SRI VENKATESWARA UNIVERSITY:: TIRUPATI

SVU COLLEGE OF SCIENCES

M.Sc., STATISTICS

Syllabus for M.Sc. Statistics

Choice Based Credit System (CBCS)

(w.e.f. the Academic Year 2019-2020)

VISION: To en-corporate certain specific objectives and scale to prepare the students to take up challenges in any one or more functional domain

1. ACADEMICS

2. BASIC AND APPLIED RESEARCH

3. RESEARCH AND DEVELOPMENT

4. SOFTWARE SKILLS

5. INDURSTRY

6. STATISTICAL ANALYSIS

MISSION: To bring out professional having knowledge of basic laws of nature together with strong fundamentals of in core areas of statistics viz. linear algebra, probability and distributions, statistical inference, multivariate analysis, econometric methods, operations research-i, time series analysis and forecasting methods , operations research-ii. Specializations subjects like….Sampling techniques, stochastic process, linear models and applied regression analysis, computer programming and data analysis, demography and official statistics, bio-statistics, statistical process and quality control, advanced econometric models. Technical subjects like… statistical analysis using excel and spss, python, design and analysis of experiments, industrial statistics and quality control, statistical analysis using R + R practical's

Program Educational Objectives: At the end program the student will be able to

- **PEO1:** Apply principals of basic scientific concepts in understanding and predictions of statistical sciences
- **PEO2:** Develop human resources with specializations in theoretical and experimental techniques required for carrier in academic, research and industry
- **PEO3:** Engage in lifelong learning and adopt changing in professional and society needs

PROGRAM EDUCATIONAL OBJECTIVES: at the program the student will be able to

- **P01:** Apply the scientific knowledge to solve the statistical data analysis problems
- **PO2:** Identify, formulate and analyze advanced scientific problems reading substantiated conclusions for all kind of disciplines like medical, biological series and so on.
- **PO3:** Creative design solutions for advanced scientific problems `and design system components using statistical analysis that meet the specified need with appropriate attention to health and safety risks.
- **PO4:** Using statistical analysis understanding the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
- **PO5:** Create, select and apply appropriate techniques, resources and modern statistical tools to complex statistical problems with understanding of the limitations.
- **PO6:** analyzing the impact of marketing sales into the society using data science techniques.
- **PO7:** By statistical methods demonstrating the knowledge and understanding the scientific principles and applying the statistical tools to manage projects and in multidisciplinary environments.
- **PO8:** apply ethical principles and norms of scientific practices
- **PO9:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings by statistical approach.

- **PO10:** Understanding the working of various analog communication techniques by using data science methods
- **PO11:** Project management of finance in collaboration with various firms by data science techniques
- **PO12:** Recognize the need and have the preparation and ability to engage independent and life-long learning in the broadest context of scientific and technological change by statistical approach.

Program Specific Outcomes: At the end of the program the student will be able to

- **PSO1:** Understand the basic and advanced concepts of probability, distributions.
- **PSO2:** Perform and design experiments in the area of Bio-statistics, advanced Bio-statistics, Time series
- **PSO3:** Apply knowledge on software like Excel, SPSS and R software

S.V. UNIVERSITY, TIRUPATI

DEPARTMENT OF STATISTICS
M.Sc., STATISTICS
CBCS Pattern (With effect from 2019-20)
The course of Study and Scheme of Examinations

SEMESTER-I

Sl. No.	Course Code	Components of Study	Title of the Course	Cont act Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	ST - 101	Core	Linear Algebra	6	4	20	80	100
2	ST - 102	Core	Probability Theory	6	4	20	80	100
3	ST - 103	Core	Distribution Theory	6	4	20	80	100
4	ST - 104	Core	Practical-I (75 Practical + 25 Record)	6	4	-	-	100
5	ST - 105	Compulsory Foundation **(Related to Subject)**	Statistical Computing	6	4	20	80	100
6	ST - 106	Elective Foundation	Human Values and Professional Ethics-I	6	4	20	80	100
	Total			**36**	**24**			**600**

SEMESTER-II

Sl. No.	Course Code	Components of Study	Title of the Course	Cont act Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	ST - 201	Core	Statistical Inference	6	4	20	80	100
2	ST - 202	Core	Multivariate Analysis	6	4	20	80	100
3	ST - 203	Core	(a) Linear Models and Applied Regression Analysis (b) Stochastic Processes (c) Mathematical Analysis	6	4	20	80	100
4	ST - 204	Core	Practical-II (75 Practical + 15 Viva- voce + 10 Record)	6	4	-	-	100
5	ST - 205	Compulsory Foundation **(Related to Subject)**	Sampling Techniques	6	4	20	80	100
6	ST - 206	Elective Foundation	Human Values and Professional Ethics-II	6	4	20	80	100
	Total			**36**	**24**			**600**

SEMESTER-III

Sl. No.	Course Code	Components of Study	Title of the Course	Cont act Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	ST - 301	Core	Econometric Methods	6	4	20	80	100
2	ST - 302	Core	Design and Analysis of Experiments	6	4	20	80	100
3	ST -303	Core	Operations Research-I	6	4	20	80	100
4	ST -304	Core	Practical-III (75 Practical + 25 Record)	6	4	-	-	100
5	ST - 305	Generic Elective * **(Related to Subject)**	(a)Bio-Statistics (b)Computer Programming and Data Analysis (c) Total Quality Management and Six - Sigma	6	4	20	80	100
6	ST - 306	Open Elective **(For other Department)**	(a) Statistics for Biological and Earth Sciences (b) Statistics for Social and Behavioral Sciences	6	4	20	80	100
	Total			**36**	**24**			**600**

*** Among the Generic Electives the student shall choose ONE**

SEMESTER-IV

Sl. No.	Course Code	Components of Study	Title of the Course	Cont act Hours	No. of Credits	IA Marks	End SEM Exam Marks	Total Marks
1	ST - 401	Core	Time Series Analysis and Forecasting Methods	6	4	20	80	100
2	ST - 402	Core	Demography and Official Statistics	6	4	20	80	100
3	ST - 403	Core	Operations Research-II	6	4	20	80	100
4	ST - 404	Core	Practical-IV (75 Practical + 15 Viva-voce + 10 Record)	6	4	-	-	100
5	ST - 405	Generic Elective * **(Related to Subject)**	(a) Statistical Process and Quality Control (b) Statistics for Research, industry and Community Development (c) Advanced Econometric Models	6	4	20	80	100
6	ST - 406	Open Elective **(For other Department)**	(a) Business Analytics (b) Survival Analysis	6	4	20	80	100
	Total			**36**	**24**			**600**

*** Among the Generic Electives the student shall choose ONE**

SEMESTER-I

ST 101: 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.

Subject Code	Subject Name	Credits Allotted		Total
ST-101	**Linear Algebra**	Theory	Practical	4
		4	---	
Course Objective	1. To Prepare Students about algebra of matrices and vector spaces. 2. To explain about roots vectors and linear transformations with an examples 3. To give the knowledge of orthogonality and its properties. 4. To know about the canonical form and its reduction.			
Course Out comes	1. Students understood for estimation of elementary transformations in matrix and their solutions. 2. Students learnt about characteristic roots and vectors with numerical examples. They also know theoretical proofs of theorems. 3. Discriminate between diagonalizable and non-diagonalizable matrices; orthogonally diagonalizable symmetric matrices and quadratic forms 4. Combine methods of matrix algebra to compose the change-of-basis matrix with respect to two bases of a vector space, identify linear transformations of finite dimensional vector spaces and compose their matrices in specific bases			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**2**	**1**				**3**	**2**	**2**	**2**
CO2	**3**	**2**	**3**	**2**	**1**				**3**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**1**				**3**	**2**	**2**	**2**
CO4	**3**	**2**	**3**	**2**	**1**				**3**	**2**	**2**	**2**

ST 102: 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.

Subject Code	Subject Name	Credits Allotted		Total
ST-102	**Probability Theory**	Theory	Practical	4
		4	---	
Course Objective	1. To Explain about classes of sets and Probability measures 2. To discuss on random variables and convergence in probability and the important theorems with proofs. 3. To discuss about inequalities on expectations with their derivations and laws of numbers. 4.To have a clear idea of central limit theorem.			
Course Out comes	1. Students must have knowledge about random variables, expectations, sets and their properties and inequalities where ever necessary. 2. Students also know the weak law, strong law and central limit theorem and their importance. 3. Students get the knowledge of the Central limit theorem and their real life uses. 4. Students can get the knowledge of the inequalities of probability and their uses.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO2	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO3	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO4	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**

ST 103: 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.

Subject Code	Subject Name	Credits Allotted		Total
ST-103	**Distributions Theory**	Theory	Practical	4
		4	---	
Course Objective	1. To explain about different discrete and continuous distributions and their properties. 2. To learn about derivations and properties of various sampling distributions. 3. To explain order Statistics and their properties 4. To get a clear idea about the distributions in statistics.			
Course Out comes	1. Students know about different continuous and discrete distributions and their properties. 2. They have awareness about central and non-central sampling distributions and order Statistics. Idea about simple, partial and multiple correlation coefficients. 3. Students get the knowledge of the statistical Tests and their real life uses and applications. 4. Students get the knowledge of Regression and Correlations and their real-life applications.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO2	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO3	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**
CO4	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**3**

ST 104 : PRACTICAL-I

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 25 marks for record in the semester)

<table>
<tr><td>Subject Code</td><td>Subject Name</td><td colspan="2">Credits Allotted</td><td>Total</td></tr>
<tr><td rowspan="2">ST-104</td><td rowspan="2"><u>PRACTICALS</u></td><td>Theory</td><td>Practical</td><td rowspan="2">4</td></tr>
<tr><td>----</td><td>4</td></tr>
<tr><td>Course Objective</td><td colspan="4">. 1. To write different problems manually solving through calculators.
2. To write problems and solving them on computers using Statistical software like Excel and other relevant software etc.,
3. To make the students to apply the statistical techniques in the Real life.
4. To know the statistical analysis using R software.</td></tr>
<tr><td>Course Out comes</td><td colspan="4">1. Numerical problems related to, Linear Algebra and Sampling Techniques are solved by executing programs of computers.
2. Linear algebra concepts when working with data preparation, such as one hot encoding and dimensionality reduction.
3. Applying linear algebra problems in real life situations.
4. Perform sampling methods analysis using R-software.</td></tr>
</table>

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**2**	**2**	**2**			**2**	**3**	**1**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**2**			**2**	**3**	**1**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**2**			**2**	**3**	**1**	**2**
CO4	**3**	**3**	**3**	**2**	**2**	**2**			**2**	**3**	**1**	**2**

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.

Subject Code	Subject Name	Credits Allotted		Total
ST-105	**Statistical Computing**	Theory	Practical	4
		4	----	
Course Objective	1. To familiar and to develop learning mindsets to analyze statistical data through C software. 2. To learn basic syntax, coding and vocabulary to aid in data analysis. 3. To give the students a real life practice on analysis. 4. To have a clear idea about the operations in excel.			
Course Out comes	1. Students get the basic Programming Skills of C and C++. 2. Students learnt how the Data entre in the Excel with Headings. 3. Students get the knowledge of creating data ase using the MS-Access. 4. Students get the knowledge how to create the reports using MS-EXCEL and MS ACCESS.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**2**	**3**	**1**			**1**	**2**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**3**	**1**			**1**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**3**	**1**			**1**	**2**	**3**	**3**
CO4	**3**	**3**	**2**	**2**	**3**	**1**			**1**	**2**	**3**	**3**

ST 106 : HUMAN VALUES AND PROFESSIONAL ETHICS-1

UNIT-I: Definition and Nature of Ethics-Its relation to Religion ,Politics, Business, Legal ,Medical And Environment, Need And Implementation Ethics-Goals-Ethical Values in Various Professions.

UNIT-II: Nature Of Values-Good and Bad, Ends and Means, Actual and Potential Values, Objectives and Subjective Values ,Analysis Of Basic Moral Concepts-rights, Ought, Duty, Obligation, Justice. Responsibility and Freedom .Good Behavior and Respect for Elders, Character and Conduct.

UNIT-III: Ahimsa (Non-Violence), Satya (Truth),Brahmacharya (Celibacy),Asteya (Non-possession) and APARIGRAHA (Non-stealing).Purusharthas (Cardinal virtues)-Dharma (Righteousness), Artha (Wealth), Kama(Fulfillment bodily desires).Moksha (Liberation)

UNIT-IV: Bhagavad Gita-(a) Niskama karma.(b).Buddhism-The four noble truths-Arya Astanga marga, (c) Jainisam- mahavratas and anuvratas. Values embedded in various religions, Religious tolerance, Gandhian ethics.

UNIT-V: Crime and Theories or punishment-(a) Reformative , Retributive and Deterrent ,(b) Views on manu and Yajnavalkya.

References:

1. R.Subramanian ,Professional Ethics, Oxford University Press.
2. Joha S Mackenjie:A Manual Of Ethics.
3. The Ethics of Management by Larue Tone Hosmer.Richard D.Irwin Lnc.
4. Management Ethics Integrity at Work by Joseph A.Petrick and John F.Quinn.Respons Books;New Delhi.
5. “Ethics in Management” By S.A.Sherlekar, Himalaya Publication House.
6. Harold H.Titus ; Ethics For Today.
7. Maitra,S.K;Hindu Ethics.
8. William Lilly;Introducation Ethics.
9. Sinha: A Manual of Ethics.
10. Manu:Manava Dharma Sastra or the Institute of Manu:Comparising the Indian Syastem of Duties :Raligious and civil (ed.) G.C.Halighton.
11. Susrpta samh ita: Tr.Kaviraj Kunjanlal , Kunjalal Brishagratha .Chowkarnaba Sanskrit series. Vol LII and III , Varanasi , Vol I 00, 16’20,21-32 and 74-77 only.
12. Caraka samhita :Tr.Dr.Ram karan sarma and vaidya bhagavan dash, Chowkarnaba Sanskrit series office. Varanasi I,11.111 Vol IPP 183-191.
13. Ethics, Theory and contemporary issues.Barbara mackinnon wadsworth / Thomsaon learning, 2001.
14. Analyzing moral.issues,Judith A.Boss.May Field Publishing Company-1999.
15. An introduction to applied ethics(ed.)John H.Piet and Ayodhya Prasad.cosmo publications.
16. Text book for intermediate first year ethics and human values. Board of intermediate education-Telugu-academy, Hyderabad.
17. I.C.Sharma ethics philosophy of india.Nagin & co julundhar.

Course Objectives:

1. Students need get the awareness of the Human Values and Ethics.
2. Students need to get the knowledge of the value education.
3. To teach the students how to behave in society.
4. To have a clear idea about the theme of bagavatgita.
5.

Course Outcomes:

1. Students get the knowledge of the Ethical values.
2. Students get the idea about the Value education.
3. Students learn how to behave in Society.
4. Students get the knowledge of the Bhagavat Geetha and Can apply in their life's.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**		**3**	**3**	**3**	**3**	**2**		**3**
CO2				**3**		**3**	**3**	**3**	**3**	**2**		**3**
CO3				**3**		**3**	**3**	**3**	**3**	**2**		**3**
CO4				**3**		**3**	**3**	**3**	**3**	**2**		**3**

SEMESTER – II

ST 201: STATISTICAL INFERENCE

Unit-I: Point estimation - Unbiasedness, Consistency, Efficiency and Sufficiency; Fisher-Neyman factorization theorem, complete sufficient statistics, minimum variance unbiased estimator (MVUE), Cramer - Rao inequality, Battacharayas inequality, Rao – Blackwell theorem. Exponential family, Maximum Likelihood estimation method, method of moments, method of minimum chi-squares and interval estimation.

Unit-II: Tests of hypothesis: Basic concepts, Most Powerful (MP) test, Neyman – Pearson Lemma, Consistency and Unbiased tests, Uniformly Most Powerful (UMP) test, UMP Unbiased tests, similar critical regions, Lehmann –Scheffe theorem, Likelihood Ratio Tests, Asymptotic Distribution of LR test, Bartlett's test for homogeneity of variances and Wald Test.

Unit-III: 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. 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-IV: Statistical decision theory – decision problems and two person games, problems of inference viewed as 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 Minimax principle, determination of minimax rule, minimax theorem. Minimax estimates of parameters of Binomial, Poisson and Normal distributions.

References:

1. Rohtagi, V.K (1988): An Introduction to Probability and Mathematical Statistics, Wiley Eastern
2. Rao C.R (1973), Linear Statistical Inference and its applications, (Revised Edition), Wiley Eastern
3. Lehmann, E.L (1986), Theory of point estimation, (Student Edition)
4. Lehmann, E.L (1986), Testing Statistical Hypothesis (Student Edition)

5. Gibbons, J.D (1985), Non-parametric statistical inference, 2nd Edition, Mercel Dacker Inc
6. Siegal Sidney (1987), Non-parametric Statistics for behavioral sciences, 3rd Edition, Springer Verlog
7. Kendal, M.G and Stuart, A (1968), The advanced theory of statistics, Vol-II, Chales Griffin and Co., London
8. Ferguson, T.S (1967), Mathematical Statistics – a decision theoretic approach, Academic Press
9. Goon, A.M, Gupta, M and Das Gupta, B (1980), An outline of statistical theory, Vol-II, World Press, Calcutta.

Subject Code	Subject Name	Credits Allotted		Total
ST 201	**STATISTICAL INFERENCE**	Theory	Practical	4
		4	----	
Course Objective	1. To study the Estimation methods of point and their different measures and theorems, inequality. 2. To discuss about Testing of hypothesis that contains NP Lemma, UHP test, Bartlett's, Wald test, LR test and some theorems relates to hypothesis testing. 3. To discuss different non-parametric tests with examples. Asymptotic relative efficiency and truncated distributions. 4. To study the Game theory and their problems, minimax rule, minimax theorem and minimum estimates of parameters using different distributions.			
Course Out comes	1. Students know about point estimation, non-parametric models, Game theory, theorems and Proofs where ever necessary. 2. They can understand the concept of random sample from a distribution, sampling distribution of statistic, standard error of important estimates such as mean and proportions. 3. Students may gain the knowledge of testing of hypotheses (both large sample test and small sample test). 4. They can also calculate the problems related to point estimation and interval estimation.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

CO1	**3**	**2**	**2**	**2**	**1**				**1**		**1**	**2**
CO2	**3**	**2**	**2**	**2**	**1**				**1**		**1**	**2**
CO3	**3**	**2**	**2**	**2**	**1**				**1**		**1**	**2**
CO4	**3**	**2**	**2**	**2**	**1**				**1**		**1**	**2**

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

Subject Code	Subject Name	Credits Allotted		Total
ST 202	**Multivariate analysis**	Theory	Practical	4
		4	----	
Course Objective	1. To study about Multivariate normal distributions and their properties, it's importance. 2. To discuss Hotelling's T^2, Mahalanobis D^2 statistic and its applications and properties. 3. To explain MANOVA with one and two way classified data. 4. To discuss about Principal Component Analysis, Factor Analysis and Cluster Analysis with appropriate methods.			
Course Out comes	1. Students learnt about importance of multivariate variables and their distributions 2. T^2, D^2, MANOVA models are understood and know it's importance. 3. Implement dimension reduction techniques using software on real life problems. 4. Classification analysis methods explained according to their classification algorithm.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**1**	**3**	**1**			**2**		**1**	**1**
CO2	**3**	**3**	**2**	**1**	**3**	**1**			**2**		**1**	**1**
CO3	**3**	**3**	**2**	**1**	**3**	**1**			**2**		**1**	**1**
CO4	**3**	**3**	**2**	**1**	**3**	**1**			**2**		**1**	**1**

ST 203 (a): 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 Practice of Econometrics, John Wiley and Sons.
4. Draper, N and Smith, B (1981): Applied Regression Analysis, Second Edition

Subject Code	Subject Name	Credits Allotted		Total
ST 203(a)	**Linear models and Applied Regression Analysis**	Theory	Practical	4
		4	----	

Course Objective	1. To discuss about linear regression models and their assumptions. 2. To study about different criteria for model selection and their Goodness of fit measures. 3. To explain Non normal disturbances and their consequences and statistical analysis of residuals. 4. To discuss about Non-linear regression estimation methods.
Course Out comes	1. Students learnt about different linear and non-linear regression models and their appropriate computational procedures. 2. They know R^2, adjusted R^2 and C_p criteria for model selection. 3. They will get the knowledge of building and fitting linear regression models with software. 4. They also learn about the theory underlying point estimation,hypothesis and confidence intervals for linear regression models.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**2**	**2**	**1**			**2**		**1**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**1**			**2**		**1**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**1**			**2**		**1**	**2**
CO4	**3**	**3**	**3**	**2**	**2**	**1**			**2**		**1**	**2**

ST 203 (b): 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.

Subject Code	Subject Name	Credits Allotted		Total
ST 203 (b)	**STOCHASTIC PROCESSES**	Theory	Practical	4
		4	----	
Course Objective	1. To explain stochastic process and their classification according to space and domain. 2. To discuss about Birth and death process, Renewal theory and its applications. 3. To knowa about stochastic process and their importance, Markov chains, Poisson process, Renewal theory, Branching process etc. 4. To explain the concept of the Moving Averages and its			

	applications..
Course Out comes	1. Understand the stochastic processes, Markov chains, Transition probability matrix and various types of states. 2. Explain Random walk, Gambler ruins problem and apply Poisson process in real life situations. 3. Formulate and solve problems which involve setting up stochastic models. 4. Understand renewal theory and branching processes with applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**1**	**1**				**1**	**1**	**2**	**1**
CO2	**3**	**2**	**1**	**1**	**1**				**1**	**1**	**2**	**1**
CO3	**3**	**2**	**1**	**1**	**1**				**1**	**1**	**2**	**1**
CO4	**3**	**2**	**1**	**1**	**1**				**1**	**1**	**2**	**1**

ST 203 (c): 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.

Subject Code	Subject Name	Credits Allotted		Total
ST 203 (c)	**MATHEMATICAL ANALYSIS**	Theory	Practical	4
		4	----	
Course Objective	1. Students get the knowledge of real no.'s and set theory. 2. Students get the knowledge of the sequencing. 3. Students to know the concepts of the double and triple integrals. 4. To review the topics related to complex number system			
Course Out comes	1. Students get the knowledge of real no.'s and set theory and their theories. 2. Students easily earn the knowledge of the sequencing theory. 3. Students get the knowledge if the integrations and their applications in the real life. 4. Students get the knowledge of the complex no. system and their applications I the statistics.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**1**
CO2	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**1**
CO3	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**1**
CO4	**3**	**2**	**1**	**1**	**1**				**1**		**2**	**1**

ST 204 : PRACTICAL-II

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 15 marks for viva-voce + 10 marks for record in the semester)

Subject Code	Subject Name	Credits Allotted		Total
ST-204	**PRACTICALS**	Theory	Practical	4
		----	4	
Course Objective	1. To exercise different practical problems manually through calculators. 2. To discuss problems relates to semester - II papers. 3. To discuss the real life agriculture problems. 4. To have a knowledge of the statistical tests to be used in the different situations.			
Course Out comes	1. Students know about the solving of Numerical problems related to Multivariate data. 2. Students can learn how the Statistical tests uses in their real life's by doing the tests on the Real times Data. 3. They can also use the statistical tools and techniques for analyzing the statistical data. 4. Students can solve the agriculture related problems using the Regression Methods.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**
CO2	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**
CO3	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**
CO4	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**

ST 205: SAMPLING TECHNIQUES

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 Theory, Vol. I and Methods and Applications Vol. II, John Wiley and Sons.
11. Philli. I. Good (2013):Introduction to statistics through resampling methods and R, 2nd edition.

Subject Code	Subject Name	Credits Allotted		Total
ST-205	**Sampling Techniques**	Theory	Practical	4
		4	----	
Course Objective	1. Discuss about basic concepts of sampling techniques PPS WR/WOR models. 2. To study about Hurwitz Thompson estimator, PPS scheme. 3. To learn about Ratio and Regression methods and their properties. 4. To explain Double sampling for difference estimators using ratio regression and PPS's, Non sampling error and their remedies.			
Course Out comes	1. Students learnt different sampling techniques of with replacement/ without replacement and Different sampling models. 2. Students studied non-Sampling errors and different remedies. 3. Implement Cluster sampling, Ratio and Regression estimation in real life problems 4. Apply unequal probability sampling designs viz. PPSWR, PPSWOR including Lahiri's method and Murthy's estimator for survey.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**3**	**3**	**1**			**2**		**2**	**2**

CO2	**3**	**2**	**1**	**3**	**3**	**1**			**2**		**2**	**2**
CO3	**3**	**2**	**1**	**3**	**3**	**1**			**2**		**2**	**2**
CO4	**3**	**2**	**1**	**3**	**3**	**1**			**2**		**2**	**2**

ST 206: HUMAN VALUES AND PROFESSIONAL ETHICS-II

UNIT-I: Value Education –Definition-Relevance to present day-Concept of Human Values-self introduction-self-esteem-family values-Components , Structure and responsibilities of family-Neutralization of anger-Adjustability-Threats of family life –Status of women in family and society –Caring for need elderly –Time allotment for sharing ideas and concerns.

UNIT-II: Medical ethics-Views if charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia ,ethical obligation to animals, ethical issues in relation to health care professional patients. Social justice in health care , human cloning , problems of abortion .Ethical issues ingenetic engineering and ethics issues raised by new biological technology of knowledge.

UNIT-III: Business ethics – Ethical standards of business-immoral and illegal practices and their solutions. Characteristics of ethical problems in management, ethical theories causes of unethical behavior , ethical abuses and work ethics.

UNIT-IV: Environmental Ethics- Ethical Theory , man And Nature- Ecological Crisis , Pest Control , Pollution and Waste , Climate Change, Energy and Population, Justice and Environmental Health.

UNIT-V: Social ethics – Organ trade. Human trafficking, Human rights violation and social disparities, Feminist ethics. Surrogacy / pregnancy, Ethics of media-Impact of newspapers, Television , Movies and Internet.

References:

1. Joha S Mackenjie:A Manual Of Ethics.
2. The Ethics of Management by Larue Tone Hosmer.Richard D.Irwin Lnc.

3. Management Ethics Integrity at Work by Joseph A.Petrick and John F.Quinn.Respons Books;New Delhi.
4. “Ethics in Management” By S.A.Sherlekar, Himalaya Publication House.
5. Harold H.Titus ; Ethics For Today.
6. Maitra,S.K;Hindu Ethics.
7. William Lilly;Introducation Ethics.
8. Sinha: A Manual of Ethics.
9. Manu:Manava Dharma Sastra or the Institute of Manu:Comparising the Indian Syastem of Duties :Raligious and civil (ed.) G.C.Halighton.
10. Susrpta samh ita: Tr.Kaviraj Kunjanlal , Kunjalal Brishagratha .Chowkarnaba Sanskrit series. Vol LII and III , Varanasi , Vol I 00, 16’20,21-32 and 74-77 only.
11. Caraka samhita :Tr.Dr.Ram karan sarma and vaidya bhagavan dash, Chowkarnaba Sanskrit series office. Varanasi I,11.111 Vol IPP 183-191.
12. Ethics, Theory and contemporary issues.Barbara mackinnon wadsworth / Thomsaon learning, 2001.
13. Analyzing moral.issues,Judith A.Boss.May Field Publishing Company-1999.
14. An introduction to applied ethics(ed.)John H.Piet and Ayodhya Prasad.cosmo publications.
15. Text book for intermediate first year ethics and human values. Board of intermediate education-Telugu-academy, Hyderabad.
16. I.C.Sharma ethics philosophy of india.Nagin & co julundhar.

Course Objectives:

1. Students need to get the knowledge of the Responsibilities.
2. Students need to get the awareness of the Medical Ethics.
3. Students to learn about the biological technology and its ethics.
4. Students to know about the value of bagavatgita.

Course Outcomes:

1. Students get the Knowledge of Status of Women in the family and society.
2. Students get the idea of the Medical Rights and Their responsibilities in the medical practitioners.
3. Students get the idea about the environmental Ethics.
4. Students Get the knowledge of Human Rights.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**		**3**	**3**	**3**	**3**	**2**		**3**

CO2				**3**		**3**	**3**	**3**	**3**	**2**		**3**
CO3				**3**		**3**	**3**	**3**	**3**	**2**		**3**
CO4				**3**		**3**	**3**	**3**	**3**	**2**		**3**

SEMESTER – III

ST 301: ECONOMETRIC METHODS

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.

Subject Code	Subject Name	Credits Allotted		Total
ST-301	**ECONOMETRIC METHODS**	Theory	Practical	4
		4	----	
Course Objective	1. To explain about heteroscedasticity, multicollinearity and their sources, consequences and tests. 2. To discuss about Autocorrelation, different orders of Autocorrelation and their estimation procedures. 3. To explain different lag models and their estimate procedures. 4. To discuss about simultaneous linear equations model and their different methods and estimation.			
Course Out comes	1. Students learnt heteroscedasticity, multicollinearity and autocorrelation and their estimation procedures. 2. Students understood about different lag models and simultaneous linear equations model with their estimation methods. 3. Explain core concepts and techniques in econometrics, with a special focus on the classical linear regression model. 4. Understand the assumptions upon which different econometric methods are based and their implications.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**
CO2	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**
CO3	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**
CO4	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**

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.

Subject Code	Subject Name	Credits Allotted		Total
ST 302	**Design and Analysis of Experiments**	Theory	Practical	4
		4	----	
Course Objective	1. 2. To learn ANOVA and ANCOVA for one- and two-way classifications analysis and their multiple comparison tests. 3. To explain Latin squares, different types of Latin squares and their missing plots. 4. To discuss on Confounding, their types, confounding 2^n, 3^2 and 3^3 factorial designs etc. 5. To discuss about BIBD, PBIBD construction analysis.			
Course Out comes	1. Students learnt ANOVA, ANCOVA technique for one way and two-way classifications. Multiple comparisons tests using Tukey's, Duncans, Sheffe's and Dunnet's tests. 2. Students understood about Latin squares and their construction, missing plot technique etc. 3. Students explained about Incomplete Block Designs and their analysis, etc. 4. Understand the basic terms used in design of experiments by using appropriate experimental methods.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**
CO2	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**

CO3	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**
CO4	**3**	**2**	**1**	**2**	**3**	**1**			**1**		**2**	**2**

ST 303: 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.

Subject Code	Subject Name	Credits Allotted		Total
ST-303	**Operations Research-I**	Theory	Practical	4
		4	----	
Course Objective	1. To introduce operations research, Dual-primal, Revised simplex methods. 2. To discuss Non-linear programming and integer programming and their related problems. 3. To explain Network flow charts, CPM and PERT, project management models. 4. To discuss Game theory of 2×2, $2\times m$, $m\times n$ and non-zero-sum games with their illustrations.			
Course Out comes	1. Students understood about Dual primal, Revised simplex methods. 2. Students learnt non-linear programming, integer programming, CPM, PERT, different models of games. 3. Students can think the real-life problems in the way of Linear Programming Problems and try to solve the problems in Mathematical Way. 4. Students can take a decision in real life by Using the Game Theory Techniques.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO2	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**

CO3	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO4	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**

ST 304 : PRACTICAL-III

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 25 marks for record in the semester)

Subject Code	Subject Name	Credits Allotted		Total
ST-304	**PRACTICAL**	Theory	Practical	4
		----	4	
Course Objective	1. To solve the different practical problems manually through calculators and computers. 2. To do the Practical problems related to semester - III papers. 1. To construct the life tables in demography. 2. To know the statistical tools in biological aspects.			
Course Out comes	1. Students can understand the Statical Methos in Economical Views. 2. Students solved the Numerical problems related to operations research. 3. Students Understand the Life Tables in Demography. 4. Students can understand how the statistics use in biological aspects. .			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**
CO2	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**

CO3	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**
CO4	**3**	**3**	**2**	**3**	**3**				**2**	**2**	**3**	**1**

ST 305 (a): BIOSTATISTICS

Unit-I: Structure of Biological assay , Types of Biological assays: Direct assays, Potency ratio, Fieller's theorem, Behren's distribution, Two generalizations of Fieller's theorem.

Unit-II: 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-III:: 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-IV: 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, Maximum Likelihood Method, Minimum Chi-Square method, Genetic parameters; Heritability Coefficients, Genetic Correlations, Repeatability, selection index; Inbreeding coefficient.

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.

Subject Code	Subject Name	Credits Allotted		Total
ST 305(a)	**Bio-Statistics**	Theory	Practical	4
		4	----	
Course Objective	1. To understand about biological assay and their types, distribution and some of theorems. 2. To learn dose response relationships, their estimation, transformations. 3. To discuss Geno types and phenol types, Matrix operations to base mattings of single gen cross etc. 4. To estimate Gene frequency using different methods.			
Course Out comes	1. Students learnt about biological assay, their distribution and theorems, dose response relationships, basic concepts of biological assay, estimation methods of gene frequencies, etc. 2. Describe single and multi-species population growth models. 3. Apply the concept of deterministic and stochastic models on simple and general epidemics. 4. Understand linearization of dynamical systems with various dimensions.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**1**	**2**	**1**			**2**		**2**	**3**

CO2	**3**	**3**	**2**	**1**	**2**	**1**			**2**		**2**	**3**
CO3	**3**	**3**	**2**	**1**	**2**	**1**			**2**		**2**	**3**
CO4	**3**	**3**	**2**	**1**	**2**	**1**			**2**		**2**	**3**

ST 305 (b): 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

Course Outcomes:

1: UnderstandtheatomictypesofR, differentmethodsofcreatingandfilteringof vectors,manipulationoftextdata,factordataanddates.
2: Understandhowtocreate,subsetandmodifydatastructureslikematrices, arrays,dataframesandlists.UnderstandhowtoreaddataintoandoutofR.
3: Understand the control statements of R, writing functions and scripts in R and debuggingfeatures ofR.Understandtheuseofapply familyoffunctions.
4: Understandtheusethehigh-levelplottingfunctionsinRtocreategraphsin baseRandthe low-levelplottingfunctionstocustomizethe graphs.
5: Understandtheuseofbuilt-infunctionstoperformhypothesestesting, correlationandregressionanalysis,andANOVA.

Course objectives:

1. Able to create and manipulate vectors, matrices, arrays, data frames and lists.
2. Should be able to work with character data, factor data and dates.
3. Able to write scripts and function in Rand read data from. csvfiles, EXCEL files And SPSS files.
4. Abletodistinguishbetweenhigh-levelandlow-levelplottingfunctionsavailable in base R.
5. Abletousebuilt-infunctionstoanswerquestionsrelatingtoprobability

distributions, parametric and non-parametric hypothesis testing, correlation and regression analysis, and one-way and two-way ANOVA.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**3**	**1**			**2**	**1**	**2**	**1**
CO2	**3**	**3**	**3**	**3**	**3**	**1**			**2**	**1**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**3**	**1**			**2**	**1**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**1**			**2**	**1**	**2**	**1**

ST305 (c): TOTAL QUALITY MANAGEMENT AND SIX SIGMA

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 : SIX SIGMA AND PDSA: An overview of six sigma methodology, DMAIC,DFSS and lean six sigma; product / process understanding : SIPOC, VSM, FMEA ; The Seven QC Tools of Quality, New Seven management tools, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles.

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.

Subject Code	Subject Name	Credits Allotted		Total
ST305 (c)	**TOTAL QUALITY MANAGEMENT AND SIX SIGMA**	Theory	Practical	4
		4	----	
Course Objective	1. To learn TQM, quality and their philosophy. 2. To discuss Planning and Organization. 3. To learn about SIX SIGMA AND PDSA 4. To have a clear idea about the tools of quality.			
Course Out comes	1. Students learnt about TQM, quality and SIX SIGMA AND PDSA. 2. Students can develop the leadership skills. 3. Students can get the awareness of team work. 4. Students can identify the real-life problems in Various business			

	fields.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO2	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO3	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO4	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**

ST 306 (a): STATISTICS FOR BIOLOGICAL AND EARTH SCIENCES

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; 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.

Subject Code	Subject Name	Credits Allotted		Total
ST 306 (a)	**Statistics for Biological and Earth sciences**	Theory	Practical	4
		4	----	
Course Objective	1. To learn basic statistics and their worked out examples. 2. To discuss about different tests like t, F, χ^2 and Z fro means, proportions, variances, standard deviation etc. with illustrations. 3. To explain ANOVA and ANCOVA for one way and two way classification and their importance in analysis. 4. To discuss Special statistical tools and multivariate analysis.			
Course Out comes	1. Students learnt about Graphs, measures of averages, measures of dispersion etc. 2. Students understood about Basic probability and important distributions with workout examples. 3. Students used t, F, χ^2 , ANOVA and ANCOVA and non-parametric tests with examples. 4. Students used Advanced statistics tools with working illustrations.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**2**	**1**	**2**		**1**		**2**	**1**
CO2	**3**	**2**	**1**	**1**	**2**	**1**	**2**		**1**		**2**	**1**
CO3	**3**	**2**	**1**	**1**	**2**	**1**	**2**		**1**		**2**	**1**
CO4	**3**	**2**	**1**	**1**	**2**	**1**	**2**		**1**		**2**	**1**

ST 306 (b): STATISTICS FOR SOCIAL AND BEHAVIOURAL SCIENCES

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 $\overline{R}^2$ 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.

Subject Code	Subject Name	Credits Allotted		Total
ST 306 (b)	**Statistics for social and behavioral sciences**	Theory	Practical	4
		4	----	
Course Objective	1. To learn about Basic statistics measures with examples. 2. To discuss important concepts, probability distributions like Binomial, Poisson and Normal properties and applications. 3. To explain Parametric and non-parametric test and discussed with illustrations. 4. To discuss advanced statistical tools with examples.			
Course Out comes	1. Students learnt about Graphs, measures of averages, measures of dispersion etc. 2. Students understood about basic probability and important distributions with workout examples. 3. Students applied t, F, χ^2, ANOVA and ANCOVA and non-parametric tests and discussed with examples. 4. Students used Advanced statistics tools with illustrations.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**2**	**1**	**2**	**1**			**1**		**2**	**2**
CO2	**3**	**1**	**2**	**1**	**2**	**1**			**1**		**2**	**2**
CO3	**3**	**1**	**2**	**1**	**2**	**1**			**1**		**2**	**2**
CO4	**3**	**1**	**2**	**1**	**2**	**1**			**1**		**2**	**2**

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.

Subject Code	Subject Name	Credits Allotted		Total
		Theory	Practical	
ST401	**Time series Analysis and forecasting methods**	4	----	4
Course Objective	1. To fit growth curves, measurement of cyclical and irregular component with simple examples. 2. To discuss Forecasting and their techniques like regression, non-linear regression, exponential smoothing, etc. 3. To explain Box Jenkins time series models and their estimation of parameters, fitting and diagnostic checking. 4. To Check and validate models with its residual analysis and diagnostic checking.			

Course Out comes	1. Students understood Time series analysis with some important growth models and their fitting 2. Students forecasting using regression, non-linear regression techniques, single, double, triple and adoptive exponential smoothing models. 3. Students obtained knowledge on AR, MA, ARMA, ARIMA, models fitting, diagnostic checking, etc. 4. Check and validate models with its residual analysis and diagnostic checking.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO2	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO3	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO4	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**

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.

Subject Code	Subject Name	Credits Allotted		Total
ST 402	**Demography and official statistics**	Theory	Practical	4
		4	----	
Course Objective	1. To study about demography and their importance, different reproduction. 2. To explain population Genetics, CSO, NSSO and their scope and contents in population census in India. 3. To learnt about population census methods, organizations in India and their functions. 4. To make to students as a means of analyzing and predicting social, cultural, and economic trends related to population.			
Course Out comes	1. Students know the growth rates, life tables, GRR, NRR and growth models. 2. Students understood about gene frequencies, genotypes, phenotypes etc. 3. Students learnt about population census methods, organizations in India and their functions. 4. Useful to students as a means of analyzing and predicting social, cultural, and economic trends related to population.			

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO2	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO3	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**
CO4	**3**	**1**	**1**	**1**	**2**				**2**		**3**	**3**

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.

.

Subject Code	Subject Name	Credits Allotted		Total
ST- 403	**Operations Research-II**	Theory	Practical	4
		4	----	
Course Objective	Students learnt about Queuing models, Dynamic programming, Goal programming, Stochastic programming, inventory control models, replacement problems with some simple examples.			
Course Out comes	1. To perform Dynamic programming and their applications and computation procedure with illustration. 2. To discuss different Queuing models steady state solutions with examples. 3. To explain Inventory models with and without shortages, S-splicy, EOQ estimation with simple examples. 4. To understand Replacement problems such as block and age replacement problems, individual and group replacement policies with examples.			

ST 404 : PRACTICAL –IV

At least 20 practicals covering all papers relating to the subject in this semester must be carried out. (75 marks for practical examination + 15 marks for viva-voce + 10 marks for record in the semester)

Subject Code	Subject Name	Credits Allotted		Total
ST-304	**PRACTICAL**	Theory	Practical	4
		----	4	
Course Objective	1. To solve the different practical problems manually through calculators and computers. 2. To do the Practical problems related to semester - III papers.			

	1. To do the Practical problems related to semester - III papers. 2. To use the statistical tools in the biological aspects.
Course Out comes	1. Students can understand the Statical Methos in Economical Views. 2. Students solved the Numerical problems related to operations research. 3. Students Understand the Life Tables in Demography. 4. Students can understand how the statistics use in biological aspects. .

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**3**	**2**			**3**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**			**3**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**			**3**	**2**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**			**3**	**2**	**3**	**2**

ST 405 (a): 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. Mittage, 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

Subject Code	Subject Name	Credits Allotted		Total
405 (a)	**STATISTICAL PROCESS AND QUALITY CONTROL**	Theory	Practical	4
		2	2	
Course Objective	1. To understand the basic concepts of control charts for variables and their indices. 2. To discuss different control charts like Shewart's moving average, multivariate etc. with their applications. 3. To explain different sequential sampling plans and six sigma tool etc. with their properties and applications.. 4. To use the statistical tools for quality management.			
Course Out comes	1. Students understood the basic concepts of control charts for variables and their indices. 2. Students performed different control charts like Shewart's moving average, multivariate etc. with their applications. 3. Students used different sequential sampling plans and six sigma tool etc. in solving the problems. 4. Students have awareness about Total Quality Management.			

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO2	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO3	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO4	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**

ST 405(b): STATISTICS FOR RESEARCH, INDUSTRY AND COMMUNITY DEVELOPMENT

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.

Taha, H.A. (1992), Operations Research, An Introduction, Fourth Edition

Subject Code	Subject Name	Credits Allotted		Total
ST 405(b)	**STATISTICS FOR RESEARCH, INDUSTRY AND COMMUNITYDEVELOPMENT**	Theory	Practical	4
		4	----	
Course Objective	1. To understand Response surface models, stepwise, partially linear and non-parametric regression models with their applications. 2. To discuss Simulation models, demand analysis and their related tools 3. To explain social server, steps in social server measurements with examples. 4. To know about social surveys and community development.			
Course Out comes	1. Students have done Simulation models, response surface models, demand analysis, social survey and their related measures. 2. Students can understand the basic of research blooms taxonomy of learning levels. 3. Find the topic from current research in statistics education. 4. Students can apply the tools in design, research and developments.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

CO1	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO2	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO3	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**
CO4	**3**	**1**	**1**	**2**	**2**				**1**		**1**	**1**

ST 405 (c): ADVANCED ECONOMETRIC MODELS

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 Models: Estimation and Inference, Marcel Dekker, Inc
5. Cook. D and Weisberg. S (1982), Residuals and Inference in Regression, Chapman and Hall.

Subject Code	Subject Name	Credits Allotted		Total
ST 405 (c)	**Advanced Econometric Models**	Theory	Practical	4
		4	----	
Course Objective	1. To explain OLS, GLS, BLUE and Recursive residuals with their properties. 2. To discuss different regression models and their importance. 3. To perform estimation in censored and Truncated Samples. 4. To fit sets of linear regression models and their related estimators.			
Course Out comes	1. Students understood GLM, SURE, nested and non-nested statistical models. 2. Students learnt about specification error, adding, switching models. 3. Students performed probit, logit models and their estimation. 4. Students can understand the qualitative and limited dependent variable models.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**

ST 406 (a) BUSINESS ANALYTICS

UNIT-I: BUSINESS MATHEMATICS: Matrix Algebra: Addition, Multiplication, Transpose and Inverse of Matrices; Determinants, Solution of Linear Equations; Limits of Algebraic functions; Rules for Differentiation; Linear programming problem-Graphical Method; Applications.

UNIT-II: BUSINESS ANALYSIS: Statistical Measures: Mean, Median and Mode; Standard Deviation and Coefficient of Variation; Correlation and Regression analysis; Linear and Compound growth rates; Measures of Association; concepts of R^2 and $\overline{R}^2$.

UNIT-III: BUSINESS STATISTICAL INFERENCE: Elements of Probability; Concepts of Binomial, Poisson and Normal Distributions; Sampling Techniques: Simple Random Sampling and Stratified Random Sampling; Determination of sample size; Tests of Significance: z, t, χ^2 and F tests, ANOVA Technique.

UNIT-IV: BUSINESS INFORMATICS: Time series Analysis; Determination of Trend and seasonal components, Basic Forecasting Methods; computer Applications to Business Analysis; Statistical Quality Control: control charts $\overline{X}$, R, p, np and c-charts.

References:

1. Azel and Sounderpandian, Complete Business Statistics, TMH.
2. JK Sharma, Business Statistics, Pearson.
3. RS Bhardwaj, Mathematics for Economics and Business, EB.
4. RP Hooda, Statistics for Business and Economics, McMillan.
5. GC Beri, Business Statistics, TMH.
6. Glynn Davis and BrankoPecar, Business Statistics using Excel, Oxford University press, 2010.
7. J.K. Sharma, Fundamentals of Business Statistics, 2nd Edition, Vikas Publication, 2014.
8. SC Gupta, Fundamentals of Statistics, Himalaya Publications, 2013.
9. N.D. Vohra, Business Statistics, Tata McGraw Hill, 2013.
10. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Publishers, New Delhi.
11. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons Publishers, New Delhi.
12. R. Pannerselvam, Research Methodology, Published by PHI Learning Private Limited, New Delhi.
13. Donald R Cooper and Pamela S Schnidler, Business Research Methods, Nineth Edition, Tata Mc Graw Hill Publishing Company Limited, New Delhi.

Subject Code	Subject Name	Credits Allotted		Total
ST 406 - (a)	**Business Analytics**	Theory	Practical	4

		4	----	
Course Objective	1. To learn basic statistics and their worked out examples. 2. To discuss different tests like t, F, χ^2 and Z fro means, proportions, variances, standard deviation etc. with an illustrations. 3. To study ANOVA and ANCOVA for one way and two way classification and their importance in analysis. 4. To use special statistical tools and multivariate analysis.			
Course Out comes	1. Students learnt Graphs, measures of averages, measures of dispersion etc. 2. Students studied basic probability and important distributions with workout examples. 3. Students used t, F, χ^2, ANOVA and ANCOVA and non-parametric tests and discussed with examples. 4. Students performed advanced statistics tools for solving the problems.			

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**3**	**2**

ST406 (b) : SURVIVAL ANALYSIS

UNIT – I:

Functions of Survival Time – Definition, Relationship of Survival Functions; Nonparametric Methods of Estimating Survival Functions: Product-Limit Estimate of Survival Function – Kaplan-Meier Estimator of Survival Function.

UNIT – II:

Nonparametric Methods for Comparing Two Survival Distributions – Gehan's Generalized Wilcoxon Test, Cox - Mantel test, Logrank Test, Peto and Peto's Generalized Wilcoxon Test, Cox's F-test and Mantel-Haenszel Test.

UNIT – III:

Parametric Methods for Comparing Two Survival Distributions: Exponential, Weibull and Gamma distributions only. Nonparametric and Parametric Methods for Identifications of Prognostic Factor Relating to Survival Time, Cox Proportional Hazard (PH) Model for Survival Data.

UNIT – IV:

Analytical Estimation Procedures for Survival Distributions: Exponential, Weibull, Log-Normal and Gamma distributions only.Graphical Methods for Survival Distributions Fitting: Probability Plotting, Hazard Plotting Methods, Tests of Goodness-of-Fit, A Regression Method for Fitting Survival Distribution.

REFERENCES:

1. Elisa T.Lee (1992): *Statistical Methods for Survival Data Analysis*, John Wiley Sons.
2. Miller, R.G. (1981): *Survival Analysis*, New York, John Wiley & Sons, Inc.
3. Cross A.J. and Clark V.A. (1975): *Survival Distribution, Reliability Applications in the Biomedical Sciences*, John Wiley and Sons.
4. Elandt Johnson, R.C., Johnson N.L. (1999): *Survival Models and Data Analysis*, New York, John Wiley & Sons, Inc.
5. Collett, D. (1994), *Modeling Survival Data in Medical Research,* London: Chapman & Hall.
6. Cox, D. R. and Oakes, D. (1984), *Analysis of Survival Data,* London: Chapman & Hall.
7. Lawless, J. F. (1982), *Survival Models and Methods for Lifetime Data,* New York: John Wiley & Sons, Inc.

Subject Code	Subject Name	Credits Allotted		Total
ST 406 (b)	**Survival analysis**	Theory	Practical	4
		4	----	
Course Objective	1. To learn Survival functions and their estimation models. 2. To discuss Distributions relating to survival analysis. 3. To know the Parametric and Non-Parametric methods of			

	survival time. 4. To understand the terms like hazaed function and its applications.
Course Out comes	1. Students learnt about survival functions, their estimating methods, Distributions and their comparison for survival distributions. 2. Understand the elements of reliability, hazard function and its applications. 3. Understand the concept of censoring, life distributions and ageing classes. 4. Estimate nonparametric survival function of the data.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**1**	**1**					**1**		**2**	**2**
CO2	**3**	**3**	**1**	**1**					**1**		**2**	**2**
CO3	**3**	**3**	**1**	**1**					**1**		**2**	**2**
CO4	**3**	**3**	**1**	**1**					**1**		**2**	**2**