M. Sc Statistics Online Program (2021)

A – CORE COURSES

Subject Code	Title of the Course	C/E/S	L	T	P	C
I SEMESTER						
MSI C121	Statistical Mathematics	C	3	1	0	4
MSI C122	Measure and Probability Theory	C	3	1	0	4
MSI C123	Distribution Theory	C	3	1	0	4
MSI C124	R Programming	C	3	1	0	4
	Elective 1	E	2	1	0	3
	Elective 2	E	2	1	0	3
	Soft Skill	S				2
II SEMESTER						
MSI C125	Linear Regression Analysis	C	3	1	0	4
MSI C126	Sampling Theory	C	3	1	0	4
MSI C127	Statistical Estimation Theory	C	3	1	0	4
MSI C128	Statistical Laboratory-I	C	0	0	2	2
	Elective 3	E	2	1	0	3
	Elective 4	E	2	1	0	3
	Soft Skill	S				2
III SEMESTER						
MSI C129	Multivariate Analysis	C	3	1	0	4
MSI C130	Testing Statistical Hypotheses	C	3	1	0	4
MSI C131	Design & Analysis of Experiments	C	3	1	0	4
	Elective 5	E	2	1	0	3
	Elective 6	E	2	1	0	3
	Soft Skill	S				2
	Internship	I				2
IV SEMESTER						
MSI C132	Statistical Quality Management	C	3	1	0	4
MSI C133	Advanced Operations Research	C	3	1	0	4
MSI C134	Statistical Laboratory-II	C	0	0	2	2
MSI C135	Statistical Software Practical	C	0	0	2	2
MSI C136	Project Work / Dissertation	C	0	6	0	6
	Elective 7	E	2	1	0	3
	Soft Skill	S				2

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B – ELECTIVE COURSES :

Subject Code	Title of the Course	L	T	P	C
MSI E121	Actuarial Statistics	3	0	0	3
MSI E122	Statistical Methods for Epidemiology	3	0	0	3
MSI E123	Stochastic Processes	3	0	0	3
MSI E 124	Non-Parametric Inference	3	0	0	3
MSI E125	Data Mining	3	0	0	3
MSI E126	Bayesian Inference	3	0	0	3
MSI E127	Reliability Theory	3	0	0	3
MSI E128	Survival Analysis	3	0	0	3
MSI E129	Categorical Data Analysis	3	0	0	3
MSI E130	Bio-Statistics	3	0	0	3

MSI C121	Statistical Mathematics	C	3	1	0	4	

Pre-requisite: Undergraduate level Mathematics.

Unit I: Metric Space – open, closed sets – Intervals (rectangles), Real valued Continuous functions-Discontinuities - compact sets, Bolzano – Weirstrass theorem, Heine – Borel theorem.

Unit II: Derivatives - maxima and minima - Riemann integral & Riemann – Stieltjes integral with respect an increasing integrator – properties of R.S. integral. Functions of several variables, constrained and unconstrained maxima – minima of functions, partial and total derivatives

Unit III: Basic properties of matrices (orthogonal, idempotent, kronecker product, projection operators etc); Linear dependence, independence and rankof a matrix; characteristic roots and polynomial, multiplicity of characteristic roots ;Cayley Hamilton theorem; inverse of a matrix and determinants;

Unit IV: Reduction of matrices, Echelon form, Hermite canonical form, diagonal reduction, rank factorization, triangular reduction Jordan form; Symmetric matrices and its properties; Decomposition like, singular value decomposition, spectral decomposition, Cholesky decomposition etc.

Unit V: Matrix differentiation; Generalized inverse and its propeties, Moore-Penrose inverse ; Application of g-inverse; Quadratic forms, classification, definiteness, index and signature, extremum;transformation and reduction of quadratic form; applications of quadratic forms.

REFERENCES:

Rudin, Walter (1976) : Principles of Mathematical Analysis, McGraw Hill.
Apostol, T.M. (1985) : Mathematical Analysis, Narosa, Indian Ed. Royden,
H.L.(1995) : Real analysis, 3ed., Prentice Hall of India.
Rangachari,M.S.(1996) : Real Analysis, Part 1, New Century Book House.
Ash, R.B. (1972) : Real analysis and probability, Academic press.
Biswas, S. (1984) : Topics in Algebra of Matrices, Academic Publications.
David, A.Harville(1997) : Matrix algebra from a statistician's perspective, Springer.
Hoffman, K. and Kunze, R. (1971) : Linear Algebra, 2nd ed. Prentice Hall, Inc.
Graybill, F.A. (1983) : Matrices with application in Statistics, 2nd ed. Wadsworth.
Rao, C.R. & Bhimasankaran, P.(1992) : Linear algebra, Tata McGraw Hill Pub. Co. Ltd.
Searle, S.R. (1982) : Matrix Algebra useful for Statistics, John Wiley and Sons, Inc.

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MSI C122	Measure and Probability Theory	C	3	1	0	4	

Pre-requisite: Undergraduate level Mathematics.

Unit I: Measure Theory - Limits of sequence of sets, classes of sets – Field , Sigma Field and Monotone class, Measure and Measure Space – Measurable function

Unit II: Lebesgue – Stieltjes measure, Measure integral and its properties, Dominated convergence theorem – Radon– Nikodymn theorem, almost everywhere convergence, convergence in measure and convergence in mean.

Unit III: Events, sample space, different approaches to probability, random variables and random vector, Distribution functions of random variables and random vector, Expectation and moments, basic, Markov, Chebyshev's, Holder's, Minkowski's and Jensen's inequalities.

Unit IV: Independence of sequence of events and random variables, conditional probability, conditional expectation, Characteristic functions and their properties, inversion formula, convergence of random variables, convergence in probability, almost surely, in the r-th mean and in distribution, their relationships, convergence of moments, Helly-Bray theorem, continuity theorem and convolution of distributions.

Unit V: Central limit theorem, statement of CLT, Lindeberg, Levy and Liapounov forms with proof and Lindeberg Feller's form examples. Khintchine weak law of large numbers, Kolmogorov inequality, strong law of large numbers

REFERENCES :

Bhat, B.R. (1985) : Modern probability theory, 2nd ed. Wiley Eastern.
Chow, Y.S. and Teicher, H. (1979) : Probability theory, Springer Verlag.
Chung, K.L. et al : A course in probability theory, Academic press.
Parthasarthy, K.R. (1977) : Introduction to probability and measure, MacMillan Co.,
Breiman, L. (1968) : Probability, Addison Wesley.
Munroe, M.E. (1971) : Measure and integration, 2nd ed. Addision Wesley.
Halmos, P.R. (1974) : Measure theory, East-West.
De Barr, G. (1987) : Measure theory and integration, Wiley Eastern.

MSI C123	Distribution Theory	C	3	1	0	4	

Pre-requisite: Undergraduate level Mathematics.

Unit I : Brief review of distribution theory, functions of random variables and their distributions using Jacobian of transformation, Laplace and Caushy distribution, lognormal distribution, gamma, logarithmic series.

Unit II : Bivariate normal, Bivariate exponential, Bivariate Poisson, Compound, truncated and mixture of distributions, concepts of convolution.

Unit III : Sampling distributions, non-central chi-square distribution, t and F distributions and their properties, distributions of quadratic forms under normality and related distribution theory – Cochran's and James theory.

Unit IV: Order statistics their distributions and properties, Joint and marginal distributions of order statistics, extreme value and their asymptotic distributions, approximating distributions of sample moment, delta method.

Unit V : Kolmogorov Smirnov distributions, life distributions, exponential, Weibull and extreme value distributions Mills ratio, distributions classified by hazard rate.

REFERENCES:

Gibbons(1971) : Non-parametric inference, Tata McGraw Hill.
Rohatgi, V.K. and Md. Whsanes Saleh, A.K.(2002) : An introduction to probability & Statistics, John Wiley and Sons.
Rao, C.R. (1973) : Linear statistical inference and its applications, 2ed, Wiley Eastern.
Mood,A.M. & Graybill, F.A. and Boes, D.C. : Introduction to the theory of statistics, McGraw Hill.
Johnson,S. & Kotz,(1972): Distributions in Statistics, Vol. I, II & III, Hougton & Miffin.
Dudewicz, E.J., Mishra, S.N.(1988) : Modern mathematical statistics, John Wiley.
Searle, S.R.(1971) : Linear models, John Wiley.

MSI C124	R Programming	C	3	1	0	4	

Unit I: R fundamentals – Components of R Console – Use of Packages – Data Types in R – Arithmetic, Relational and Logical Operators
Unit II : Loop Structures – Conditional Structures – Functions
Unit III: R Graphics – Creating simple graphic applications for Statistical problems
Unit IV: R packages for sample generation, computing probabilities and fitting probability distributions.
Unit V : Building packages in R

Online help manuals and other materials available in R project site will form basis for the course.

MSI C125	Linear Regression Analysis	C	3	1	0	4	

Pre-requisite: Matrix Algebra.

Unit I: Linear models, Estimation – Least square estimation of parameters and properties (BLUE), Gauss Markov theorem – Estimation by MLE, Testing – general linear hypothesis and subhypothesis, Interval estimation – classification of linear models (Fixed, random and mixed) (Chapter 2 & 3).

Unit II: Model Adequacy checking – Residual analysis, detection and treatment of outliers, Transformation to correct model adqequacies – ariance stabilizing transformation, transformation to achieve linearity, removal of heteroscedasticity – principle of weighted least squares (Chapter 4 & 5).

Unit III: Multicollinearity – Sources and effects of multicollinearity, multicollinearity diagnostics, methods of dealing with multivollinearity, impact on forecasting (Chater 10).

Unit IV: Robust estimators – need for robust regression, types of estimators, properties and computational aspects of robust regression (Chapter 11).

Unit V: Generalized Linear models – models with Binary response variable, estimation and testing in a logistic regression model, Poisson regression, link functions, estimation and inference in the GLM (Chapter 13).

REFERENCES :
D.C. Mongomery et al (2003) -. Introduction to Linear Regression Analysis (3rd ed.) Wiley & Sons
Doshi, D.D. (1987) : Linear estimation and design of experiments, Wiley Eastern Ltd.
Searle, S.R. (1971) Linear Models John Wiley,NY
Anand M. Kshirsagar(1983) A Course on Linear Models, Marcel dekker, NY
P.McCullagh and J.A. Nelder (1989) 2nd ed Generalised Linear Models, Chapman and Hall, London

MSI C126	Sampling theory	C	3	1	0	4	

UNIT I : Preliminaries – Simple Random Sampling - PPS selection methods

UNIT II :– Midzuno sampling method – PPSWR and PPSWOR sampling methods – Ordered and Unordered estimators

UNIT III: Stratified Sampling – Allocation Problems – Systematic Sampling Methods – Balanced, Modified and Centered systematic sampling methods – Yates corrected estimator.

UNIT IV: Ratio Estimation – Unbiased Ratio Type estimators – Regression Estimation - Double Sampling for Ratio and Regression Estimation

UNIT V: Multistage Sampling - Randomized Response Methods – Call Back Techniques

REFERENCES:

S.Sampath (2005) : Sampling Theory and Methods, Narosha Publishing House.
W.G. Cochran (1965) : Sampling Techniques, Wiley and Sons
M.N.Murthy(1967) : Sampling Theory and Methods: Statistical Publishing Society, Calcutta
Parimal Mukhopadhyay (2005) : Theory and Methods of Survey Sampling , Prentice Hall of India
P.V.Sukhatme, B.V.Sukhatme, S.Sukhatme and C.Asok (1984) L Theory of Same Surveys with Applications, IASRI, New Delhi

MSI C127	Statistical Estimation Theory	C	3	1	0	4	

Pre-requisite: Probability Theory.

Unit I : Sufficient statistics, Neyman, Fisher Factorisation theorem, the existence and construction of minimal sufficient statistics, Minimal sufficient statistics and exponential family, sufficiency and completeness, sufficiency and invariance.

Unit II: Unbiased estimation : Minimum variance unbiased estimation, locally minimum variance unbiased estimators, Rao Blackwell – theorem. Completeness- Lehmann Scheffe theorems, Necessary and sufficient condition for unbiased estimators

Unit III: Cramer- Rao lower bound, Bhattacharya system of lower bounds in the 1-parameter regular case. Chapman -Robbins inequality.

Unit IV: Maximum likelihood estimation, computational routines, strong consistency of maximum likelihood estimators, Asymptotic Efficiency of maximum likelihood estimators, Best Asymptotically Normal estimators, Method of moments.

Unit V : Bayes' and minimax estimation : The structure of Bayes' rules, Bayes' estimators for quadratic and convex loss functions, minimax estimation, interval estimation.

REFERENCES :

V.K.Rohatgi etal(2002) : An introduction to probability and statistics, John Wiley.
Lehmann, E.L. (1983): Theory of point estimation, John Wiley.
Zacks, S. (1971) : The theory of statistical inference, John Wiley.
Rao, C.R. (1973) : Linear statistical inference and its applications, Wiley Eastern, 2nd ed.
Ferguson, T.S. (1967): Mathematical statistics, A decision theoretic approach, Academic press, New York and London.
Lindley, D.V. (1965): Introduction to probability and statistics, Part 2, Inference, Cambridge University Press.

MSI C128	Statistical Laboratory-I	C	2	0	0	2	

Practical Problems covering subjects MSI C121, MSI C123, MSI C 126 and MSI C125.

MSI C129	Multivariate Analysis	C	3	1	0	4	

Pre-requisite: Distribution theory.

UNIT I: Multivariate Normal Distribution and Its Properties. Maximum Likelihood Estimators of Parameters, Distribution of Sample Mean Vector, Sample Dispersion Matrix.

Unit II: Partial and multiple correlation coefficients- Null distribution - Application in testing. Null distribution of Hotelling's T^2 statistics. Application in tests on mean vector for one and more multivariate normal populations and also on equality of the components of a mean vector in a multivariate normal population

UNIT III: Classification and discrimination procedures for discrimination between two multivariate normal populations – Linear Discriminant function, Mahalanobis Distance, tests associated with Discriminant functions, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations**.**

Unit IV: Principal component Analysis, Canonical variables and canonical correlation, clustering-similarity measures- hierarchical algorithms- Single Linkage, Non-hierarchical Clustering

Unit V: Contingency Tables, Correspondence Analysis for Two Dimension Contingency Table

REFERENCES :

Anderson, T.W. (1983) : An Introduction To Multivariate Statistical Analysis. 2nd Ed.Wiley.
Johnson,R.& Wichern(2008) **:** Applied Multivariate Statistical Analysis, Pearson, 6ed
Brain S. Everitt and Graham Dunn (2001) **:** Applied Multivariate Data Analysis, 2nd Ed.(chap 4)
Neil H.Timm (2002): Applied Multivariate Analysis –Springer-Verlag
Dallas E.Johnson (1998) :Applied Multivariate Methods For Data Analysts- Duxbury Press
William R Dillon and Mathew Goldstein (1984): Multivariate Analysis Methods And Applications, John Weily

MSI C130	Testing Statistical Hypotheses	C	3	1	0	4	

Pre-requisite: Probability Theory.

Unit I: Uniformly most powerful tests, the Neyman-Pearson fundamental Lemma, Distributions with monotone likelihood ratio.Problems

Unit II: Generalization of the fundamental lemma, two sided hypotheses, testing the mean and variance of a normal distribution.

Unit III : Unbiased ness for hypotheses testing, similarly and completeness, UMP unbiased tests for multi parameter exponential families, comparing two Poisson or Binomial populations, testing the parameters of a normal distribution (unbiased tests), comparing the mean and variance of two normal distributions.

Unit IV: Symmetry and invariance, maximal invariance, most powerful invariant tests.

Unit V: SPRT procedures, likelihood ratio tests, locally most powerful tests, the concept of confidence sets, non parametric tests.

REFERENCES :

V.K.Rohatgi et a l(2002) : An introduction to probability and statistics, John Wiley.
Lehmann, E.L. (1986) : Testing of statistical hypothesis, John Wiley.
Ferguson, T.S. (1967) : Mathematical statistics, A decision theoretic approach, Academic press.
Rao, C.R. (1973) : Linear statistical inference and its applications, Wiley Eastern, 2nd ed.
Gibbons, J.D. (1971) : Non-parametric statistical inference, McGraw Hill.

MSI C131	Design and Analysis of Experiments	C	3	1	0	4	

Pre-requisite: Matrix algebra & Linear Models.

Pre-requisite: Mathematics for statistics.

Unit I: Review of basic designs; Orthogonal latin squares, Hyper Graeco Latin squares – analysis of variance – multiple comparisons – multiple range tests - Missing plot technique.

Unit II: General factorial experiments, study of 2 and 3 factorial experiments in randomized blocks; complete and partial confounding; Fractional designs for symmetric factorials; basic idea of asymmetric factorials

Unit III: General block design and its information matrix (C), criteria for connectedness, balanced and orthogonality; BIBD – recovery of interblock information; PBIBD(2).- Association scheme, Intrablock analysis, Lattice Design –analysis; Youden design – intrablock analysis;

Unit IV: Nested and split plot designs – Two stage nested designs, split plot designs, split plot plot designs, strip-split designs, Analysis of covariance with one, two covariates; clinical trials.

Unit V: Response surface methodology - first order and second order rotatable designs, applications:

REFERENCES:

Das, M.N. and Giri, N. (1979) : Design and analysis of experiments, Wiley Eastern.
John, P.W.M. (1971) : Statistical design and analysis of experiments, Macmillan.
Montgomery, C.D. (2001) : Design and analysis of experiments, John Wiley, New York.
Robert, O., Kuelhl(2000) : Design of experiments. Statistical principles of research design and analysis, Duxbury.
Federer, W.T.(1963) : Experimental design; Theory and application, Oxford & IBH publishing Co.

MSI C132	Statistical Quality Management	C	3	1	0	4	

Unit I: Dimensions of Quality, Pareto And Ishikawa diagrams, Standardization of Quality, Shewart Control chart for attributes and variables O.C. curve and A.R.L. of Control charts, Control charts for variables

Unit II: Modified Control Charts; Moving average and EWMA charts; Cusum charts. Capability Indices Cp, Cpk and Cpm- estimation and confidence intervals of capability indices for Normally distributed characteristics

Unit III: Total Quality Management, six-sigma, Taguchis Loss Function, Signal To Noise Ratio Optimization, Orthogonal Arrays, Parameter Design

Unit IV: Product Control Techniques, Acceptance sampling plans for attribute inspection; single, double and sequential sampling plans, O.C.Curve. Variable Sampling Plan for Process Parameter, Sampling By Variables For Proportion Nonconforming

Unit V: Acceptance Sampling Plan For Variables for one-sided and two-sided specifications, X Bar Method, K-Method, M- Method**,** Mil-Std and IS plans, Sampling Schemes; Continuous Sampling Plans; Chain Sampling plan, Skip-Lot Sampling Plan, Dodge- Roming Plans

REFERENCES :

Montgomery, D.C. (2008) : Introduction to Statistical Quality Control, John Wiley, 6th Ed.
E.G.Schilling (2009): Acceptance Sampling in Quality Control, CRC Press 2nd Ed.
Grant, L. and Leavenworth, S. (1996) : Statistical quality control, McGraw Hill. 7th Ed.
Murthy, M.N. (1989) : Excellence through Quality & Reliability, Applied statistical centre.
Thomas P.Ryan (2000) : Statistical Methods for Quality Improvement 2ed., John Wiley.

MSI C133	Advanced Operations Research	C	3	1	0	4	

Unit I: Integer Programming – Pure and Mixed Integer programming problems – Cutting Plane Algorithm – Mixed Algorithm With proof. Additive and Zero One algorithm – Branch and Bound method

Unit II: Dynamic Programming – Modelling and solving of recursive equations – Cargo Loading Model – Reliability Model – Warehousing Model – Investment Model. Solving of optimization problems of mathematical nature using dynamic programming models.

Unit III: Non-Linear programming – Kuhn-Tucker conditions – Wolfe's and Beale's method – with proof

Unit IV: Stochastic programming – Chance constrained optimization problems – E, V and EV models – simple applications

Unit V: Inventory models – Single item and multitem (Deterministic and Nondeterministic) invento0ry models with and without back logs.

REFERENCES :

Taha, H : Operations Research, Prentice Hall of India, 8th edition,2007
Rao. S.S. : Engineering Optimization, New Age International (P) Ltd, New Delhi 2004
Kambo,N S : Mathematical Programming techniques, Affiliated East-west Press Pvt Ltd.1991
Sharma J K : Operations Research, Macmillan, New Delhi, 3rd Edition, 2007

MSI C134	Statistical Laboratory-II	C	0	0	2	2	

Practical Problems Covering: MSI C 129, MSI C 130, MSI C 131 and MSI C 132.

MSI C135	Statistical Software based Practical	C	0	6	0	6	

Practical problems : Covering all topics using a commercial software for MSIC 129, MSI C130, MSI C131 and MSI 132.

MSI C136	Project Work /Dissertation	C	3	1	0	4	

Pre-requisite: Probability Theory.

ELECTIVES

MSI E121	Actuarial Statistics	3	0	0	3	

Pre-requisite: Open to all – Offered in the Second Semester

Unit I : Mortality : Gompertz - Makeham laws of mortality - life tables.
Annuities: Endowments, Annuities, Accumulations, Assurances, Family income benefits.

Unit II : Policy Values : Surrender values and paid up policies, industrial assurances, Joint life and last survivorship, premiums.

Unit III: Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capital sums on retirement and death, widow's pensions, benefits dependent on marriage.

REFERENCES:

Study Material, 104-Survival Models, Actuarial Society of India.
Hooker,P.F., Longley, L.H.-Cook (1957) : Life and other contingencies, Cambridge.
Alistair Neill(1977) : Life contingencies, Heinemann professional publishing.
Hosack,I.B., Pollard, J.H. and Zehnwirth, B.(1999) : introductory statistics with applications in general insurance, Cambridge University.

MSI E122	Statistical Methods for Epidemiology	3	0	0	3	

Unit I: Measures of disease frequency: Mortality / morbidity rates, incidence rates, prevalence rates. Source of mortality / morbidity statistics – hospital records, vital statistics records. Measures of secrecy or validity: sensitivity index, specificity index. Measure of reliability.
Epidemiologic concepts of diseases : Factors which determine the occurrence of diseases, models of transmission of infection, incubation period, disease spectrum and herd immunity.

Unit II: Observational studies in Epidemiology: Retrospective (case control) & prospective (cohort or longitudinal) studies. Measures of association : Relative risk, attributable risk. Statistical techniques used in analysis: Cornfield and Garts method, Mantel – Haenszel method. Conditional and unconditional matching. Analysis of data from matched samples, logistic regression approach.

Experimental Epidemiology: Clinical and community trials Statistical techniques: Methods for comparison of two treatments. Crossover design with Garts and McNemars test. Randomization in a clinical trials, sequential methods in clinical trials, clinical life tables, assessment of survivability in clinical trials.

Unit III: Mathematical modeling in Epidemiology: (deterministic and stochastic) simple epidemic model, generalized epidemic model, Read-Frost and Green-wood models, models for carrier borne and host vector diseases. Estimation of latent and infectious periods, geographical spread of the disease, simulation of an epidemic.

REFERENCES:

Kahn, H.A., Sempose, C.T.(1989) : Statistical methods in Epidemiology, Oxford University press.
Daley, D.J., Gani, J.(1999) : Epidemic modeling an introduction, Cambridge.

MSI E123	Stochastic Processes	3	0	0	3	

Unit I : Elements of Stochastic Processes – Definition and Examples – Classification of general Stochastic Processes – Markov Chains – Definition and Examples – Recurrent and Transient States, Peridiocity, Examples – One dimensional random walk.

Unit II : Basic Limit Thorem and applications – Irreducible Markov Chain, Basic Limit Theorem – examples – Stationary distribution of a Markov Chain – Illustrations.

Unit III – Continous time Markov Chains – Poisson Process – Marginal distribution of a Poisson process- Pure Birth Process – Marginal Distribution of a Pure Birth Process.

REFERENCES:

J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.
S.M. Ross, Stochastic Processes, 2nd Edition, Wiley, 1996 (WSE Edition).
G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
H.M. Taylor and S. Karlin, An Introduction to Stochastic Modeling, 3rd Edition, Academic Press, New York, 1998.

MSI E124	Non parametric Inference	3	0	0	3	

Unit I : Rank tests for comparing two treatments, Wilcoxon ranksum tests, Asymptotic null distribution of Wilcoxon statistics, Siegel-Tukey and Smirnov tests, power of Wilcoxon rank, sum tests, Asymptotic power, comparison with students t-test, estimating the treatment effect.

Unit II: Block comparison for two treatments, sign test for paired comparisons, Wilcoxon signed rank test, a balanced design for paired comparisons, power of sign and Wilcoxon signed rank tests and their comparisons.
Comparison of more than two treatments, the Kruskal, Wallis test, 2 x t contingency table, comparing several treatments with a control, ranking several treatments.

Unit III: Randomised complete blocks, Friedman, Cochran, McNemar tests, Aligned ranks. Tests of randomness and independence, testing against, trend, testing for independence, zxt contingency tables.

REFERENCES :

Lehmann, E.L.(1975) : Non parameteric: Statistical methods based on Ranks, McGraw Hill.
Gibbons, J.D.(1971) : Non parametric Statistical inference, McGraw Hill.
Hajek, J. and Sidak, Z.(1967) : The theory of rank tests, Academic press.
Hollandar, M. and Wolfe, D.A.(1973) : Non parametric statistical methods, John Wiley.
Walsh, J.F.(1962) : Handbook of non parametric statistics, Van Nostrand.

Puri,M.L.(Ed.) (Bloomington1969)n (1972) : First international symposium on non parametric inference, Cambridge University press.

MSI E125	Data Mining	3	0	0	3	

Unit I: Data types – Measures of similarity and dissimilarity - Hierarchical Clustering Methods – k-means and k-medoids clustering methods – Clustering Validity measures

Unit II: Fuzzy c-means – Fuzzy Clustering Validity Measures – Decision Trees – Building a decision tree – Tree induction algorithm – Splitting of nodes based on information gain and Gini index - Nearest Neighbor classifiers – kNN algorithm – Naïve Bayesian classifier

Unit III: Association rules mining – Basics – Apriori algorithm – Pruning and candidate generation – Rule mining.

REFERENCES:

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

MSI E126	Bayesian Inference	3	0	0	3	

Unit I : Bayesian point estimation : as a prediction problem from posterior distribution. Bayes estimators for (i) absolute error loss (ii) squared error loss (iii) 0-1 loss. Generalization to convex loss functios. Evaluation of the estimate in terms of the posterior risk. theorem – prior and posterior distributions. Conjugate priors and Jeffrey's priors, examples.

Unit II : Bayesian interval estimation : Credible intervals. Highest posterior density regions. Interpretation of the confidence coefficient of an interval and its comparison with the interpretation of the confidence coefficient for a classical confidence interval.

Unit III : Bayesian testing of hypotheses : Specification of the appropirate form of the prior distribution for a Bayesian testing of hypothesis problem. Prior odd,s Posterior odds, Bayes factor for various types of testing hypothesis problems depending upon whether the null hypothesis and the alternative hypothesis are simple or composite.

REFERENCES :

Berger,J.O. : Statistical decision theory and Bayesian analysis, Springler Verlag.
Robert, C.P. and Casella, G.Monte Carlo : Statistical methods, Springer Verlag.
Leonard, T. and Hsu, J.S.J. : Bayesian methods, Cambridge University press.
Degroot, M.H. : Optimal statistical decisions, McGraw Hill.
Bernando, J.M. and Smith, A.F.M. : Baysian theory, John Wiley and sons.
Robert, C.P. : The Bayesian choice : A decision theoretic motivation, Springer.

MSI E127	Reliability Theory	3	0	0	3	

Unit I: Introduction to Reliability concepts, Quality and Reliability, Reliability Modeling, Life testing and Reliability, Reliability data, Likelihood Principle, Censoring Concepts, Bathtub Curves, Mean Time to Failure, Mean Time between Failures

Unit II: Statistical Inference, Discrete Failure Time Models and Inferences, Continuous Failure Time Models and Inferences- Exponential, Weibull, Gamma, Lognormal, Logistic and Beta Distributions.

Unit III: Reliability Plotting, Reliability Testing, Reliability Prediction, Concept of Software Reliability.

REFERENCES:

Muralidharan,K. and Syamsundar,A.(2012): Statistical Methods for Quality, Reliability and Maintainability, PHI Learning Pvt. Limited.
Miller,R.G.(1981) : Survival analysis, John Wiley.

MSI E128	Survival Analysis	3	0	0	3	

Pre-requisite: Probability Theory.

Unit I: Introduction to Survival concepts, Survival functions and hazard rates, concepts of Type I, Type II, Random and other types of censoring, likelihood in these cases.

Unit II: Life distributions-Exponential Weibull, Gamma, Lognormal, Pareto, Linear failure rate, estimation / testing under censoring setup. Life tables, failure rate, mean residual life and their elementary properties.

Unit III: Estimation of survival functions-actuarial estimator, Product– limit (Kaplan-Meier) estimator, properties. Cox proportional hazards regression models with one and several covariates, exponential, Weibull, lognormal regression.

REFERENCES:

Miller,R.G.(1981) : Survival analysis, John Wiley.
Collet, D.(1984) : Statistical analysis of life time data.
Despande,J.V., Gore, A.P. and Shanbhogue, A.(1995) : Statistical analysis of non normal data, John Wiley.
Cox, D.R. and Oakes, D.(1984) : Analysis of survival data, Chapman & Hall, New York.
Gross, A.J. and Clark, V.A.(1975) : Survival distribution: Reliability applications in the Biomedical sciences, John Wiley and Sons.
Elandt-Johnson,R.E. Johnson, N.L. : Survival models and data analysis, John Wiley & sons.
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Unit I: Frequency distribution - Diagrammatic representation - Measures of Central tendency - Dispersion - Probability - Probability distribution - Binomial, Poisson & Normal Distribution.

Unit II: Elements of sampling theory – Simple, stratified and systematic sampling schemes. Applications in Biology Correlation and Regression, Rank Correlation. Multiple correlation and Regression, Partial correlation.

Unit III: Large Sample test - Small sample test - Student't', 'F' tests - Chi-Square test for independence and Goodness of fit - Analysis of Variance. Non parametric Tests - Sign test, Run test, Median test, Two Sample Rank test.

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