SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF STATISTICS
(Common for CBCS and non CBCS)
(Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the Academic Years 2015-16 for I and II Semesters and 2016-17 for III and IV Semesters)

M.Sc. STATISTICS

SCHEME OF INSTRUCTION AND EXAMINATION

Sem	Course Code	Title of the Course	Core/ Elective	No. of Credits	IA	SEE	Total Marks
I	ST 101	Mathematical Analysis	Core	4	30	70	100
	ST 102	Linear Algebra	Core	4	30	70	100
	ST 103	Probability Theory	Core	4	30	70	100
	ST 104	Distribution Theory	Core	4	30	70	100
	ST 105	Statistical Computing	Core	4	30	70	100
	ST 106	Practical-1(75 practical +25 Record)	----	4		100	100
II	ST 201	Statistical Inference-I	Core	4	30	70	100
	ST 202	Multivariate Analysis	Core	4	30	70	100
	ST 203	Linear Models and Applied Regression Analysis	Core	4	30	70	100
	ST 204	Stochastic Processes	Core	4	30	70	100
	ST 205	Sampling Theory	Core	4	30	70	100
	ST 206	Practical-1(75 practical +15Viva-voce+10 Record)	----			100	100
	ST 207	Human Values and Professional Ethics – I		4		70	100
III	ST 301	Statistical Inference-II	Core	4	30	70	100
	ST 302	Design and Analysis of Experiments	Core	4	30	70	100
	ST 303	Theory of Econometrics	Core	4	30	70	100
	ST 304	Operations Research-I	Core	4	30	70	100
	ST 305	Statistical Process and Quality Control	Core	4	30	70	100
	ST 306	Practical-III (75 practical +25Record)	--	---	---	100	100
	ST 307	Simulation techniques	IE	4	30	70	100
	ST 308	Actuarial Statistics	IE	4	30	70	100
	ST 309	Statistics for Biological and Earth Sciences	EE	4	30	70	100
	ST 310	Statistics for Social and Behavioural Sciences	EE	4	30	70	100

IV	ST 401	Time series Analysis and Forecasting Methods	CORE	4	30	70	100
	ST 402	Demography and Official Statistics	CORE	4	30	70	100
	ST 403	Opeations Research-II	CORE	4	30	70	100
	ST 404	Computer Programming and Data Analysis	CORE	4	30	70	100
	ST 405	Biostatistics	CORE	4	30	70	100
	ST 406	Practical-IV(75practical+15 Viva-voce+10Record)	-----	4	30	100	100
	ST 407	Total Quality Management	IE	4	30	70	100
	ST 408	Statistical Data Mining Methods	IE	4	30	70	100
	ST 409	Generalized Linear Models	SSC	4	30	-	100
	ST 410	Statistics for Research, Industry and Community Development	SSC	4	30	-	100
	ST 411	Realiability Theory and Survival Analysis	SSC	4	30	-	100
	ST 412	Human Values and Professional Ethics – II	CORE	4	30	70	100

Total Mandatory Credits:96 IE:Internal Elective,EE: ExternalElective,SSC:Self-Study Course

IA: Internal Assessment for Non-CBCS Students 20 80 100

SEMESTER-I

ST 101: MATHEMATICAL ANALYSIS

Unit-I: Real numbers; Bounded and unbounded Sets; Supremum and Infimum; Completeness in R; Open and closed sets; Countable sets; Bolzano-weierstrass theorem; Heine-Borel theorem, Uniform continuity.

Unit-II: Sequences: convergence of sequences; limits, inferior and superior; Cauchy sequences; Sandwich theorem; uniform convergence of sequences. Series: convergence of series; comparison tests for series. uniform convergence of series, Power series.

Unit-I11: Reimann Integration; mean value theorems of integral calculus; concepts of Reimann-Stieltjes integral and Improper integrals; Double and Triple integrals; Gamma and Beta integrals.

Unit-IV: Review of complex number systems, analytic functions and their properties, complex integration, Cauchy's theorem, integral formula, Taylor's and Laurant's series, singularities, residues, Cauchy residue theorem.

References:

1.Malik,S.C. (1985), Mathematical Analysis (Second Edition); New Age International Pvt. Limited, New Delhi.

2.Apostol, T. M. (1985), Mathematical Analysis, Narosa Publishers, New Delhi.

3.Narayan, S.(1985) , A course of Mathematical Analysis, S.Chand & Company, New Delhi.

4.Royden, H.L.(1988), Real Analysis, 3rd Edition, MacMillan, New York.

5.Rudin Walter (1976), Principles of Mathematical Analysis, 3rd Edition, McGraw Hill, New York.

6.Chaudhary B (1983): The elements of complex analysis, Wiley Eastern.

7.Curtiss J.H (1978): Introduction to the functions of complex variables, Marcel Dekker.

ST 102: LINEAR ALGEBRA

Unit-I: Algebra of matrices; Elementary transformations; Rank and Inverse of a matrix; Nullity; Partitioned matrices; Kronecker product; Generalized inverse of matrix; Moore-Penrose generalized inverse; Solutions of simultaneous equations.
Unit-II: Finite dimensional Vector Spaces; Vector Spaces and Subspaces; Linear dependence and independence; Basis and dimension of a vector space; Completion theorem; Inner product Spaces; Orthonormal basis and Gram-Schmidt orthogonalization process; Orthogonal projection of a vector.
Unit-III: Linear transformations and properties; Orthogonal and unitary transformations; Real quadratic forms; Reduction and classification of quadratic forms; Hermitian forms; Sylvesters law of inertia; Canonical reduction of quadratic form.
Unit-IV: Characteristic roots and vectors; Cayley – Hamilton theorem; Minimal polynomial; Similar matrices; Spectral decomposition of a real symmetric matrix; Reduction of a pair of real symmetric matrices; Hermitian matrices.

References

1.Graybill, F.A. (1983). Matrices with applications in statistics, 2nd ed. Wadsworth, Belmont (California).
2.Rao, C. R. (1985). Linear statistical inference and its applications, Wiley Eastern Ltd., New Delhi.
3.Searle, S. R. (1982). Matrix Algebra useful for Statistics, John Wiley and Sons. Inc.
4.Bellman, R. (1970), Introduction to Matrix Analysis, 2nd ed. McGraw Hill, New York.
5.Campbell, H.G. (1980), Linear Algebra with Applications, 2nd Edition, Prentice-Hall, Englewood Cliffs (new Jersey), 1980.
6.Biswas, S. (1984), Topics in Algebra of Matrices, Academic Publications.
7.Hadley, G. (1987), Linear Algebra, Narosa Publishing House.
8.Halmos, P.R. (1958), Finite-dimensional Vector Spaces 2nd ed. D.Van Nostrand Company, Inc.
9.Hoffman, K. and Kunze, R, (1971). Linear Algebra, 2nd ed., Prentice Hall
10.Rao, A.R. and Bhimasankaram, P. (1992), Linear Algebra, Tata McGraw Hill Publishing Company Ltd.
11.Rao, C.R. and Mitra, S.K. (1971), Generalized Inverse of Matrices and its Applications, John Wiley and Sons, Inc.
12.Narayan, S. (1970), Theory of Matrices, S. Chand &Company, New Delhi.

ST 103: PROBABILITY THEORY

Unit-I: Classes of sets, fields, σ -fields, minimal σ -field, Borel σ – field in R^K, sequence of sets, limsup and liminf of a sequence of sets. Measure, Probability measure, properties of a measure, Caratheodory extension theorem (statement only), Lebesgue and Lebesgue-Stieltjes measures on R^K.
Unit-II: Measurable functions, Random variables, sequence of random variables, almost sure convergence, convergence in probability (and in measure). Integration of a measurable function with respect to a measure, Monotone convergence theorem, Fatou's lemma, Dominated convergence theorem.
Unit-III: Expectation of a random variable, inequalities on expectations, Markov, Holder, Jensen and Liapiunov inequalities. Borel- Cantelli - Lemma, Independence, Weak law and strong law of large numbers for iid sequences, Chebyshev's theorem, khinchine's theorem, Kolmogorov theorems (statements only).

Unit-IV: Convergence in distribution, theorem (statement only), CLT for a sequence of independent random variables under characteristic function, uniqueness theorem, CLT for iid random variables, Lindberg-Levy Central limit theorem; Liapounov theorem (statements only).

References:

1.Ash, Robert. (1972). Real Analysis and Probability. Academic Press.
2.Billingsley, P. (P. (1986) Probability and Measure. Wiley.
3.Dudley, R.M. (1989). Real Analysis and Probability, Wadsworth and Brooks/Cole.
4.Kingman, J F C and Taylor, S. J. (1966). Introduction to Measure and Probability. Cambridge University Press.
5.Loeve, M (1963), Probability theory
6.Bhatt B.R (1998), Modern Probability theory, Wiley Eastern
7.Mukhopadhyay, P.(2002), Mathematical Statistics, Books& Allied (p) Ltd., Kolkata.

ST 104: DISTRIBUTION THEORY

Unit-I: Brief review of basic distribution theory, joint, marginal and conditional p.m. functions and p.d. functions. Rectangular, lognormal, exponential, gamma, beta, Cauchy, Laplace and Weibull distributions. Functions of random variables and their distributions using Jacobian of transformations and other tools.

Unit-II: Sampling distributions: central Chi Square, t and F distributions and its properties, applications, relation between t and F, F and χ^2; Fisher's Z-distribution, fisher's Z-transformation. Non-central chi-square, t and F distributions and their properties.

Unit-III: Order statistics and their distributions, joint and marginal distributions of order statistics, distribution of range. Extreme values and their asymptotic distributions.

Unit-IV: Multiple and partial correlation coefficients, multiple linear regression, inter relationship among partial and multiple correlation and regression coefficients. Null distributions of simple, partial and multiple correlation coefficients. Compound binomial distribution and compound Poisson distribution.

References:

1.Dudewicz E.J and Mishra S.N (1988): Modern Mathematical Statistics, Wiley, International Students Edition.
2.Rohatgi V.K. (1984): An Introduction to probability theory and mathematical statistics.
3.Rao C.R (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.
4.Pitman J. (1993): Probability, Narosa Publishing House.
5.Johnson, N.L and Kotz, S.M. (1972): Distributions in Statistics, Vol. I , II & III. Houghton and Miffin.
6.Yule, U and M.G. Kendall: An introduction to the theory of Statistics.
7.David H.A (1981): Order Statistics, II Edition, and John Wiley.
8.Feller W (1966): Introduction to probability theory and its applications, Vol. III, second edition. Wiley Eastern.
9.S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics. Sulthan and Chand Company.
10.Mukhopadhyay, P(2002), Mathematical Statistics, Books and Allied (p) Ltd., Kolkata.

ST 105: STATISTICAL COMPUTING

Unit-I: Programming in C: Identifiers and Key words, data types and their declaration. Data input and output, operators and expressions. Control statements, if, if-else, case, go to statements. Loops, while, do-while and for statements. One and two-dimensional arrays. Concept of structures, Unions and pointers. Simple programs.

Unit-II: Structure of C++ program, Concept of OOP, tokens, key words, data types, dynamic initialization, manipulators, operator overloading. Function prototyping, inline functions, friend function and virtual functions with examples. Data binding using class, creating objects, defining member functions with simple examples. The concept of inheritance and polymorphism. Dynamic memory allocation and processing of linked lists.

Unit-III: Review of Excel, sorting, filtering and construction of charts. Curve fitting and interpretation of the output. Statistical functions in Excel - Calculating theoretical probability using Binomial, Poisson and Normal distributions. Matrix operations- Transpose, Product and Inverse operations using Excel. Pivot tables and look up functions.

Unit-IV: Data bases using MS-Access – working with tables and forms. Various types of queries – make table, update, crosstab and delete quires and their SQL code. Creating reports using Access. Crystal reports tool - standard and cross tab reports using Access and Excel data. Group expert, sort expert, select expert and section expert. Running totals and formulas. Simple statistical charts like Bar graph and Pie Diagrams.

References

1.Balaguruswamy, E (2007), Programming in ANSI C, 4E, Tata Publishing McGraw-Hill Publishing Ltd.

2.Balaguruswamy, E (1998), Object Oriented Programming with C++, Tata Publishing McGraw-Hill Publishing Ltd.

3.Ravi Chandran. D (2002), Programminig with C++, Tata Publishing McGraw-Hill Publishing Ltd.

4.Sarma K.V.S. (2010), Statistics Made Simple Do it Yourself on PC, Prentice Hall.

SEMESTER – II

ST 201: STATISTICAL INFERENCE – I

Unit-I: Point estimation: Properties of good estimators: Unbiasedness, Consistency, Efficiency and Sufficiency; Fisher-Neyman factorization theorem, complete sufficient statistic, mean square error (MSE), minimum MSE estimator, minimum variance unbiased estimator (MVUE), Cramer - Rao inequality, Battacharaya's inequality, Rao – Backwell theorem.

Unit-II: Exponential families, Methods of estimation: Maximum Likelihood Estimation method, method of moments, method of minimum Chi – Square, interval estimation, shortest confidence interval.

Unit-III: Tests of hypotheses: Basic concepts, Most Powerful (MP) test, Neyman – Pearson Lemma, MP test for simple hypothesis, Consistency and Unbiased tests, Uniformly Most Powerful (UMP) test, UMP Unbiased tests, similar critical regions, Lehmann – Scheffe theorem.

Unit-IV: Likelihood Ratio Tests, Asymptotic Distribution of LR test, Bartlet's test for homogeneity of variances, Wald Test, Non – Parametric tests of significance: Sign Test, Wilcoxon – Mann _Whitney U – test, Run test, Kolmogorov – Simrnov one and two sample tests, Median test, Kendall's τ test.

References:
1.Kale, B.K (1999): A First Course in Parametric Inference, Narosa Publishing House
2.Rohtagi, V.K (1988): An Introduction to Probability and Mathematical Statistics, Wiley Eastern Ltd., New Delhi (Student Edition)
3.Rao C.R (1973), Linear Statistical Inference and its applications, (Revised Edition), Wiley Eastern
4.Lehmann, E.L (1986), Theory of point estimation, (Student Edition)
5.Lehmann, E.L (1986), Testing Statistical Hypothesis (Student Edition)
6.Zacks, S (1971), theory of Statisical Inference, John Wiley and Sons, New York
7.Gibbons, J.D (1985), Non-parametric statistical inference, 2nd Edition, Mercel Dacker Inc
8.Fraser D.A.S (1957), Non-parametric methods in Statistics, John Wiley & Sons
9.Siegal Sidney (1987), Non-parametric Statistics for behavioral sciences, 3rd Edition, Springer Verlog
10.Kendal, M.G and Stuart, A (1968), The advanced theory of statistics, Vol-II, Chales Griffin and Co., London

ST 202: MULTIVARIATE ANALYSIS

Unit-I: Multivariate normal distribution, marginal and conditional distributions, characteristics functions, Maximum likelihood estimators of parameters, distribution of sample mean vector and dispersion matrix, distribution of quadratic form in the exponent of the multivariate normal density.
Unit-II: Hotelling's T^2 and its applications – T^2 distribution, application of T^2 to single sample, two sample and multiple sample problems, optimum properties of T^2 test. Mahalobis D^2 statistic and its distribution, Multivariate Analysis of Variance (MANOVA) of one and two-way classified data.
Unit-III: Classification and discrimination: procedures for classification into two multivariate normal populations, Fisher's Discriminant function, classification into more than two multivariate normal populations, Wishart distribution and its properties, concept of sample generalized variance and its distribution.
Unit-IV: Principal Component Analysis – properties, method of extraction of principal components; Canonical variables and canonical correlations; Factor Analysis – mathematical model, estimation of factor loading, concept of factor rotation; Cluster Analysis – similarities and dissimilarities, Hierarchical clustering: single and complete linkage method.
References:
1.Anderson, T.W (1983), An introduction to Multivariate Statistical Analysis, Wiley, 2nd Edition.
2.Rao, C.R (1973), Linear Statistical Inference and its applications, 2nd edition, Wiley
3.Srivastava. M.S and Khatri, C.G (1979), An introduction to Multivariate Statistics, North Holland
4.Morrison,F(1985): Multivariate Statistical Methods, Mc Graw Hill Book Company.
5.Johnson A.R and Wishern, D.W (1996), Applied Multivariate Statistical Analysis, Prentice Hall of India
6.Sharma, S (1996), Applied Multivariate Techniques, Wiley
7.Krishisagar, A.M (1972), Multivariate Analysis, Marcel Dekker
8.K.C. Bhuyan(2005): Multivariate Analysis and its Applications, Central

ST 203: LINEAR MODELS AND APPLIED REGRESSION ANALYSIS

Unit-I: Two and Three variable Linear Regression models; General linear model: Assumptions; OLS estimation; BLUE; Tests of significance of individual regression coefficients; Testing the equality between two regressions coefficients; Test of significance of complete regression.

Unit-II: Criteria for model selection; Goodness of fit measures; R^2 and adjusted R^2 Criteria; C_p criterion; testing the general linear hypothesis; Chow test for Equality between sets of regression coefficients in two linear models; test for structural change; restricted least squares estimation; Generalized Mean Squared error criterion.

Unit-III: Non-normal disturbances and their consequences; test for normality; Jarque-Bera test; Shapiro-Wilk test, Minimum Absolute Deviation (MAD) estimation; Box-Cox transformations.

Statistical analysis of residuals, OLS residuals, BLUS residual, Studentised residual, Predicted residual, tests against heteroscadasticity.

Unit-IV: Non-Linear regression; Non linear least squares estimation; Maximum Likehood estimation; Idea of computational methods; Gradient methods, Steepest descent method and Newton-raphson method; testing general Nonlinear hypothesis; Wald test, Lagrange multiplier test and likelihood ratio Test. Robust , probit, binomial logistic ,multiple logistic regression.

References

1.Johnston, J (1984): Econometric Methods, III rd edition. MC Graw Hill.
2.Gujarathi, D (1979): Basic Econometrics, MC Graw Hill.
3.Judge, C.G., Griffiths, R.C.Hill, W.E ., Lutkephol, H and Lee, T.C (1985): The Theory and
4.Practice of Econometrics, John Wiley and Sons.
5.Draper, N and Smith, B (1981): Applied Regression Analysis, Second Edition

ST 204: STOCHASTIC PROCESSES

Unit-I: Introduction to stochastic processes (sp's): classification of sp's according to state apace and time domain. Countable state Markov chains (MC's), Chapman – Kolmogorov equations, calculation of n – step transition probability and its limit. Stationary distribution, classification of states,, transient MC, random walk and gambler's ruin problem.

Unit-II: Discrete state space continuous time MC: Kolmogorov – Feller differential equations, Poisson process, birth and death process; Applications to queues and storage problems. Wiener process as a limit of random walk, first – passage time and other problems.

Unit-III: Renewal theory: Elementary renewal theorem and applications. Statement and uses of key renewal theorem, study of residual life time process: weakly stationary and strongly stationary process; Moving averages and auto regressive process.

Unit-IV: Branching process: Galton – Watson branching process, probability of ultimate extinction, distribution of population size. Martingale in discrete time, inequality, convergence and smoothing properties. Statistical inference in MC and Markov process.

References:

1.Adke, S.R and Manjunath, S.M (1984): An Introduction to Finite Markov Processes, Wiley Eastern.
2.Bhat, B.R (2000): stochastic Models: Analysis and Applications, New Age International, India.
3.Cinlar, E (1975): Introduction to Stochastic Processes, Prentice Hall.
4.Feller, W (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern.

5.Harris, T.E (1963): The Theory of Branching Processes, Springer – Verlag.
6.Hoel, P.G., Port, S.C and Stone, J.C (1972): Introduction to Stochastic Processes, Houghton Miffin & Co.
7.Jagers, P (1974): Branching Process with Biological Applications, Wiley.
8.Karlin, S and Taylor, H.M (1975): A First Course in Stochastic Processes, Vol. 1, and Academic Press.
9.Medhi, J (1982): Stochastic Processes, Wiley Eastern.
10.Parzen, E (1962): Stochastic Processes, Holden – Day.

ST 205: SAMPLING THEORY

Unit-I: Review of basic concepts of sampling theory such as sampling design, sampling scheme, sampling strategy etc., Sampling with varying probability with and without replacement, PPS WR/WOR methods – Lahiri's sample scheme, Hansen – Hurwitz, Des Raj estimators for a general sample size and Murthy estimator for a sample of size 2, Symmentrized Des Raj estimator.
Unit-II: Hurwitz – Thompson estimator (HTE) of a finite population total / mean, expression for V(HTE) and its unbiased estimator. IPPS scheme of a sampling due to Midzuno – Sen and JNK Rao (sample size 2 only). Rao – Hartley-Cochran sampling scheme for a sample of size n with random grouping.
Unit-III: Ratio and Regression methods of estimation, Two stage sampling, Multi stage sampling, Cluster sampling. Resampling methods and its applications.
Unit-IV: Double sampling for difference, ratio, regression and PPS estimators; Large scale sample surveys, Errors in surveys, A mathematical model for errors of measurement, Sampling and Non-sampling errors, Sources and types of non-sampling errors, Remedies for non-sampling errors.

References:

1.Chaudhuri. A and Mukerji. R (1988): Randomized Response Theory and Techniques, New Yory, Marcel Dekker Inc.
2.Cochran W.G (1988): Sampling Techniques III Edition (1977) Wiley.
3.Des Raj and Chandak (1988): Sampling Theory. Narosa.
4.Murthy M.N (1977): Sampling Theory and Methods. Statistical Publishing Society.
5.Sukhatme et al (1984): Sampling Theory of Surveys with Applications. Iowa State University Press & IARS
6.Sing D and Chudary F.S (1986): Theory and Analysis of Sample Survey Designs. New Age International Publishers.
7.Hedayat A.S and Sinha B.K. (1991): Design and Inference in Finite Population Sampling. Wiley.
8.Mukhopadhyay P(1996): Inferential problems in Survey Sampling. New Age International.
9.Wolter K.M (1985): Introduction to Variance Estimator. Springer. Verlag.
10.Hansen M.M and Hurwitz W.M and Mandow W.G (1954): Sample Survey Methods and
11.Theory, Vol. I and Methods and Applications Vol. II, John Wiley and Sons.
12.Philli. I. Good (2013):Introduction to statistics through resampling methods and R, 2nd edition.

SEMESTER – III

ST 301: STATISTICAL INFERENCE-II

Unit-I: Concept of asymptotic relative efficiency, CAN, BAN, CAUN and BEST CAUN estimators, MLE in Pitman family and Double Exponential distribution, MLE in Censored Truncated distribution.

Unit-II: Statistical decision theory – decision problems and two person games, problems of inference viewed as a decision problems, non-randomized and randomized decision rules, Loss and Risk functions, admissibility, complete and essentially complete class, complete class theorem, Bayes principle, determination of Bayes rule, admissibility of Bayes rule.

Unit-III: Minimax principle, determination of minimax rule, minimax theorem, minimax and Bayes estimates of parameters of Binomial, Poisson and Normal distributions. Sequential decision rules.

Unit-IV: Sequential Analysis – Need for sequential procedures, sequential tests of Hypotheses, Sequential Probability Ratio Test (SPRT) and stopping rule principle. Wald's fundamental identity, OC and ASN functions for SPRT with reference to Binomial, Poisson and Normal distributions.

References:

1.C.R.Rao (1973), Linear Statistical Inference and its applications, 2nd Edition, Wiley Eastern Limited.

2.Ferguson, T.S (1967), Mathematical Statistics – a decision theoretic approach, Academic Press

3.Wald, A (1947), Sequential Analysis, Wiley

4.Rohatgi, V (1988), An introduction to probability and mathematical statistics, Wiley Eastern Limited, New Delhi (Student Edition)

5.Ghosh, B.K (1970), Sequential tests of statistical hypothesis, Addison-Wessly

6.Goon, A.M, Gupta, M and Das Gupta, B (1980), An outline of statistical theory, Vol-II, World Press, Calcutta.

7.Kale, B.K (1999), A first course in parametric inference, Narosa Publishing House

8.Lehman, E.L (1986), Testing sequential hypothesis (student edition)

9.Mukhopadhyay, P. (2002), Mathematical Statistics, Books and Allied (P) Ltd., Kolkata.

ST 302: DESIGN AND ANALYSIS OF EXPERIMENTS

Unit-I: Linear Model; Estimability of linear parametric functions; BLUE, Gauss-Markoff theorem; Generalized Gauss-Markoff theorem, ANOVA model, ANOVA for Two way and three way classifications, ANCOVA technique for one way and two-way classifications. Multiple comparisons tests using Tukey's, Duncans, Sheffe's and Dunnet's tests.

Unit-II: Latin squares and their construction, Mutually orthogonal Latin squares; Missing plot technique in Latin square Design, Graeco-Latin square Design; Analysis of Factorial Experiments involving factors with two and three levels in randomized blocks.

Unit-III: Necessity of confounding, Types of confounding, complete and partial confounding in 2^n, 3^2 and 3^3 factorial designs, Analysis of confounded factorial designs; Fractional Replication, Split Plot design.

Unit-IV: Incomplete Block Designs; B I B D, Inter and Intra Block analysis of a BIBD, Types of BIBD, construction of BIBD's using Mutually orthogonal Latin squares; Concepts of Youden square and lattice Design, Two – Associate PBIB design, Analysis of P B I B design.

References:
1.M.N. Das and N.C.Giri (1979), Design and Analysis of Experiments, Wiley, Eastern, , Pvt. Ltd., New Delhi.
2.C.D. Montgomery (1976), Design and Analysis of Experiments, Wiley & Sons, New York
3.M.C.Chakbravarthy, (1962), Mathematics of Design of Experiments, Asia Publishing House, Calcutta.
4.Oscar Kempthrone (1974), The Design and Analysis of Experiments, Wiley Eastern, Pvt. Ltd., New Delhi.
5.W.T. Federer (1972), Experimental Designs Theory and Application, Mac Millan Company, New York.
6.Angela Dean and Daniel Ross (1999), Design and Analysis of Experiments, Springer-Verlag.
7.D.D.Joshi (1987), Linear Estimation and Design of Experiments, Wiley Eastern, Pvt. Ltd., New Delhi.
8.P.W.M.John (1971), Statistical Design and Analysis of Experiments, Macmillan
9.F.Pukelshiem (1993), Optimal Design of Experiments, Wiley & Sons
10.D.Raghava Rao (1971), Construction and combinatorial problems in Design of Experiments, Wiley & Sons
11.Aloke Day (1986), Theory of Block Designs, Wiley Eastern, Pvt. Ltd., New Delhi.

ST 303: THEORY OF ECONOMETRICS

Unit-I: Quick review of Inference in general linear model; multi collinearity; Sources and consequences; detection, Farrar-Glauber Test; remedies, Ridge family of estimators and its properties; Heteroscedasticity; sources and consequences; Tests for Heteroscedasticity; Glejser's test Goldfeld-Quandt test; remedies, estimation under Heteroscedasticity.
Unit-II: Autocorrelation; sources and consequences; first order auto regressive Scheme; Durbin-Watson test; Remedies; Estimation under autocorrelation; Stochastic Regressors; Errors-in-Variables linear model; IV and ML estimation methods.
Unit-III: Finite Distributed lag models; Arithmetic lag; Inverted V-lag; Almon's Polynomial lag and Shiller's lag models; Infinite distributed lag models; Geometric lag model; OLS and IV methods of estimation; Koyek's two step and Wallis three step procedures; Pascal lag model.
Unit-IV: Simultanious linear equations models; identification; rank and order conditions; indirect least squares, IV and LIML methods; two stage least squares; k-class estimators; three stage least squares and FIML methods of estimation.

References:

1.Johnston, J (1984): Econometric Methods, III rd Edition, MC Graw Hill.
2.Judge, C.G., Griffths, and Hill, R.C. et al (1985): Theory and Practice of Econometrics, John Wiley.
3.Gujarathi, D (1979): Basic Econometrics, Mc Graw hill.
4.Intrilligator, M.D (1980): Econometric Models, Techniques and Applications, Prentice Hall.

ST 304: OPERATIONS RESEARCH – I

Unit-I: Definition and scope of Operations research; phases in Operations Research; models and their solutions (Review of Linear Programming). Definition of Dual-Primal, Relationships- Dual Simplex Sensitivity or Post Optimal Analysis, Revised Simplex method.
Unit-I1: Non-linear programming - Kuhn Tucker conditions. Wolfe's algorithm for solving quadratic programming problems. Integer programming – Branch and bound algorithm and cutting plane algorithm.
Unit-III: Flows in networks max-flow-min-cut theorem. Project Management; PERT and CPM probability of project completion, PERT – crashing.
Unit-IV: Decision making in the face of competition, two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero- sum games, finding solution in 2x2, and 2xm, and mxn games. Non – zero sum games, co-operative and competitive games, equilibrium solutions and their existence in bi- matrix games. Nash equilibrium solution.
References:

1. Taha H.A (1982) Operational Research: An Introduction; Macmillan.
2. Hiller F. Sand Leiberman G.J. (1962) Introduction to Operations Research; Holden Day
3. Kanti Swarup; Gupta P.K and Singh M.M (1985) Operations Research; Sultan Chand.
4 . Philips D.T, Ravindran A and Solberg J Operations Research, Principles and Practice.
5. Curchman C.W; Ackoff R.L and Arnoff E.L(1957) introduction to Operations Research; John Wiley
6. Hadley G (1964) Non-Linear and Dynamic programming Addison Weslay.
7. Mckinsey J.C.C(1952) Introduction to the theory of games Mc Graw Hill.P.K.Gupta; D.S.Hira Operations Research S.CHand.

ST 305: STATISTICAL PROCESS AND QUALITY CONTROL

Unit-I: Basic concepts of quality, causes of variation, principle of Shewart's control chart, control charts for attributes and variables. Control limits and probability limits. Process monitoring and control, process capability, modified control chart. Capability indices C_p, C_{pk}, and C_{pm}. Concept of Six sigma and its relationship with process capability.
Unit-II: The OC and ARL of Shewart's control charts. Control by gauging, Moving Average and Exponentially Weighted Moving Average charts. CUSUM charts using V-mask and decision interval methods. Multivariate control charts – Control Ellipsoid, Hotelling's T^2 chart.
Unit-III: Acceptance sampling plans for attribute inspection – Type-A and Type-B OC curves. Single, double and sequential sampling plans and their properties. Sampling plans with rectifying inspection-concept of AOQ, AOQL. Design of Single sampling plan with given ATI. Plans for inspection by variables with one-sided and two-sided specifications.
Unit-IV: Sampling plans for continuous inspection-construction of Dodge CSP-1, CSP-2 and Multi level plans and their properties. Chain sampling and its applications. Design of Skip lot sampling plan and its ASN. Sampling plans with inspection error- derivation of AOQ and ATI in presence of errors.
References:

1.Montgomery D.C (2009), Introduction to Statistical Quality Control, 6/e, John Wiley and Sons, New York.
2.Edward G. Schilling, Dean V. Neubauer, (2009), Acceptance sampling in quality control Second Edition, Taylor & Francis.

3.Mttage, H.J and Rinne, H (1993): Statistical Methods of Quality Assurance, Chapmann Hall, London, UK.
4.Ott. E.R (1975), Process Quality Control, Mc Graw Hill
5.Phadke, M.S (1989), Quality Engineering through Robust Design, Prentice Hall
6.Duncan, A.J (1974), Quality Control and Industrial Statistics, 3rd Ed., New York, Irwin.
Philip J. Ross (1989), Taguchi techniques for quality engineering, McGraw Hill

ST 307: SIMULATION TECHNIQUES (IE)

Unit I: Introduction, need of simulation, physical versus digital simulation, Bufferies needle problem, Use of simulation in defence, inventory problems and other fields.
Unit II: Random numbers generation: Congruential generators, metropolis Hasting algorithm, Statistical tests for pseudo random numbers. Random generation from mixture of distribution, compound distributions.
Unit III: Random variate generation methods: Inverse transform methods, acceptance rejection method, composition methods. Generating random variables from continuous and discrete univariate distributions.
Unit IV: Generation of random vectors from multivariate distributions. Monte Carlo integration and variance techniques. Hit or Miss Monte Carlo methods, sample mean Monte Carlo method. Resampling techniques: Bootstrap, Jackniffe techniques and their Applications.
Reference:
1.Deo, Narshingh(1991):System simulation with digital computer, Prentice Hall of India Pvt.Ltd, New Delhi.
2.Lewis, P.A.W. and Orav, E.J.(1988):Simulation methodology for statisticians, Operations
3.Analysis and Engineering ,Wadsworth and Books Cole Advanced Books and Software,Vol.1
4.Sethi, I.K.and Jain,A.K.(1991):Artificial Neural Networks and statistical pattern recongnition, North-Holland, Amsterdon.
5.Mclachlan,G. and Krishnan,T.(2007):The EM Algorithm and Extensions, John Wiley and Sons.

ST308: ACTUARIAL STATISTICS (IE)

Unit I : Basic deterministic model: Cash flows, discount function, interest and discount rates, balances and reserves, internal rate of return, The life table: Basic definitions, probabilities, construction of life tables, life expectancy, Life annuities: Introduction, calculating annuity premium, interest and survivorship discount function, guaranteed payments, deferred annuities.
Unit II : Life insurance: Introduction, calculation of life insurance premiums, types of life insurance, combined benefits, insurances viewed as annuities, Insurance and annuity reserves: The general pattern reserves, recursion, detailed analysis of an insurance, bases for reserves, non forfeiture values, policies involving a return of the reserve, premium difference and paid-up formula.
Unit III : Fractional durations: Life annuities paid monthly, immediate annuities, fractional period premium and reserves, reserves at fractional durations, Continuous payments: Continuous annuities, force of discount, force of mortality, Insurance payable at the moment of death, premiums and reserves. The general insurance – annuity identity, Select morality: Select an ultimate tables, Changed in formulas.

Unit IV : Multiple life contracts: Joint life status, joint annuities and insurances, last survivor annuities and insurances, moment of death insurances. The general two life annuity and insurance contracts, contingent insurances

Reference :

1. Neill, A. (1977) Life contingencies, Heinemann, London.
2. Newton L. Bowers, Jr, Hans U. Gerber, James C. Hickmann, Donald A. Jones and Cecil J. Nesbitt (1997) Actuarial Mathematics, The Society of Actuaries.
3. King, G. Institute of Actuaries Text Book. Part 11, Second edition, Charles and Edwin Layton, London.
4. Donald D.W.A. (1970) Compound Interest and Annuities, Heinemann, London.
5. Jordan, C.W. Jr. (1967) Life Contingencies, Second edition, Chicago Society of Actuaries.
6. Hooker, P.F. and Longley Cook, L.W. (1953) Life and other Contingencies, Volume I and Volume II (1957) Cambridge University Press.

ST 309: STATISTICS FOR BIOLOGICAL AND EARTH SCIENCES (EE)

Unit - I: Statistical measures: Statistical diagrams and graphs; Frequency distributions; Measures of central tendency: Arithmetic mean, Median and Mode; Measures of variation: Range, Quartile Deviation, Mean Deviation, Standard deviation, Coefficient of variation; Karl Pearson's coefficient of Skewness.

Unit- II : Random Variable and Probability Distributions: Definition of Probability, Additive and Multiplicative laws of probability (statements only), Random variable, Binomial, Poisson, Normal and Exponential distributions (properties and applications), Curve Fitting: Principle of least squares; Fitting of a straight line, Exponential curve and Power curve; Correlation and Regression Analysis: Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient; Simple linear regression; Multiple and Partial correlation coefficients; Multiple linear regression; Yules coefficient of Association.

Unit –III: Tests of Significance: Basic concepts; Z- test for proportions and means; Applications of t, χ^2 and F tests; Paired t- test; Paired t-test; Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) techniques for one way and two way classifications (single observation per cell), Confidence limits.

Unit- IV: Special Statistical Tools: Experimental designs CRD, RBD and LSD and their analysis; concept of critical difference; Duncan's Multiple range test; Elements of Principal components Analysis, Factor Analysis; Cluster Analysis and Discriminant analysis; Hotelling's T^2 and Mahalanobis D^2 statistics; Multivariate Analysis of Variance (MANOVA); Canonical correlations; Concept of Probit analysis.

References:

1.Bailey, N.T.J.(1959), Statistical Methods in Biology, The English Universities Press Ltd.,
2.Pillai, S.K., and Sinha, H.C.(1968), Statistical Methods for Biological workers, Ram Prasad and sons, Agra.
3.Basu, S.P.(1996), Quantitative Genetics Research techniques, Kalyani publishers, New Delhi.
4.Misra, B.N., and Misra, M.K.(1998), Introductory Practical Biostatistics, Naya Prakash, Kolkata.
5.Johnson, R.A., and Wichern, D.W.(2001), Applied Multivariate Statistical Analysia, Third edition, Prentice Hall of India, New Delhi.
6.Federer, W.T.(1963), Experimental Designs and its applications, Macmillon.

ST 310: STATISTICS FOR SOCIAL AND BEHAVIOURAL SCIENCES (EE)

Unit- I: Statistical Measures: Measures of central tendency: Arithmetic Mean, Median and Mode; Measures of Variation: Range, Quartile Deviation, Standard Deviation, Coefficient of Variation, Measures of Skewness.
Unit- II: Probability and Distributions: Concept of Probability, Laws of Probability (statements only); Random Variable; Probability Distributions: Binomial, Poisson and Normal distributions (properties and applications).
Unit- III: Tests of Significance: Basic concepts; Random sampling techniques; Standard error of statistic; Large sample tests for proportions and means; Small sample tests: Applications of t, χ^2 and F tests; Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) techniques for one way and two way classifications (single observation per cell); Nonparametric tests: Wilcoxon Signed Rank test, Median test and Mann-Whitney U-test.
Unit- IV: Special statistical tools: Computation of Linear and Compound Growth rates and their tests of significance; Chow test for Structural change; Granger Causality test; Stepwise regression; R^2 and r2 statistics; Multiple Range tests: l.s.d. test and Duncan's test: ANOVA for Ranked data; Krushkal-wallis test, Friedman test; Elements of Factor analysis and Discriminant analysis.

References:
1.Gupta, S.C.(1997), Fundamentals of Statistics, Himalayan Publishers, Mumbai.
2.Kshirasagar, A.M. (1972), Multivariate Analysis, Marcel Decker, New York.
3.Gujarati, D.(1995), Basic Econometrics, Mc Graw Hill.
4.Ferguson, C.A.(1971), Statistical Analysis in Psychology and Education, McGraw Hill.
5.Johnson, R.A., and Wichern, D.W. (2001), Applied Multivariate Statistical Analysis, Third Edition, Prentice-Hall of India (p) Ltd.,. New Delhi.

SEMESTER – IV

ST 401: TIME SERIES ANALYSIS AND FORECASTING METHODS

Unit-I: Review of Time Series Analysis. Growth models: Modified Exponential Curve, Gompertz curve, Logistic curve and their Fitting; Measurement of cyclical component: Harmonic analysis, auto regression series: Markoff and Yule's series, Periodogram and correlogram analysis, measurement of irregular component: variate difference method.
Unit-II: Need and uses of forecasting, classification and characteristics of forecasts, forecasting based on regression techniques: simple and multiple linear regression and non-linear regression techniques, moving averages smoothing methods: simple and double, multi average methods; explanatory version time series forecasting, test for trend seasonality.
Unit-III: Exponential smoothing methods: trend adjusted exponential smoothing, double and triple exponential smoothing, win ten's method, chow's adaptive control methods, brown's one parameter adaptive method: Box-Jenkins three parameter smoothing, Harrison's Harmonic smoothing methods, tracking signal.
Unit-IV: Box-Jenkin's time series methods: 1. Moving average 2. Autoregressive (AR) 3. ARMA and 4. AR integrated MA (ARIMA) models, estimation of ARIMA model parameters, forecasting with ARIMA models, Diagnostic checking of the model: Analysis of residuals, forecasting using transfer function model, concept of Kalmon's Filters.

References:

1.Thomopouls, N.T (1980): Applied Forecasting Methods. Engle Wood Cliffs, N.J, Prentice Hall.
2.Wheel Wishart, S.C; and S. Makridaks (1980): Forecasting Methods for Management . III edition, New York. John Wiley.
3.Sullivan, William G. and Wayne Claycambe. W (1977): Fundamentals of Forecasting. Prentice Hall. Virginia.
4.Gupta. S.C and V.K. Kapoor (1995): Fundamentals of Applied Statistics, Sulthan & Chand Sons. New Delhi.
5.Bovas, Abraham and Johannes Ledolter (1983): Statistical Methods for Forecasting, John Wiley & Sons. New York.
6.Box, G.E.P and Jenkkins, G.M (1976): Time Series Analysis Forecasting and Control, Holden Day, San Francisco.
7.Anderson, T.W (1971): The Statistical Analysis of Time Series, John Wiley, New York.
8.Markidakis, S Steven C. Wheel Wright and Victor E. Mcgee (1983): Forecasting: Methods and Applications, 2nd Edition, New York, John Wiley & Sons.

ST 402: DEMOGRAPHY AND OFFICIAL STATISTICS

Unit-I: Nature, Scope and limitations of demography; Sources of Demographic data in India; Measures of Mortality; life-tables; construction of abridged life table; Measures of fertility Stochastic models for reproduction, Reproduction rates: GRR and NRR; Concepts of Migration and Urbanization.
Unit-II: Population Projections: Stable and Stationary populations, Lotka's model; Use of Leslie matrix. Population estimates; Chandrasekhar and Deming's method, component method, Stochastic models of population growth, Exponential and logistic population growth models: Birth and death model, Birth-death and migration model.
Unit-III: Population Genetics: Concepts of Genotypes and Phenotypes; Basic Mating from Single gene cross, Punnet Square method, Mendal's laws of heredity; Random mating; Hardy-Weinberg Equilibrium law; Calculation of Gene frequencies, Estimation of Gene frequencies in ABO blood group system.
Unit-IV: Statistical systems in India; CSO, NSSO and their functions; scope and content of population Census in India; Methods of conducting population census, Economic census and Agricultural census in India and defects; Sources of forest statistics.

References:

1.Suddender Biswas (1988), Stochastic Process in Demography and Applications, Wiley Eastern Ltd, New Delhi.
2.K.B. Pathak and F. Ram (1992), Techniques of Demographic Analysis, Himalayan Publishing House, Bombay.
3.Osacr Kempthorne (1973), An Introduction to Genetic Statistics, Jagmohan Book Agency, New Delhi.
4.William D. Stansfield (1969), Theory and Problems of Genetics, Schaum's Outline Series, MC Graw Hill, New York.
5.B.N. Gupta (1994), Statistics, Sahitya Bhavan, Agra.
6.B.L. Agrawal (1994), Basic Statistics, 2nd Edition, Wiley Eastren, New Delhi.
7.Asthana (1970), Indian Official Statistics.

ST 403: OPERATIONS RESEARCH – II

Unit-I: Bellman's principle of optimality, general formulation, computational methods and application of Dynamic programming. Multi-stage decision processes and Dynamic programming. Goal Programming and stochastic programming.
Unit-I1: Queuing models-specifications and effectiveness measures.Steady state solutions of M/M/1 and M/M/c models with associated distributions of queue length and waiting time. M/G/1 Queue and Pollazcek Khinchine result. Steady-state solutions of M/Ek/1 and Ek/M/1 queues. Bulk queues.
Unit-I1I: Analytical structure of inventory problems; EOQ formula of Harris, its sensitivity analysis and extensions allowing quantity discounts and shortages. Multi-item inventory, subject to constraints. Models with random demand, the static risk model. (s-S) policy for inventory and its derivation in the case of exponential demand; multi-echelon inventory models. Models witlh variable supply and models for perishable items; estimation of EOQ in some simple cases.
Unit-IV: Replacement problems; block and age replacement polices; dynamic programming approach for maintenance problems; replacement of items with long life. Group and individual replacement policies.
References :
1.Hadley G (1964) Non-Linear and Dynamic programming Addison Weslay.
2.Kleinrock L.(1975) Queueing systems vol.1, Theory; John Wiley.
3.Saaty T.L(1961) : Elements of Queueing Theory with Applications.
4.Gross D and Harris. C.M(1974) Fundamentals of queueing theory ; John Wiley.
5.Philips D.T, Ravindran A and Solberg J Operations Research, Principles and Practice.
6.Curchman C.W; Ackoff R.L and Arnoff E.L(1957) introduction to Operations Research;John Wiley
7. Mckinsey J.C.C(1952) Introduction to the theory of games Mc Graw Hill.P.K.Gupta; D.S.Hira Operations Research S.CHand.

ST 404: COMPUTER PROGRAMMING AND DATA ANALYSIS

Unit-I: Essentials of R-language – Expressions and objects, assignments, creating vectors, vectorized arithmetic, creating matrices, operations on matrices, lists, data frame creation, indexing, sorting and conditional selection with examples. Programming using conditional statements and loops, data editor, reading data from text files.
Unit-II: Obtaining summary statistics, generating tables, bar plots, pie charts, box plots, histograms. Random sampling from discrete and continuous distributions, plotting density and cumulative density curves, Q-Q plots with suitable examples.
Unit-III: Data Analysis Pak in Excel, descriptive statistics, tests of hypothesis, ANOVA, Correlation and Regression, Random Number Generation from different distributions, Binomial, Poisson, Uniform, Normal and from discrete distributions with given mean and variance. Forecasting Using Excel – Moving Averages and Exponential Smoothing, Use of functions, Linest, Logest, Forecast , Growth, Trend for trend analysis. The use of solver for optimization – Application to LPP.
Unit-IV:: Data handling using SPSS: Opening Excel files in SPSS. Merging of files, selection of records, recoding. Analysis tools, descriptive statistics, cross tabs (with stress on procedures and syntax). Post-hoc analysis for multiple comparisons using Tukey's test, Duncan's Multiple Range Test, Dunnet's test and Scheffe's test with interpretation. Selection of variables in Multiple Linear Regression – stepwise procedures and analysis of residuals. Procedure for Binary Logistic regression, Factor analysis, Linear Discriminant analysis and Cluster analysis.

References:

1.Introductory Statistics with R by Peter Dalgaard, Springer, 2nd editions, 2008
2.The R book by Micheal J. Crawley, John Wiley and Sons, Ltd, 2007
3.Sarma, K.V.S (2010), Statistics Made Simple, Do it Yourself on PC, Prentice Hall of India.
4.Johnson and Wichern, Multivariate Analysis, Prentice Hall

ST 405: BIOSTATISTICS

Unit-I: Structure of Biological assay, Direct assays, Potency ratio, Feller's theorem and its generalization. Quantitative dose-response relationships, Linear dose-response regression, Parallel line bioassay, Slope Ratio Bioassay, Quantal responses, estimation of median effective dose, Transformations: Probit and Logit transformations.

Unit-II:: Basic Biological concepts: Gene, Chromosomes, Alleles, Concepts of Geno types and Phenotypes, Family studies, Basic mating from single gene cross, Matrix approach to basic matings of single gene cross, Checker board method, Mendal's law of heredity: Geneotypes and Pheno type ratios, Branching system method.

Unit-III:Types of matings, Random Mating, Concept of Gene pool, Gene frequency, Hardy–Weinberg law of equilibrium, Calculation of Gene frequencies, Genotypic frequency, Generation matrix approach to inbreeding, Estimation of Gene frequencies in ABO blood group system.

Unit-VI: Statistical Methods in Clinical Trials- phase I, II, III and IV trails. Statistical design for clinical trials- fixed sample trials. Simple randomized design, stratified randomized design, crossover and sequential designs – open and close sequential design. Dynamic randomization, Permuted block randomization; Single, double and triple blinding methods.

References:

1.D.J. Finney (1971): Statistical Methods in Biological Assay, Charles Griffen and Company, London.
2.D.J. Finney (1971): Probit Analysis, 3rd Edition, S.Chand and Company Ltd, New Delhi.
3.William D. Stansfield. (1969): Theory and Problems of Genetics, Schaum's Outline Series, MC Graw Hill, New York.
4.Oscar Kempthorne (1973): An Introduction to Genetic Statistics, Jagmohan Book agency, New Delhi.
5.J.P. Jain (1992): Statistical Techniques in Quantitative Genetics, 2nd Edition, Hindustan Publishing House, New Delhi.
6.Basu, S. B. (1996), Quantitative Genitics Research Technique, Kalyani Publishers, New Delhi.
7.Elisa T. Lee &John Wenyu Wang (2003): Statistical methods for Survival Data analysis, 3rd Edition, John Wiley
8.Jerrold H. Zar (1999): Biostatistical Analysis, 4th edition, Pearson.
9.Armitage, P, Berry G and Mathews J.N.S. (2002): Statistical Methods in Medical Research, 4/e, Blockwell Scientific Publications.
10.Rastogi. V.B. (2006), Fundamental of Biostatistics. ANE Books, India.

ST407: TOTAL QUALITY MANAGEMENT (IE)

Unit I: Need for TQM, evolution of quality, Definition of quality, TQM philosophy – Contributions of Deming, Juran, Crosby, Taguchi and Ishikawa.
Unit II: Vision, Mission, Quality policy and objective, Planning and Organization for quality, Quality policy Deployment, Quality function deployment, Analysis of Quality Costs.
Unit III: Customer focus, Leadership and Top management commitment, Employee involvement – Empowerment and Team work, Supplier Quality Management, Continuous process improvement, Training, performance Measurement and customer satisfaction.
Unit IV :PDSA, The Seven QC Tools of Quality, New Seven management tools, Concept of six sigma, FMEA, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles. Need for ISO 9000 Systems, clauses, Documentation, Implementation, Introduction to QS 9000 , Implementation of QMS, Case Studies.

Reference :

1. Narayana V. and Sreenivasan, N.S.(1996): "Quality Management – Concepts and Tasks", New Age International.
2. Zeiri(1991): "Total Quality Management for Engineers", Wood Head Publishers.
3. Juran J.M and Frank M.Gryna Jr.(1982): "Quality Planning and Analysis", TMH, India.
4. Brain Rethery(1993): ISO 9000, Productivity and Quality Publishing Pvt.Ltd.
5. D.Mills(1993): Quality Auditing, Chapman and Hall.

ST-408: STATISTICAL DATA MINING METHODS (IE)

UNIT-I: Introduction to data mining – data types – Measures of similarity and dissimilarity – Data mining tools – supervised and unsupervised learning – Introduction to cluster Analysis – Types of clustering – Agglomerative Hierarchical clustering algorithm – Issues – strength and weaknesses.
UNIT-II: Basic k – means algorithm – Issues – Bisecting k – means – fuzzy clustering – fuzzy c means algorithm – cluster evalutation – unsupervised and supervised measures – Introduction to classification – Decision Trees – Building a decision tree – Tree induction algorithm – Spliting of nodes based on information gain and Gini index – model over fitting – Evaluating the performance of a classifier
UNIT-III: Nearest Neighbor classifier – kNN algorithm – Naïve Bayesion classifier – Binary logistic regression – odds ratio – Interpreting logistic regression coefficients – Multiple logistic regression.
UNIT-IV: Association rules mining – basics – Apriori algorithm – Pruning and candidate generation – Rule mining. Case studies based on k means clustering, fuzzy c means clustering, kNN classification, Binary logistic regression using R programming language or Excel Miner.

References:

1.Tan, T., Steinbach, M. and Kumar, V. (2006): Introduction to Data Mining, Pearson Education. (relevant portions of Chapters 1,2,4,5 and 8).
2.Gupta, G.K. (2008): Introduction to Data Mining with case studies, Prentice – Hall of India Pvt. Ltd. (relevant portions of Chapter 2).
3.Daniel T. Larose (2006): Data Mining: Methods and models, John Wiley and sons. (relevant portions of Chapter 4).
4.Rajan Chattamvelli (2009): Data Mining Methods, Narosa Publishing House, New Delhi.
5.Han, J. and Kamber, M. (2006): Data Mining: Concepts and Techniques, 2nd Edition, Morgan Kanfmann Publishers.
6.Paolo Gludici (2003): Applied Data Mining: Statistical Methods for Business and Industry, John Wiley and sons.

ST 409: GENERALIZED LINEAR MODELS (SSC)

Unit-I: Generalized linear Model; Aitken's theorem; GLS estimator, Asymptotic distribution of GLS estimator; Analysis of residuals, OLS, BLUEs and Recursive residuals; Sudentized and predicted residuals; Granger's test of causality; nested and non nested statistical models; Cox and J tests.

Unit-II: Specificiation error; Consequences; specification bias; Ramsey's RESET test; Lagrange Multiplier test for adding variables; comparing two linear regression models; Dummy variable approach; Stepwise and Piecewise linear regression; Switching Regression Model.

Unit-III: Qualitative and limited dependent variable models; the linear probability model; probit model; Logit model and their estimation; concept of limited dependent variables; specification of Tobit model; concepts of censored and Truncated samples; estimation in censored and Truncated Samples.

Unit-IV: Sets of linear regression models; specification of the Seemingly Unrelated Regression Equations (SURE) model; OLS and GLS estimation of SURE model; Zellner's Feasible GLS estimator; Seemingly Unrelated Unrestricted Residuals (SUUR) estimator; Seemingly Unrelated Restricted Residuals (SURR) estimator; Reduction of the Zeller's Feasible GLS estimator to the OLS estimator.

References:

1.Johnston, J (1984): Econometric Methods, III rd edition , MC Graw Hill.

2.Judge, C.G., Griffths, and Hill, R.C. et al (1985): Theory and Practice of Econometrics, John Wiley.

3.Gujarathi, D (1979): Basic Econometrics, Mc Graw hill.

4.Srivastava, V.K and Giles, D.E.A (1987), Seemingly Unrelated Regression Equations

5.Models: Estimation and Inference, Marcel Dekker, Inc

6.Cook. D and Weisberg. S (1982), Residuals and Inference in Regression, Chapman and Hall.

ST 410: STATISTICS FOR RESEARCH, INDUSTRY AND COMMUNITY DEVELOPMENT (SSC)

UNIT- I: Response Surface Designs: First and Second order Response Surface models; Rotatable designs; concept of connected design; outliers and Winsorized t - statistic; Stepwise regression; Specification of Random coefficients Regression model; Specification of variance components model; MINQUE Theory; Non parametric regression, the partially linear regression model.

UNIT-II: Simulation: Scope and limitations; Simulation models; Generation of RandomNumbers; Monte-Carlo simulation; Simulation of Queueing, Inventory Systems; Networks and Job sequencing.Data Envelopment Analysis (DEA): Non parametric approach to productive efficiency; Input, output correspondences for Frontier production function; Mathematical Programming for productive efficiency: Farrell and Timmer approaches with reference to Cobb-Douglas production function.

UNIT-III: Demand Analysis: Laws of Demand and Supply; price and partial elasticities of demand; Pigous method for Time Series and Family Budget data; Engel's curve; Pareto law of Income distribution;Production Functions: Basic concepts; Isoquants; Cobb-Douglas, CES and Translog Production functions and their properties and estimation; Tools for Data Mining.

UNIT-IV: Social Surveys for Community Development: Objects, Types of Social Survey; Steps in social survey; Gallop polls; Prephology, Data collection; Kinds of measurement; Scaling methods: Thurstone, Likert and Guttman methods; Concepts of Validity and Reliability; Methods of calculating reliability coefficients; Test Reliability; ANOVA for Ranked data: Kruskal-Wallis and Friedman tests; Elements of cluster analysis, Factor analysis., path coefficient analysis and Discriminant analysis.

References:

1.Das, M.N. and Giri, N.C. (1979), Design and Analysis for Experiments, Wiley Eastern (P) Ltd., New Delhi.
2.Montgomery, C.D. (1976), Design and Analysis of Experiments, Wiley & Sons, New York.
3.Johnston, J., and Dinardo, J. (1997), Econometric Methods, Fourth Edition, Mc Graw-Hill International Editions, New York.
4.Judge., C.G., et.al (1985), Theory and Practice of Econometrics, John Wiley.
5.Taha, H.A. (1992), Operations Research, An Introduction, Fourth Edition,

ST 411: RELIABILITY THEORY AND SURVIVAL ANALYSIS (SSC)

Unit-I: Reliability: Concept and Measures of Reliability, bath tub curve, Reliability and failure density in terms of hazard rate; Hazard models, System Reliability Models: Reliability of Series and parallel systems, Mixed configuration models, Non-series-parallel systems; r-out of-n systems, Fault tree analysis.
Unit-II: Reliability improvement methods: Redundancy, element, unit and standby redundancies; Maintainability and availability; Reliability allocation; Life testing and Reliability estimation; Exponential failure model, Normal, Gamma and weibull distributions and their applications in reliability estimation.
Unit-III: Functions of Survival time: Definitions, Relationships of Survival Functions; Non-parametric Methods of Estimating Survival Functions: Kaplan Meier Product limit Estimate; Non-parametric methods for comparing two survival distributions: Gehan's generalized wilcoxon test, Cox-Mantel test, log rank test, Peto and peto's generalized wilcoxon test, Cox's F test and Mantel-Haenszel test.
Unit-IV: Graphical Methods for survival distributions fitting: Probability plotting, hazard plotting methods, testing of goodness of fit; Analytical Estimation Procedures for Survival distributions: Exponential, Weibull, Lognormal and Gamma Distributions only; Regression method for fitting Survival distributions; Parametric methods for comparing two survival distributions: Exponential, Weibull and Gamma Distributions only; Non-parametric and Parametric methods for identification of Prognostic factor relating survival time

References :

1.L.S. Srinath (1998): Reliability Engineering, Applied East west Press PVT Ltd.,New Delhi.
2.E. Balaguruswamy (1984): Reliability Engineering, Tata MC Graw Hill publishing company, New Delhi.
3.S.K. Sinha and B.K. Kale (1980): Life Testing and reliability Estimation, Wiley Eastern Ltd, New Delhi.
4.S.K. Sinha (1986): Reliability and Life Testing, Wiley Eastern Ltd, New Delhi.
5.Elisa T.Lee (1992), Statistical methods for survival data analysis, John Wiley sons.
6.Miller, R.G (1981), Survival Analysis, John Wiley
7.Cross A.J and Clark, V.A (1975), Survival distribution, reliability applications in the biomedical sciences, John Wiley and sons.
8.Elandt Johnson, R.E., Johnson, N.L.,(1999), Survival Models and Data Analysis, John Wiley and sons