Course Outcomes
Department of Statistics

Semester	Subject & paper	Outcomes
1st semester	**STAT-C-101 Descriptive Statistics**	At the end of the 1st sem. Students will be able to- • Understand different types of data & will be able to classify data in tabular form • To understand different scales such as Nominal, Ordinal, Ratio & Interval. • To draw diagrammatic & graphical representation of statistical data using bar diagram, histogram, ogive etc. • Understand the concept of grouped & ungrouped data & calculate problems based on measures of central tendency & Dispersion. • Understand the concept of skewness & Kurtosis. • Perform bivariate analysis & will be understand the basic concepts of correlation& regression & their properties. • Solve problems based on multiple & partial correlation coefficient. • Concept of Index Number & able to solve different Index number such as weighted, Unweighted, Chain based & Consumers price Index Number.
	STAT-C-102 Calculus	• Understand about partial differentiation, total differentiation, indeterminate form & able to find the limit of function. • Able to understand Leibnitz rule, Euler's theorem, maxima & minima offunctions. • Concept of Jacobian, concavity, convexity & points of inflextion. • Solve different problems based on differentiation under integral sign, double integral. • Solve the problems of Beta & Gamma functions & their properties. • Solve various differential equations such as homogeneous & non-homogeneous linear differential equations, 1st order & 1st degree,

		1st order but not of 1st degree etc. • Understand the concept of Clairaut's equation & will be able to solve the higher order differential equations. • Form & solve simple partial differential equations, linear & non-linear partial differential equations. • Solve problems based on homogeneous & non-homogeneous linear differential equations with constant coefficients. • Understand the Charpit's method and different cases for complementary functions & particular integrals.
2nd Semester	**STAT-C-201 Probability & Probability Distribution**	At the end of the 2nd sem. Students will be able to- • Understand the basic concept of probability & Bay's theorem. • Understand the concepts of discrete or continuous random variables, pmf & pdf etc. • Know the concepts of expectation, mgf, cf & pgf & their individual properties. • Understand different types of discrete distributions such as Bernoulli, Binomial, Poisson & other related distributions & continuous distributions such as Normal, Gamma, Beta etc. along with their properties& limiting cases.
	STAT-C-202 Algebra	• Understand the fundamental theorems of algebra, relation between roots & coefficients or polynomial equations. • Solve & evaluate cubic & biquadratic equations. • Know about vector space, linear dependence & independence & also the dimension theorem. • Understand different forms of matrices. • Solve different matrices, inverse of matrices. • Solve the system of linear equations. • Estimate rank of matrix. • Understand about characteristic roots, characteristic vectors & their properties. • Understand Caley Hamilton theorem.

		• Understand different types of Quadratic forms such as positive definite, positive semi-definite, negative definite matrix etc & also the linear orthogonal transformation & their diagonalization.
3rd Semester	**STAT-C-301 Sampling Distribution**	**At the end of the 3rd sem. Students will be able to-** • Know about convergence in probability, Chebychev's inequality, WLLN, SLLN & their application. • Understand Central Limit theorem & its applications & also the Liapunov theorem. • Understand about order Statistics & the distribution of sample median & sample range. • Define random sample, parameter & statistic, Standard Errors of sample mean, variance & proportion. • Define & construct Null & Alternative hypotheses. • Understand level of significance, two types of errors & critical region. • Use CLT for testing large sample test for mean (s) & proportion (s), Standard Deviation (s) by classical & p-value approaches. • Know the Exact sampling distribution. • Derive the p.d.f of chi-square, Student's & Fisher's t distribution using m.gf. • Understand the nature of p.d.f curve for various d.f. of these distributions. • Derive c.g.f & mode of chi square distribution. • Understand the additive property & limiting form, test of significance & Confidence Interval based on these distributions. • Understand the relationship between these three distributions.
		• Understand about population & sample, difference between complete enumeration & sampling & also the sampling & non-sampling errors. • Know about various types of sampling such as probability & non-probability sampling.

	STAT-C-302 Survey sampling & Indian Official statistics	• Know about the basic principle of sample survey. • Understand about SRSWR & SRSWOR. • Know the procedure of selecting a sample from a population. • Know the estimates of population mean, total & proportion, variances of these estimates. • Determine the sample size from a population • Understand stratified random sampling, proportional & optimum allocations. • Compare Stratified random sampling with SRS. • Understand Systematic random sampling. • Compare Systematic random sampling with SRS & Stratified random sampling in the presence of linear trend& corrections. • Understand Ratio & Regression method of estimation. • Estimate the variances of these estimates. • Understand Cluster sampling & its relative efficiency with SRS in terms of intra class correlation. • Know about sub-sampling. • Understand about present official system in India, methods of collection of official statistics - their reliability &limitations. • Understand the Role of MOSPI, CSO, NSSO,& National Statistical Commission. • Know about the principal publication of Govt of India on population, industry & finance.
	STAT-C-303 Mathematical Analysis	• Represent real numbers as points on a line & the set of real numbers as complete ordered field. • Understand bounded set, unbounded set, neighbourhood & limit points, supremum & infimum & other related definitions. • Understand cauchy's general principle of convergence, Cauchy's theorem on limit. • Understand monotonic sequences, limit superior, inferior of a bounded sequence. • Test the convergency of infinite series, positive term series by applying comparison

		test, D' Alembert's ratio test, Cauchy's root test, Raabe's test, Gauss test, Cauchy's condensation test & integral test etc. • Know the absolute convergence, conditional convergence & L' Hospital rule for indeterminate form. • Understand Limit, continuity & differentiability of a function. • Understand the concept of Rolle's theorem, Mean-value theorem, Taylor's theorem,Taylor's & Maclaurin's series expansion of sinx, cos x, log(1+x) • Construct & solve difference table, interpolation &, missing term & solve problems by applying Newton's forward, backward & Lagrange's interpolation formula. • Solve problems based on divided difference formula. • Solve different problems based on numerical integration using Simpson's $1/3^{rd}$, $3/8^{th}$ & Trapezoidal rule etc. • Find the roots of Transcedental equations using Newton –Ramphson method.
4th Semester	**STAT-C-401 Statistical Inference**	**At the end of the 4th sem. Students will be able to-** • Understand the concept of theory of estimation. • Understand the criterion of point estimators such as unbiasedness, consistency , efficiency , sufficiency- their realted problems & theorems. • Know the Facorization theorem, MVUE, Rao-Blackwell & Lehmann-Schffe theorems, C-R Inequality, MVB estimators & their applications. • Know about the methods of estimation such as Maximum Liklihood Estimation, Method of Moments,& Method of minimum chi-square. • Get the basic idea of Bay's estimators. • Understand about test of significance & its related definitions. • Understand about size & power of critical

		region, BCR , most powerful & uniformly most powerful test. • Know the Neymann- Pearson Lemma, Liklihood ratio test & its properties. • Understand about the Sequential Probability Ratio Test (SPRT) for simple vs simple hypotheses & fundamental relations. • Define Wald's fundamental identity & derive the OC & ASN functions. • Solve the problems based on normal, poisson, binomial & exponential distributions.
	STAT-C-402 Linear Models	• Know about Gauss- Markov set up including linear estimation, linear parametric functions, method of least squares, gauss- Markov theorem & estimation of error variance. • Understand about simple regression analysis , estimation & hypothesis testing in case of simple & multiple regression models & estimates. • Know the ANOVA & ANCOVA for one way & two way classified data with one observation per cell for fixed effect models. • Understand model checking including prediction from a fixed model, violation, Homoscedasticity & collinearity. • Know
	STAT-C-402 Statistical Quality Control	• Know about the historical background of SQC, seven tools of Statistical Process Control, chance causes & assignable causes of variation in any production. • Know about the construction & basis of Statistical Control Charts. • Understand about Control charts for variables such as X-bar & R chart, X-bar & s-chart, Control chart for attributes such as np-chart, p-chart, p-chart, c-chart & u-chart. • Compare between the control chart for variables& conrol chart for attributes. • Understand about principle of acceptance sampling plan, single & doble sampling plan & their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation.

		• Know the use & interpretation of Dodge & Romig' sampling inspection plan tables. • Understand about Six-Sigma, Lean manufacturing &TQM. • Know the selection criteria for Six-Sigma roles & training plans. • Know the importance of Voice of Customers (VOC) & VOC data collection. • Define different phases of DMAIC.
5th Semester	**STAT-C-501 Stochastic Processes & Queuing Theory**	**At the end of the 5th sem. Students will be able to-** • Understand the concept of Generating functions Bivariate pgf & Stochastic proess. • Define various terms related to Markov chain such as Markov chain, transition probability matrix, order of Markov chain etc. • Represent Markov chain graphically. • Know about graph theoretic approach. • Understand about the postulates of poisson process, its properties, pure birth process, pure death process, Yule –Furry process etc. • Know the concept of Queuing theory, Queuing model, M/M/1 with finite & infinite system capacity & waiting time distribution in stationary cases.
	STAT-C-502 Statistical Computing Using C Programming	• Know the History & importance of C, basic structure, keywords & identifiers. • Know the different data types, constant & variables, overflow & underflow of data. • Know the different operators & Expressions used in C such as arithmetic, relational, logical etc. • Understand about managing input & output operations. • Understand about Decision making & initialization of one-dim & two-dim arrays, character arrays & strings. • Use scanf & printf. • Know about user-defined functions, category of functions. • Know the Recursion function, passing arrays to functions & storage class of variables. • Understand about pointers which includes

		declaration & initialization of pointer variables, accessing the address of a variable, pointer expressions scale factor, pointer as function arguments, functions returning pointers etc.
	STAT-DSE-1 Operations Research	• Know the historical development of OR, various phases, types. • Understand about Linear Programming Problem(LPP). • Formulate LPP. • Solve graphically the LPP problem. • Apply Simplex method, Charne's mM-tehniques to solve LPP. • Solve LPP involving artificial variables. • Understand the Duality in LPP. • Solve Transportation problem using North-West corner rule, Least cost method & Vogel's approximation method (VAM). • Understand & solve Assignment problem by applying Hungarian method. • Understand rectangular game & its solution procedure. • Solve rectangular game graphically. • Know the dominance property to reduce the game matrix & its solution with mixed strategy. • Undrestand the ABC Inventory system & its characteristics. • Know the EOQ model & its Variations with & without shortages.
	STAT-DSE-2 Time Series Analysis	• Know the concept, components, applications & decomposition of time series. • Estimate trend by free hand curve method, method of semi-averages. • Fit various mathematical curve & growth agcurves. • Know about the method of moving averages, seasonal component & its estimation by method of simple averages. • Know the Ratio to Trend method. • Know about Seasonal component which includes Ratio to moving Averages & Link

		Relative method. • Understand the concept of Cyclic component, moving averages process & Autoregressive process. • Understand variate component method. • Know the Forcasting method such as Box-Jenkin's method, Exponential smoothing method. • Know about weak stationarity, autocorrelation function & correlogram.
6th Semester	**STAT-C-601 Design of Experiments**	**At the end of the 6th sem. students will be able to-** • Understand the concept of Experimental designs, its role, historical perspective, chice of size & shape of plots & blocks. • Understand about Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), their layout, model, statistical analysis & their relative efficiency. • Analyse these designs with single missing observation. • Know about Balanced Incomplete Block Designs (BIBD)- its parameters, relationship among its parameters, incidence matrix & its properties. • Know about the concept, notations & advantages of factorial experiment such as 2^2, $2^3 \ldots 2^n$ & 3^2 factorial experiments. • Understand about the factorial experiment in a single replicate. • Know the construction of one half & one-quarter fractions of 2^n factorial experiment.
	STAT-C-602 Multivariate Analysis & Nonparametric Methods	• Understand about Bivariate Normal Distribution(BVN), its pdf, properties, marginal & conditional pdf of BVN. • Know the multivariate data, Random vector- its pmf, pdf, Distribution function, Mean vector & Dispersion matrix, Marginal & Conditional distributions. • Know the Multivariate Normal Distribution & its properties.

		• Know the Sampling distribution for mean vector & variance-covariance matrix, Multiple & Partial correlation coefficient & their properties. • Understand the Discriminant Analysis, Principal Components Analysis & Factor Analysis in the applications of Multivariate Analysis. • Know the concept of Non-parametric tests. • Test for randomness based on total number of runs. • Understand & apply Empirical distribution function, Kolmogorov- Smirnov test, Sign test, Wlcoxon- Mann-Whitney test, Kruskal-Wallis test.
	STAT-DSE-Project Work	The Aim of the course is to initiate students to write & present a statistical report on some area of human interest. The project work will provide hands on training to the students to deal with data emanating from some real life situation & propel them to dwell on some theory or relate it to some theoretical concepts.