John Wiley & Sons.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Core Practical CP03

PRACTICAL – III

P.Code:

(Based on papers: Statistical Estimation Theory, Design of Experiments and Statistical Quality Control)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-III examination should be conducted at the end of IV Semester.

Unit I

(a) UMVUE in one parameter exponential family of distributions.

(b) ML estimation method. (c) Method of moments.

Unit II

Interval estimation based on the following distributions.

(a) Normal (b) t (c) χ^2 (d) F

Unit III

(a) Statistical Analysis of RBD with two observations missing.

(b) Statistical Analysis of LSD with two observations missing.

(c) Statistical Analysis of covariance with one concomitant variable in CRD Layout.

(d) Statistical analysis of covariance with one concomitant variable in RBD Layout.

(e) Statistical analysis of SPD with RBD layout for both Main plot and sub plot treatments.

UNIT IV

(a) Statistical analysis of 2^2,2^3 and 3^2 factorial experiments

(b) Statistical analysis of completely confounded designs (2^2,2^3 and 3^2)

(c) Statistical analysis of partially confounded designs (2^2,2^3 and 3^2)

(d) Statistical analysis of BIBD (intra block analysis only)

Unit V

(a) Construction of moving average control chart.

(b) Construction of EWMA control chart.

(c) Acceptance sampling plan for variables – construction of one sided, two sided procedure schemes, known and unknown sigma plans – O.C.curves.

(For the candidates admitted from 2012-2013 onwards)

Core Practical CP04

PRACTICAL – IV

P.Code :

(Based on papers: Testing Statistical Hypotheses and Operations Research)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-IV examination should be conducted at the end of IV Semester.

Unit I

(a) **Most powerful test** –Binomial, Normal, Exponential.
(b) **UMP test** - One sided –Normal, Exponential, and two sided Bernoulli.
(c) **UMPU test** - Binomial, Normal, Exponential.

Unit II

Sequential Probability Ratio Test (SPRT)

(a) Bernoulli. (b) Normal (c) Exponential

Unit III

Nonparametric tests.

(a) Sign test (b) Run test (c) Median test
(d) Wilcoxon Signed-Rank test (e) Mann-Whitney U test.
(f) Kolmogorov -Smirnov (one sample and two samples) test.

Unit IV

(a) Net work Diagram Construction
(b) CPM method (c) PERT method

Unit V

(a) Integer programming problem:

(1) Pure and Mixed.
(2) Gomory's cutting plane method.

(b) Quadratic Programming Problem:

(1) Wolfe's modified simplex method

(2) Beale's method.

Core Project	**PROJECT WORK**	P.Code :

Project/Dissertation work shall be carried out under the supervisor of a Faculty member on the recommendation of the Head of the Department. **Three copies** of the Project report should be submitted at least two weeks before the last working day of the fourth semester. The Marks for the Project work is 100 and the components are:

Internal Assessment: : 40 Marks
(For two reviews 20+20 = 40)

Evaluation of Project report by External Examiner and Supervisor : 40 Marks

Viva-Voce by External Examiner and Supervisor : 20 Marks

The Evaluation of the Project will be based on Project Report and a VIVA-VOCE examination to be conducted by the Supervisor and an External Examiner.

(For the candidates admitted from 2012-2013 onwards)

Elective - I **STATISTICAL QUALITY CONTORL AND OPERATIONS RESEARCH**

(III SEMESTER) P.Code :

Unit I

Statistical process control : Moving average control chart – EWMA control chart – CUSUM control chart – two sided and one sided procedures – V – mask technique – Tabular Cusum and decision interval. Economic design of $\overline{X}$ -chart – single assignable cost model only.

Unit II

Acceptance sampling plan for variables, advantages and disadvantages single sample plans – one sided and two sided specifications – known and unknown sigma. Continuous sampling plans – CSP-1, CSP-2 and CSP-3 - properties – statement only.

Unit III

Integer programming problem – all integer programming – mixed integer programming – Gomory's cutting plane method – Branch and Bound method.

Unit IV

Non-linear programming problem. Unconstrained optimization – single variable function – multivariable function. Constrained multivariable optimization with equality and inequality constraints. Lagrangian method – Khun – Tucker conditions. Quadratic programming problem (QPP) – Wolfe's modified simplex method – Beale's method.

Unit IV

Dynamic programming problem – Characteristics of DPP – Bellman's principles of optimality – General algorithm – Stage coach problem – Cargo loading model – Work force size model – Investment model – LPP as DPP.

Books for study and reference:

1. Montgomery. D.C. (2005) **Introduction to Statistical Quality Control,** 5th edn. John Wiley

2. Duncan. A.J. (1986) **Quality Control and Industrial Statistics**, Irwin Homewood

3. Grant., E.L. and Leavenworth.R.S. (1980) **Statistical Quality Control,** McGraw Hill

4. Taha. H.A. (1999) **Operational Research: An Introduction**, Prentice Hall India.

5. Sharma. J.K. (2002) **Operations research**, Mac Millan.

6. Rao. S.S. (1992) **Optimization Theory &Applications**, Wiley, New Delhi.

QP Pattern : Unit wise internal choice with maximum 75 marks

Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Elective - II

STOCHASTIC PROCESSES
(III SEMESTER) P.Code :

Unit I

Introduction to stochastic process (SP) – classification of SP according to state space and time domain. countable state markov chain (MC). Chapman- kolmogorov equations. Calculation of 'n' step transition probability.

Unit II

Discrete state space – continuous time MC. Kolmogorov differential equations. Poisson process, birth and death process .Application to queues and storage problem. Random walk – Wiener process as a limit of random walk, first passage time.

Unit III

Markov process – continuous time and continuous state space - time homogenous markov process – kolmogorov's equation. Diffusion process with Wiener process.

Unit IV

Stationary process and time series- wide sense and strict sense stationary process – moving average and auto regressive process. Covariance function - Bochner's function (statement), Khintchine's representation of wide sense stationary process, spectral decomposition for weakly stationary process.

Unit V

Renewal theory – renewal function and its properties – Elementary and key renewal theorems.

Books for study and Reference:

1. Medhi.J. (1982) **Stochastic process**, Wiley Eastern.
2. Basu. A.K. (2003) **Introduction to stochastic processes,** Newsa Publishing House.
3. Ross. S.M. (1983) **Stochastic Process,** Wiley, New York.
4. Karlin and Taylor.H.M. (1975) **First course in Stochastic Process**-Vol.I&II, Academic Press.
5. Bhat. B.R. (2000) **Models :Analysis and Applications**, New age International, India.
6. Feller. W. (1968) **Introduction to Probability and Applications**, Wiley Eastern Company

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Elective - III

RELIABILITY THEORY
(IV SEMESTER) P.Code :

Unit I

Reliability: Definition-applications- components and systems-reliability function –Cumulative distribution function-failure rate function-hazard rate function-reliability in terms of hazard rate and failure rate density-Bath tub curve-conditional reliability-Reliability measures: mean time to failure, variance of failure distribution, median time to failure and mode life to failure. Simple problems.

Unit II

Life time distributions: Exponential failure model-derivation- properties-estimation of mean life with complete samples-reliability estimation-UMVUE estimators-Two parameter exponential model -estimation of mean life and reliability estimation with complete samples.

Unit III

Two parameter gamma and two parameter weibull distributions-estimation of parameters and reliability estimation with complete samples by MLE method and method of moments- reparametrization of weibull distributions.

Unit IV

System reliability: series, parallel, parallel-series and series-parallel configurations. k out of n systems. Two component system reliability by markov analysis. System of components- Coherent structure and their representation in terms of paths and cuts. Modules of coherent system. Simple problems.

Unit IV

Reliability of coherent systems –reliability of independent components-association of random variables-bounds on system reliability – improved bounds on system reliability under modular decomposition. Shape of the reliability function.

Books for study and reference:

1.Charles.E.Ebling.(2000) **An Introduction to Reliability and maintainability engineering.** Tata McGraw Hill, New Delhi. (**For Unit-I**)

2.Sinha.S.K. and Kale. S.K.(1980) **Life Testing and Reliability Estimation**, Wiley Eastern (**For Units II and III**)

3.Barlow.R.E. and Proschen.F.(1975) **Statistical Theory of Reliability and Life testing**, Halt, Reinhart and Winston Inc.(**For Units IV and V**).

4.Balagurusamy.E. (2002) **Reliability Engineering**, Tata McGraw Hill.

5.Bain.L.J. and Engelhardt. (1991) **Statistical analysis of Reliability and life testing Models,** Marrcel Deckker.

6. Veerarajan.T. (2003) **Probability, Statistics and Random Processes**, Tata McGraw Hill, New Delhi.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Elective-IV **APPLIED REGRESSION ANALYSIS**
(IV SEMESTER) P.Code :

Unit – I

Multiple Linear Regression. Estimation of Model parameters. Least square estimation of the regression coefficients-properties of least square estimators. Maximum likelihood estimation-Tests for the significance of regression- test on individual regression coefficients –Confidence interval on the regression coefficients- Confidence interval estimation of mean response-Prediction –Standard regression coefficients-Unit normal scaling-Unit length scaling.

Unit – II

Residual analysis. Definition and properties of residuals-methods of scaling residuals-Residual plots- PRESS statistic- formal test for lack of fit. Variance -Stabilizing transformation-transformations to linearize models-Generalized and weighted least squares. Indicator variables-concept and use.

Unit – III

Model building problem-variable selection-Stepwise regression methods. Multicollinearity - sources and effects of multicollinearity –Diagnostics and methods for detecting multicollinearity.

Unit – IV

Polynomial regression. Polynomial model in one variable. Piecewise Polynomial fitting (Splines) - Non parametric regression. Kernel regression –Locally Weighted regression. Polynomial model in two or more variables.

Non-linear regression-nonlinear least square-transformation to linear model-parameter estimation.

Unit – V

Generalized Linear Models (GLM). Logistic regression-Estimation of parameters in logistic regression models-Interpretation of parameters in logistic regression models. Poisson regression-GLM-link function and linear prediction- parameter estimation in GLM.

Books for study and reference:

1. Montgomery. D.C. Peck E.A. Vining. G.G. (2003) **Introduction to Linear Regression Analysis,** John Wiley &sons, Inc, New York. (chapters 1,2,3,8,9,11).
2. Draper. N.R. and Smith. H. (1998) **Applied regression Analysis,** John Wiley
3. Chaterjee. et all (1977) **Regression Analysis by example,** John Wiley.
4. Maddala. (1977) **Econometrics,** McGraw Hill.
5. Johnston. (1972) **Econometrics,** McGraw Hill.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Elective-V **STATISTICAL COMPUTING**

(Java Programming) P.Code :

Unit I

Object Oriented Programming (OOP): Basic concepts- benefits and application of OOP-History of Java-features – Java environment-API. Program structure-statements-tokens-Implementing a Java program- Java Virtual Machine-Command line arguments Constants-variables-data types-operators and expressions.

Unit II

Control statements: if and its variants- switch statement-?operator. Loops: while, do and for statements. Jumps in loops and labeled loops.

Unit III

Classes-adding variable-adding methods-creating objects-accessing class members-constructors-methods overloading-static members-nesting of methods-Inheritance and its types-overriding methods-final variable, methods and classes-abstract methods and classes. Arrays-Strings-Vectors.

Unit IV

Interfaces-defining, extending and implementing interfaces. Packages- creating accessing and using a package. Type of errors- Exceptions- try, catch and finally statements. Applets-types - building applet code-applet life cycle-creating an executable applet.

Unit V

Writing programs In Java: Matrix operations-addition, product and inverse. Arranging observations in increasing and decreasing order. Computation of mean, median, variance, skewness and kurtosis of raw data. t-test. Chi-square test for independence of attributes. ANOVA for one-way and two-way classifications.

Books for study and reference:

1. Balagurusamy.E.(2000) **Programming with JAVA**, Tata McGraw Hill, New Delhi.

2. Hubbard.R.(1999) **Theory and Problems of Programming with JAVA,** Schaum's Outline Series, McGraw Hill**, New York.**

3. Naughton. Patrick and Herbert Schmidt. (1996): **Java: The Complete Reference**, Osborne McGraw Hill.

QP Pattern : Unit wise internal choice with maximum 75 marks

Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Elective-VI

ECONOMETRICS

P.Code :

Unit I

Nature and scope of Econometrics: Production and cost analysis -price and income Elasticity of demand. Price Elasticity and supply – Torquivisits model of demand Inferior goods-Models building –Bias in construction of models.

Unit II

The General Linear Model (GLM) and its extension. Ordinary Least square (OLS) estimation and prediction .Generalized Least square (GLS) estimation and prediction and their properties – problem of hetroscedasticity and multicollinearity pure and mixed estimation .Grouping of observations and equations.

UnitIII

Single equation linear model –dynamic case; Autocorrelation and its consequences Testing for Autocorrelation; Theil's BLUS procedure .Estimation and Prediction Estimation of parameters of a linear model with auto correlated disturbances and distributed lag models – Errors in variable models.

Unit IV

Simultaneous linear equation model – Examples. Identification problem .Estimation Using LIM, Instrumental Variables. 2 –SLS methods.

Unit V

K class estimators; Full information Maximum Likelihood methods .3-SLS estimators- Simultaneous LSE and integrated LST methods .Monte Carlo studies and simulation –Concepts of structural change –Tests of structural change

Books for study and reference:

1.Johnston. (1984) **Econometrics models (3rd edition)**, McGraw Hill, Tokyo.

2.Intrulligator.M.D. (1980) **Econometric models :- Techniques and Applications**, Prentice Hall of India.

3.Walters. A. (1970) **An introduction to Econometrics** , McMillan & Co.

4. Gold Berger. (1964) **Econometric theory**, Wiley.

5. Allen. R.G.D. (1965) **Mathematical Economics**, McMillan & Co.

6. Maddala. (1977) **Econometrics**, McGraw Hill.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Extra Disciplinary Course -I **Elements of Operations Research**

P.Code :

Unit I

Operations Research: Introduction-Origin and development of O.R-Definition and Applications of O.R. – Models in O.R.-classification of models-advantages and limitations of models. General solution for O.R models. Methodology of O.R.

Linear programming problem. Formulation of LPP.

Unit II

Graphical method of solving LPP. Simplex method –Big M method. Concept of duality in LPP. Formulation of dual problems only.

Unit III

Transportation problems: Finding initial basic feasible solution-test for optimality by MODI method. Assignment Problem: Hungarian method of solving A.P. Maximization in Assignment problem.

Unit IV

Sequencing: problem of sequencing- basic terms used in sequencing- processing 'n' jobs through two machines- processing 'n' jobs through 'k' machines- processing two jobs through 'k' machines.

Unit V

Game Theory: Definition-types of games- The Maximin - Minimax principle. Games without saddle points (mixed strategies)-graphical method of 2 x n and m x 2 games - Dominance property.

Books for study and Reference:

1. Kanti Swarup. (2007) **Operations Research,** Sultan Chand & Sons, New Delhi.

2. Sharma. J.K. (2002) **Operations Research**, McMillan & co.

3. Kalavathy.S. (2002) **Operations Research,** Vikas Publishing House, New Delhi.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

Extra Disciplinary Course –II **Statistical Methods**

P.Code :

Unit I

Definition of Statistics and its applications in various disciplines. Collection of data. Classification, tabulation and graphical representation of data. Construction of univariate and bivariate frequency distributions. Charts and Diagrams: bar diagram, Pie diagram. Histogram, frequency and cumulative frequency curves.

Unit II

Measures of central tendency: concept and uses. Mean, Median, Mode, Geometric Mean and Harmonic mean.

Measures of variation: concept and uses. Range, Quartile deviation, standard deviation and coefficient of variation. Measures of Skewness.

Unit III

Census and Sample surveys. Concept of sample and sampling-.Principles of sampling. Advantages and limitations of sampling. Random sampling: simple random sampling, Stratified random sampling. Systematic sampling and Cluster sampling.Non-random sampling: Quota sampling, convenience and Judgment sampling,snow ball sampling.

Unit IV

Simple linear correlation: meaning and its uses. Scatter diagram-Karl pearson product moment correlation-rank correlation.

Simple linear regression: meaning and its uses. Difference between correlation and regression. Regression equations.

Unit V

Definition and utility of Time series analysis. Components of Time series.

Measurement of Trend: Method of moving averages and Method of Least Squares.

Measurement of Seasonal variations: Method of Simple averages and Method of Link relatives.

Books for study and Reference:

1. Gupta. S.P. (2007) **Statistical Methods**, Sultan Chand & Sons, New Delhi

2. Agarwal.D.R. (2003) **Quantitative Methods**, Virinda Publications, New Delhi.

3. Richard Levin. (2000) **Statistics for Management**, Prentice Hall India.

QP Pattern : Unit wise internal choice with maximum 75 marks
Part A : 5 x 5 = 25 & Part B : 5 x 10 = 50

(For the candidates admitted from 2012-2013 onwards)

MODEL QUESTION PAPER

M.Sc, DEGREE EXAMINATION

BRANCH II - STATISTICS

First Semester

Core IV - SAMPLING THEORY AND METHODS

Time :Three hours **Maximum:75 marks**

PART A - (5 x 5 = 25 marks)

Answer ALL questions.

All questions carry equal marks.

1. (a) Mention the important steps involved in drafting a questionnaire.

Or

(b) What is meant by non-response? Write down its types.

2. (a) In SRSWOR, show that the sample mean square is an unbiased estimate of the population mean square

Or

(b) Explain circular systematic sampling.

3. (a) Explain separate and combined regression estimators.

Or

(b) Define multivariate ratio estimator.

4. (a) Explain Lahiri's method of selecting sample under PPSWR scheme.

Or

(b) Derive Horwitz-Thompson estimator for population total.

5. (a) Describe the sub sampling procedure.

Or

(b) In double sampling for stratification, show that the sample mean is an unbiased estimate of the population mean

PART B - (5 x 10 = 50 marks)

Answer ALL questions.

All questions carry equal marks.

6. (a) Explain the principal steps involved in sample survey?

Or

(b) Derive Warner's model in randomized response technique.

7. (a) If f.p.c is ignored, then show that

$V_{opt} < V_{prop} < V_{rand}$

Or

(b) Compare systematic sampling with stratified and simple random sampling when the population consists of linear trend.

8. (a) Define ratio estimator. Derive the variance of the ratio estimator and also obtain its relative bias.

Or

(b) Obtain an unbiased estimate of population mean and its variance in cluster sampling.

9. (a) Define Desraj's ordered estimator. Also derive the expression for the variance of the estimate of the population total.

Or

(b) In the case of pps sampling with replacement, obtain an unbiased estimator of the population total and variance of the estimator.

10. (a) Suggest an estimator for population mean in two stage sampling and obtain its variance.

Or

(b) Discuss double sampling for stratification and derive the standard error of estimate.