Syllabus
M.Sc. Statistics

Students with **B.Sc. Statistics / Mathematics** or studied at least one paper of Statistics at graduation level of **B.Sc. or B.Com. with advance statistics** are applicable for this course.

Semester - 1							
Paper no.	**Title of Paper**	**No. of Hrs. Per Week**	**Weightage For Internal Examination**	**Weightage For Semester end Examination**	**Total Marks**	**Duration of Semester end Exam in Hrs.**	**Course Credits**
MS-101	Basics of Statistical Methods	4	30	70	100	3	4
MS-102	Statistical Computing and Numerical Methods	4	30	70	100	3	4
MS-103	Statistical Inference and Non – Parametric Test	4	30	70	100	3	4
MS-104	Probability and Distribution Theory	4	30	70	100	3	4
MS-105	Mathematical Statistics	4	30	70	100	3	4
MS-106	Practical	12	-	100	100	5	4
Total		32	150	450	600	20	24

Semester – 2							
Paper no.	**Title of Paper**	**No. of Hrs. Per Week**	**Weightage For Internal Examination**	**Weightage For Semester end Examination**	**Total Marks**	**Duration of Semester end Exam in Hrs.**	**Course Credits**
MS-201	Data Warehousing and Data Mining	4	30	70	100	3	4
MS-202	Planning and Analysis of Industrial Experiments	4	30	70	100	3	4
MS-203	Applied Multivariate Analysis	4	30	70	100	3	4
MS-204	Sampling Techniques	4	30	70	100	3	4
MS-205	Base SAS Programming	4	30	70	100	3	4
MS-206	Practical	12	-	100	100	5	4
Total		32	150	450	600	20	24

Semester - 3							
Paper no.	**Title of Paper**	**No. of Hrs. Per Week**	**Weightage For Internal Examination**	**Weightage For Semester end Examination**	**Total Marks**	**Duration of Semester end Exam in Hrs.**	**Course Credits**
MS-301	Survival analysis and Clinical Trials	4	30	70	100	3	4
MS-302	Industrial Statistics	4	30	70	100	3	4
MS-303	Optimizing Techniques	4	30	70	100	3	4
MS-304	Stochastic Process	4	30	70	100	3	4
MS-305	Applied Econometrics	4	30	70	100	3	4
MS-306	Practical	12	-	100	100	5	4
Total		32	150	450	600	20	24

Semester – 4							
Paper no.	**Title of Paper**	**No. of Hrs. Per Week**	**Weightage For Internal Examination**	**Weightage For Semester end Examination**	**Total Marks**	**Duration of Semester end Exam in Hrs.**	**Course Credits**
MS-401	Project & Viva	32	-	300	300	20	24
Total		32	-	300	300	20	24

SEMESTER -1

MS – 101: BASICS OF STATISTICAL METHODS

1. Exploratory data analysis and Descriptive Statistics: Random Variables, Types of Variable and Data Types, Graphical Displays of Sample Data, Histograms, Box plot, Scatter plot, Bar chart, Measures of Centre Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis.
2. Theory of Probability: Basic Ideas, Definitions and Properties. Conditional Probability and Independent Events, Bays Formula.
3. Classical Probability Distributions:
   Discrete Distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric,
   Continuous Distributions: Normal, Uniform, Gamma, Beta distribution of first kind, Beta distribution of second kind, Exponential, Weibul, Cauchy, Central Limit Theorem.
4. Sampling Distributions: Chi-Square Distribution, t-distribution, F- distribution.
5. Statistical Inference and Hypothesis Testing: One sample tests, two sample tests, several sample tests. Applications: Case-Control Studies, Test of Association.
6. Correlation and Regression: Karl Pearson's Coefficient of Correlation, Spearman's rank correlation coefficient, Linear Regression.
7. SPSS: Introduction to SPSS, Statistical analysis using SPSS.

References

1. S. C. Gupta and V. K. Kapoor: Fundamentals of Mathematical Statistics.
2. Rohatgi, V. K. (1984). An introduction to probability theory and mathematical Statistics. New age International Publication.
3. B. L. Agarwal: Basic Statistics.
4. Kiran Pandya, Smruti Bulsari and Sanjay Sinha : SPSS in Simple Steps

MS – 102: STATISTICAL COMPUTING AND NUMERICAL METHODS

1. Concept of random number generator, congruential method of generating uniform Variate. Concept of simulation: Generation of Binomial, Poisson, Geometric, Negative Binomial & Multinomial variate. Proofs of related results.
2. Generation of continuous random variables covering Exponential, Normal, Gamma, Chi-square, Bivariate exponential, Bivariate Normal distributions, and mixture of distributions.
3. Excel Introduction to MSEXCEL and exercises on using EXCEL for Statistical analysis covering frequency distribution, histograms, t-test, and test for Independence in 2x2 contingency tables.
4. R – Language. : Introduction to R, elementary programming, application to data analysis.
5. Solution to a nonlinear equation: Bisection method, Newton-Raphson method.
6. Iterative methods: Jacobi, Gauss-Seidel methods with convergence analysis.

References

1. Morgan B. J. T.(1984): Elements of Simulation. Chapman and Hall.
2. Kennedy William J.,Jr. James E. Gentle. (1980): Statistical Computing Marcel Dekker, Inc. New York and Basel.
3. Christion P. Robert, George Casella (1999): Monte Carlo Statistical Methods, Springer-Verlag, New York, Inc.
4. Luc Devroye (1986): Non- Uniform Random Variate Generation; Springer-Verlag New York Berlin-Heidelberg Tokyo.
5. Rubinstein, R. Y. (1998): Modern Simulation and Modeling (Wiley Series in Probability and Statistics).
6. K.E. Atkinson (1989): An Introduction to Numerical Analysis, Wiley, 1989.
7. K. Eriksson, D. Estep P. Hansbo and C. Johnson (1996): Computational Differential Equations, Cambridge Univ. Press, Cambridge.
8. G.H. Golub and J.M. Ortega (1992): Scientific Computing and Differential Equations: An Introduction to Numerical Methods, Academic Press.
9. J. Stoer and R. Bulirsch (1993): Introduction to Numerical Analysis, 2nd ed., Texts in Applied Mathematics, Vol. 12, Springer Verlag, New York.

MS – 103: STATISTICAL INFERENCE AND NON PARAMETRIC TESTS

1. Viewed on unbiasedness, efficiency, consistency and sufficiency. Neyman Factorization theorem, minimal sufficient statistics.
2. Method of estimations: maximum likelihood method, method of moments, minimum Chi square method. Minimum variance unbiased estimators, Rao-Blackwell theorem. Completeness, Lehman – Scheffe's necessary and sufficient condition for MBUE, Cramer – Rao lower bound approach and Bhattacharya's system of lower bounds for a single parameter.
3. Test of hypothesis: simple and composite hypothesis, two types of errors, critical regions, randomized tests, power function, and most powerful and most powerful tests. Neyman Pearson lemma, generalized Neyman Pearson lemma.
4. Unbiased tests: uniformly most powerful unbiased test, similar test, relation between UMP unbiased test and a UMP similar test, application to one parameter exponential family. Tests with Neyman structure. Inference on scale and location parameters: estimation and tests.
5. Rank test, locally most powerful rank test, linear rank statistics and their distributional properties under null hypothesis.
6. Statistical decision problem: Non randomized and randomized decision rules. Loss function, expected loss, risk function. Concept of admissibility, Bayes rule, admissibility of Bayes rules.
7. Minimax rules, least favorable distributions, complete class and minimal complete class. Decision problem for finite parameter space. Convex loss function. Bayes minimax estimators, illustrations.
8. One sample location problem, sign test, signed rank test, two sample Kolmogorov – Smirnov tests. Two sample location and scale problems. Wilcoxon – mann – Whitney tests. Krusal – Wallis k sample tests.

Reference:

1. Kale, B.K. (1999). A first course on parametric inference. Narosa
2. Rohatgi, V. K. (1984). An introduction to probability theory and mathematical statistics. New age International Publication.

3. Rao, C. R. (1973). Linear Statsitical Inference and its applications, 2nd edition. John wiley and sons.
4. Furguson, T.S. (1967). Mathematical Statistics, Academic Press.
5. Zacks, S. (1989). Theory of Statistical Inference. John Wiley and sons.
6. Gibbons, J. D. (1985). Non parametric Statistical Inference, 2nd edition,Marcel Dekker.
7. Hajek, J. and Sidak, Z. (1967). Theory of rank tests. Academic press.
8. Fraser, D.A.S. (1957). Non parametric methods in Statistics. John wiley and sons

MS – 104: PROBABILITY AND DISTRIBUTION THEORY

1. Introduction of Probability, Probability Spaces, random variables, expectations and moments, Minkowski inequality, Schwartz inequality, Jensen inequality, Markov inequality, Holder's inequality and Tchebyshev's inequality.
2. Law of large numbers: Weak law of large numbers, Strong law of large numbers for i. i. d. sequence, strong law of large numbers, Kolmogorov's strong law of large numbers. Borel 0-1 law, Bore l- Cantelli lemma, Kolmogorov 0 – 1 law.
3. Convergence in Probability, in distribution and in mean. Central limit theorem for a sequence of independent random variables under Lindberg's condition, Liapounov's CLT (only statement).
4. Brief review of basic distribution theory. Joint, Marginal and Conditional probability mass function (pmf) and probability density function (pdf) , Discrete and continuous distributions.
5. Function of random variables and their distributions using Jacobin of transformation and their tools, probability distribution of a random variables, properties of distribution functions, Characteristics functions and its properties, Inversion theorem, uniqueness theorem and Convolutions.
6. Power series distribution: its mean, variance, mgf, cgf, and recurrence relations. Various discrete distributions as its particular cases.
7. Sampling distributions: Non central chi square, t and f – distributions and their properties. Distributions of quadratic form under normality.
8. Order statistics: their distribution and properties, joint and marginal distributions of order statistics. Extreme values and their asymptotic distributions (Statement only) and its applications.

References:

1. Asb Robert. (1972). Real analysis and probability, Academic Press.
2. Billingsley, P. (1986). Probability and Measure Wiley .
3. Kingman J.F.C. and Taylo S. J. (1966). Introducton to measure and probability. Cambridge University Press).
4. Rohatgi, V. K. (1984). An introduction to probability theory and mathematical statistics. New age International Publication.
5. Rao, C. R. (1973). Linear Statsitical Inference and its applications, 2nd edition. John wiley and sons.
6. Johnson, S. and Kotz (1972). Distributions in Statistics. Vol I, II, III. Houghton and Maffin publication.
7. Cramer, H. (1946). Mathematical methods of Statistics. Princeton.

MS – 105: MATHEMATICAL STATISTICS

1. Set of real numbers, countable and uncountable sets, countability of rationals and uncountability of the interval (0,1) Supremum and Infimum of bounded sets, limit point of a set, open, closed, dense and compact sets. Bolzano-Weierstrass and Heine-Borel Theorems (Statements only). Applications of these theorems.
2. Sequence of real numbers, convergence, divergence. Cauchy sequence. Convergence of bounded monotone sequence. Limit inferior and limit superior of the sequences.
3. Series of numbers, tests for convergence (without proof) test for absolute convergence, convergence of sequences of non-negative terms.
4. Vector space, subspace, linear dependence and independence, basis, dimension of a vector space, example of vector spaces.
5. Null space, Special types of matrices: elementary operations, rank of a matrix. Orthonormal basis and orthogonal projection of a vector. Gram-Schmidt orthogonalisation, Kroneckar product. Idempotent matrices, inverse of a matrix, their Simple properties, Partitioned Matrices, Orthogonal matrices.
6. Characteristic roots of a matrix, algebraic and geometric multiplicities, characteristic vectors and their orthogonal property. Caley-Hamilton Theorem and applications.

References:

1. Malik S. C. & Arora S.(1991) : Mathematical Analysis- Wiley Eastern Limited IInd edition.
2. Goldberg R. R. (1964): Methods of Real Analysis- Blaisdell Publishing company, New York, U.S.A.
3. Bartle G. R. (1976): Element of Real Analysis- Wiley 2nd edition.
4. Bartle G.R. & Sherbert D. R. (2000): Introduction to Real Analysis- John Wiley & Son Inc.
5. Royden (1988): Principles of Real Analysis - Macmillian.
6. Widder (1989): Advanced Calculus - Dover Publication.
7. Apostol (1985): Mathematical Analysis - Narosa Publishing House, T.M.
8. Rao A. R. & Bhimashankaram P. (1992) : Linear Algebra. Tata Mc-Graw Hill, New Delhi
9. Hadely G (1987): Linear Algebra - Narosa Publishing House.
10. Searl S. B.(1982) : Matrix Algebra Useful for Statistics – Wiley.

MS-106 Practical

MAS-106 (a) Practical Based on MAS-101 & MAS-103

MAS-106(b) Practical Based on MAS-102

SEMESTER -2

MS-201: Data Warehousing and Data Mining

1. Introduction of Data Warehouse: Operational and Informational systems, OLTP and DSS systems, Characteristics of Data Warehouse, Data Warehouse software and hardware architecture, Basic steps to develop data warehouse architecture, Architectural components of data warehouse, Data warehouse system architecture (Two-Tiered and Three-Tiered).
2. Data Marts: Data Mart structure, Usage of Data Mart, Security in Data Mart, Data warehouse and Data Mart
3. Online Analytical Transactional Process**:** OLTP and OLAP systems, Types of OLAP (MOLAP, ROLAP and HOLAP) with advantages and disadvantages.
4. ETL: Extraction of Data, Transformation of Data, Loading of Data, Comparison and contradiction of various ETL tools, Practical study of popular ETL tools.
5. Data Mining: Foundation of Data Mining, Data Mining Process, Data Understanding, Data Preparation, Creating database for data mining, Exploring database, creating for data mining model, building a data mining model, evaluating a data mining model, deployment of data mining model.
6. Data Mining Techniques: Statistics: Point Estimation, Model based summarization, Bayes theorem, Hypothesis testing, Correlation and regression. Machine Learning, Decision Trees, Neural Networks.
7. Data Mining Algorithms: Genetic Algorithms, Cross-over techniques, Mutation Function, Fitness Function. Association Rules: Apriori Algorithm, Sampling Algorithm, Partitioning algorithm, Pincer-Search algorithm, FP-Tree Growth algorithm. Clustering: Hierarchical algorithm, Agglomerative algorithm, Divisive clustering, K- Means, Nearest Neighbor, clustering large database
8. Practical Study in WEKA environment: Implementation of data set into WEKA, Rules generated using charts, Analysis of data using WEKA, Comparison of various algorithms.
9. Case Study: Insurance, Financial services, Healthcare and medicine, Telecommunications, Retail Marketing, Government, Education,

Reference Books:

(1) Data mining Explained A manager's guide to customer centric business intelligence by
(2) Rhonda Delmater, Monte Hancock, Digital Press
(3) Data mining by Pieter Adriaans, DolfZantinge
(4) Data warehousing in the real world A practical guide for business DSS by Sam Anahory, Dennis Murray

MS - 202: PLANNING AND ANALYSIS OF INDUSTRIAL EXPERIMENTS

1. Introduction to designed experiments. General block design and its information matrix C. Properties of block design: Connectedness, balance and orthogonolity.

2. Balanced incomplete block design, its properties, parametric relations, intra block analysis of BIB design. Finite group and finite field geometry projective and Euclidean. Mutually orthogonal lattice square design. Construction of (1) MOLS and (2) BIB designs using MOLS, PG (N, S), EG(N, S) and other methods.

3. Lattice design: simple and balanced lattice design. Analysis of lattice design. Missing plot techniques, estimation of missing observation and its analysis of variance of RBD and LSD design.

4. General factorial experiment, main effects and interaction effects. 2^n and 3^n factorial experiment. Analysis of 2^n and 3^n factorial experiments in randomized block. Confounding experiments: complete partial and balanced confounding and its ANOVA table.
5. Two associated PBIB design association scheme and intra block analysis. Group divisible designs, dual and linked block designs, resolvable and affined resolvable designs.
1. Diallel Crosses: complete diallel crosses, its analysis and efficiency factor, optimal diallel crosses plane. Robustness of designs. Robustness of diallel crosses plan against the lost of 1<=s<=k observation in a block.

References:

1. Jeff Wu C.F., Hamada M. (2000): Experiments: Planning, Analysis and parameter design optimization, John Wiley & Sons.
2. Phadke M.S. (1989): Quality Engineering using Robust Design, Prentice-Hall.
3. Montgomery D.C. (2001): Design and Analysis of Experiments 5th edition, Wiley New York.
4. Das,M.N. : Design of Experiment
5. Alok, Dey : Incomplete Block Design

MS - 203: APPLIED MULTIVARIATE ANALYSIS

1. Multivariate normal distribution, two definitions and their equivalence, singular and nonsingular normal distribution, characteristic function, moments, marginal and conditional distributions.
2. Maximum likelihood estimators of the parameters of the multivariate normal distribution and their sampling distributions.
3. Wishart matrix and its distribution of properties of Wishart distribution, distribution of generalized variance.
4. Hotelling's T2 Statistic and its distribution. Applications of T2 statistics and its relationship with Mahalanobis' D2 statistic. Confidence region for the mean vector.
5. Discrimination and classification. Fisher's discriminant function and likelihood ratio procedure, minimum ECM rule, Rao's U statistics and its use in tests associated with discriminant function, classification with three populations.
6. Principal components. Dimension reductions, Canonical Correlation and canonical variables.
7. Introduction to factor analysis, Cluster analysis, Heirarchical and non-Heirarchical clustering. Single, complete, average linkage method and K-means clustering.

Reference:

1. Kshirsagar A. M.(1972): Multivariate Analysis. Marcel-Dekker.
2. Johnosn, R.A. and Wichern . D.W (2002): Applied multivariate Analysis. 5th Ad. Prentice Hall.
3. Anderson T. W. (1984): An introduction to Multivariate statistical Analysis 2nd Ed. John Wiley.
4. Morrison D.F. (1976): Multivariate Statistical Methods McGraw-Hill.

5. Rao, C.R.(1973). Linear Statistical Inference and its application, new age international publication.
6. Rao, C.R. and Kleffe, J.(1988). Estimation of variance component and applications, North Holland.

MS - 204: SAMPLING TECHNIQUES

1. Concept of population and sample, Need for Sampling, census & sample surveys, basic concepts in sampling and designing of large-scale surveys design, sampling scheme and sampling strategy. Basic methods of sample selection: SRSWR, SRSWOR.
2. Stratification, Allocation and estimation problems. Construction of Strata: deep stratification, method of collapsed strata.
3. Systematic sampling: The sample mean and its variance, comparison of systematic with random sampling, comparison of systematic sampling with stratified sampling, comparison of systematic with simple and stratified random sampling for certain specified population. Estimation of variance, Two stage sample: Equal first stage units, Two stage sample: Unequal first stage units; systematic sampling of second stage units.
4. PPSWR methods: Cumulative total method, Lahiri's method related estimation Problems and PPSWOR methods and related estimation of a finite population mean (Horwitz- Thompson and Des Raj estimators for a general sample size and Murthy's estimator for a sample of size 2), Midzuno sampling.
5. Use of supplementary information for estimation: ratio and regression estimators and Their properties. Unbiased and almost unbiased ratio type estimators, Double sampling.
6. Cluster sampling. Two – stage sampling with equal number of second stage units.
7. Non - sampling errors: Response and non- response errors. Hansen – Horwitz and Demig's techniques.

References:

1. Sukhatme P. V., Sukhatme S. & Ashok C : Sampling Theory of Surveys and Applications – Piyush publications
2. Des Raj and Chandhok. P. (1998): Sample Survey Theory - Narosa publication.
3. William G. Cochran. (1977): Sampling Techniques- IIIrd edition –John and Wiley sons Inc.
4. Parimal Mukhopadhyay (1998): Theory and Methods of Survey Sampling –Prentice Hall of India private limited.
5. Murthy M.N. (1977): Sampling Theory of Methods - Statistical Publishing Society, Calcutta.

MS - 205 Base SAS Programming

1. Introd uction to SAS programs, running SAS Programs, diagnosing and correcting syntax errors. Producing List Reports using PRINT procedure; sequencing and grouping observations, using special WHERE statement operators; customizing report appearance – formatting data values, creating HTML reports. Programming with the DATA step – reading SAS data sets and creating variables, executing statement conditionally, dropping and keeping variables. Assigning and Changing variable attributes, Combining merging and SAS Data Sets Producing Summary Reports using REPORT procedure.

2. Using SAS Enterprise Guide: naming a project, working with existing code, diagnosing and correcting errors, creating SAS programs, accessing data sources with the LIBNAME statement, understanding Output Delivery System (ODS). Using Graphics in SAS Enterprise Guide. Controlling Input and Output – controlling when a record loads, reading hierarchical raw data files; outputting multiple observation, selecting variables and observations, writing to multiple SAS data sets, writing to external files. Processing Data iteratively using DO loop, SAS array processing.
3. Using SQL with SAS: Understanding the purpose, design, uses, and terminology of SQL; Basic Queries, using SQL procedure, summarizing data with column and row functions, grouping data, performing analyses on groups of data, subquerying, and remerging, ordering data, customizing query output. Combining Tables – querying multiple tables using joins, using union, intersect, and other set operators to combine tables. Creating and Modifying Tables and Views, using views to simplify queries and access changing data, creating and using indexes; maintaining tables, views, and indexes.

Note: The examination of this paper is based on short answer questions of one mark each.

Reference:

1. Cody R, Smith J. 'Applied Statistics & the SAS Programming Language'. Prentice hall 1997. 4th Edition.
2. N. Jyoti Bass, K. Madhavi Lata. "Base SAS Programming".
3. Geoff Der, Brian Everitt – 2007 Basic Statistics Using SAS Enterprise Guide: A Primer
4. Sandra D. Schlotzhauer – 2015 Elementary Statistics Using SAS
5. James B. Davis, Statistics Using SAS, SAS Institute.
6. Larry Hatcher – 2003, Step by Step Basic Statistics Using SAS: Student Guide
7. Bruce R. Lewis, Richard K. Ford – 1987, Basic Statistics Using SAS
8. Lora D. Delwiche, Susan J. Slaughter – 2012, The Little SAS Book: A Primer, Fifth Edition

MS - 206 PRACTICAL

MS-206 (a) Practical based on MS-201, MS-202

MS-206 (b) Practical based on MS-205

SEMESTER-3

MS - 301 SURVIVAL ANALYSIS AND CLINICAL TRIALS

1. Life time distributions, survival functions, hazard rate, cumulative hazard function, residual life time, survival function of residual life time, mean residual life time, one correspondence of these functions. Computation of these function for Common life time distributions: exponential Weibull, Gamma, Pareto, Rayleigh, log-normal etc: computation of survival and failure rate function proportional hazard models and proportional hazard model.
2. Concept of censoring, various types of censoring, Estimation and Testing of parameters of exponential distribution under various types of censoring.
3. Estimation of survival function: Actuarial Estimator, Kaplan Meir product limit estimator, properties: self-consistency and MLE.
4. Two-sample problem: Log rank test, Mantel Haenszel test. Semi parametric regression for failure rate – Cox's proportional hazards model. Related estimation and test procedures. Epidemiological studies: case-control and cohort designs; odds ratio and relative risk; logistic and multiple regression models.
5. Introduction to clinical trials and other types of clinical research, bias and random error in clinical studies, overview of Phase I-IV trials.
6. Design of Phase 1-3 clinical trials: parallel vs. cross-over designs, cross-sectional vs. longitudinal designs, review of factorial designs, objectives and endpoints of clinical trials, formulation of appropriate hypotheses (equivalence, non-inferiority, etc.); sample size calculation.
7. Analysis of Phase 1-3 trials: Use of generalized linear models; analysis of categorical outcomes.

References:

1. Lawless J.F.(1982) : Statistical Models & Methods of Life Time Data, John Wiley.
2. Miller R.C. (1981) : Survival Analysis. John Wiley
3. Bain L.J (1978) : Statistical Analysis of Reliability & Life testing , Models, Marcel Dekker.
4. Deshpande, Purohit: Life time data: statistical models and methods, World Scientific, 2005.
5. S.C. Chow and J.P. Liu (1998): Design and Analysis of Clinical Trials - Concepts & Methodologies, John Wiley & Sons, NY.
6. D.W. Hosmer and S. Lemeshow (1989): Applied Logistic Regression, John Wiley and Sons, NY.
7. J.G. Ibrahim, M-H Chen and D. Sinha (2001): Bayesian survival analysis, Springer, NY.
8. E. Vittinghoff, D.V. Glidden, S.C. Shiboski and C.E. McCulloch (2005): Regression Methods in Biostatistics, Springer Verlag.
9. J.L. Fleiss (1986): The Design and Analysis of Clinical Experiments, John Wiley & Sons.

MS - 302: INDUSTRIAL STATISTICS

1. Basic concept of quality control, process control and product control, seven SPC tools Flowchart. Histogram, Check sheet. Ishikawa diagram, Pareto chart, Defect

concentration diagram, control chart. Deming's PDCA cycle for continuous improvements and its applications.

2. Control charts for measurements and attributes *x,* R, S, p, np. Charts with subgrouping, CUSUM chart, tabular form and V-mask use of these charts for process control. Moving average and exponentially weighted moving average charts.
3. Sampling Inspection plans: for attribute inspection: Single, double & sequential sampling plans and their properties. Dodge & Roming characterization by OC curve and ARL-Inspection by variables for one or two sided specifications.
4. Multivariate control charts for measurements data. Hotelling T2 control charts.
5. Simulation of X -bar and R control charts, estimation of ARL and process capability indices.

References:

1. Guenther W.C (1981): Sampling Inspection in Statistical Quality Control Charter Grifits.
2. Montgomery D.C. (1996): Introduction to Statistical Quality Control, John Wiley & Sons Inc.
3. Kotz S. (1993): Process capability indices. Chapman and Hall.
4. Abraham Bovas (1998) Quality Improvement through statistical methods. Birkhauser.
5. Tim Stapenhurst (2011) Mastering Statistical Process Control.
6. Peihua Qiu (2014) Introduction to Statistical Process Control, CRC press.

MS - 303: OPTIMIZATION TECHNIQUES

1. Linear programming problem (LPP): Theorems related to the development of Simplex algorithm, Proof of the theorems related to a basic feasible solution (b.f.s); Reduction of a feasible solution to a basic feasible solution, Improvement of a basic feasible solution, Existence of unbounded solution, Optimality conditions. For other related theorems, statements only.
2. Artificial variable technique; two phase and Big M method, the case of redundancy. Revised simplex method.
3. Concept of Duality, theorems related to duality, complementary slackness property and development of dual simplex algorithm..
4. Theory of games: two person zero sum games, minimax and maximin principles, Saddle point, mixed strategies; rules of dominance, solution of 2 x 2 game by algebraic method, 13 Graphical method, Reduction of the game problem as LPP, Minimax and maximin theorem (without proof).
5. Transportation problem: North-West method, Least – Cost method, Vogel's approximation method, Modi method.
6. Assignment Problem: Introduction, Mathematical Statement, Hangarian Method, Variations of assignment problem.
7. Replacement Problem, Project Management: PERT and CPM, Inventory Control Models, Queuing theory.

References:

1. J.K. Sharma (2010): Quantitative Techniques for Managerial Decisions.
2. Hadley G.(1969): Linear Programming ,Addison Wesley

3. Taha H. A. (1971): Operation Research An Introduction- Macmillan N.Y.
4. Kanti Swaroop & Gupta M. M. (1985): Operations Research, Sultan Chand & Co.
5. J. K. Sharma (2003): Operation Research theory and Applications, IInd Edition Macmillan India ltd.

MS - 304: STOCHASTIC PROCESSES.

1. Introduction to stochastic process (sp's): classification of sp's according to state space and time domain. Countable state markov chain (mc's), stationary process, classification of states, transition probability, Chapman kolmogorow questions, calculations of n steps transition probability (higher transition probability) and its limit.

2. Random walk and gambler's ruin problem: effect of changing bet, duration of game, probability of gamblers ruin in exactly n games, one and two dimensional random walk.

3. Poisson process: introduction, probability mass function, probability generating function and property of Poisson process.

4. Birth process: Yule fury process, death process, birth and death process, its distribution, mean and variance, wiener process.

5. Branching process: Galton Watson branching process, its mean and variance, probability of ultimate extinction.

References

1. Adke, S. and Manjunath, S.M. (1984). An introduction to finite markov process, new age international.
2. Guttrop, P. (1991). Statistical inference for branching process, Wiley.
3. Bhatt, B.R. (2000). Stochastic modules, analysis and applications, new age international, New Delhi.
4. Medhi, J. (1982). Stochastic process, new age international, New Delhi.
5. Ross, S.M. stochastic process, new age international, New Delhi.

MS - 305 APPLIED ECONOMETRICS

1. Nature of econometrics: the general model (GLM) and its existence. Ordinary least square (OLS) estimation and prediction. Use of dummy variables. Generalized least square (GLS) estimation and prediction. Heteroscedastic disturbance.
2. Auto correlation, its consequences and tests. Their BLUE procedure. Estimation and prediction. Multi co linearity problem, its implication and tools for handling the problem. Ridge regression.
3. Linear regression and stochastic regression. Instrumental variable equation, error in variables. Auto regressive linear regression. Distributed Lag models.
4. Simultaneous linear equations model. Examples Identification problem. Restriction on structural parameter rank and order condition.
5. Estimation on simultaneously equation model, 2 SLS estimators, limited information estimator, 3 SLS estimation, full information maximum likelihood method. Monte Carlo studies and simulation.

Reference:

1. Apte, P.G. (1990). Text book of econometrics. Tata McGraw hill.
2. Gujarathi, D. (1979). Basic Econometrics, Tata McGraw hill.
3. Klein, L.R. (1962). An introduction to Econometrics, prentice hall of India.
4. Thiel, H. (1982). Introduction to the theory and practice of Econometrics, John Wiley.
5. Johnston, J. (1984). Econometric methods, 3rd edition, Tata McGraw hill.

MS - 306 PRACTICAL

MS-306 (a) Practical based on MAS-301 & MAS-302

MS-306 (b) Practical based on MAS-305

SEMESTER-4

MS – 401: Project and Viva