Master of Science (Applied Statistics)

Name of Program	**Master of Science (Applied Statistics)**
Abbreviation	**M.Sc. (Applied Statistics)**
Duration	**2 Years**
Eligibility Criteria	Passed B.Sc., B.Com, B.A., BCA, or BBA with subsidiary statistics.
Objective of Program	The core objective of the programme is to prepare the students to be capable of doing any kind and every kind of data analysis and to be helpful to the society and academia by providing an outstanding environment of teaching and research in the core and emerging areas of the discipline.
Program Outcome	**PO1 : Fundamental Knowledge Enrichment** The Program trains students with the core statistics knowledge. It also makes students capable of using core concepts in the conceptualization of domain specific application development. **PO2 : Critical Thinking Development** The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem. **PO3 : Advanced Emerging Technology Awareness** The program trains students with the latest technologies that are being used in the industry/ research. The continuous syllabi review adds value to the programme for the outgoing students and make them ready to face challenging demands of the industry. **PO4 : Advanced Tools Usage** The program teaches the students to apply the advanced tools to solve real world problems. **PO5 : Nurturing Project Planning and Management Capabilities** The program trains students for designing and conceptualizing the statistical techniques and software architecture, planning and managing the process of complex real life problems in statistical frame work. It also makes students understand the decision making for an appropriate technique selection capability. **PO6 : Real World Problem / Project Development** Real world project provides the candidates exposure to work in the challenging and demanding environment of the industry/research. The project development training makes students employable and industry ready. **PO7 : Team Work and Leadership Development** Trains students to work in a team and also to take leadership of the of the project management team.
Program Specific Outcomes	PSO1 : Develop and strengthen the fundamental core concepts that are required to solve complex problems PSO2 : Develop the professional and entrepreneurship skills that needs independent logical and analytical thinking, teamwork and leadership PSO3 : Nurture the students to investigate for the design and development of a workable solution for a real world problem PSO4 : Develop students for self-learning and practicing challenging problem solution

PSO5: Train students to apply statistical skills to analyze and interpret output for applications/solution of statistical analysis of real life problems.
PSO6 : Train students to use recent techniques and software/programmes for application domain specific knowledge
PSO7 : Inculcate the passion for continuous learning and doing research for making a successful professional career

Mapping between POs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
PO1	✓		✓	✓	✓		
PO2	✓	✓	✓	✓	✓		✓
PO3		✓	✓	✓	✓	✓	✓
PO4		✓	✓	✓	✓	✓	✓
PO5	✓	✓	✓	✓	✓	✓	✓
PO6	✓	✓	✓	✓	✓	✓	✓
PO7		✓		✓			

Program Structure: Semester -I

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MAS-101	Basic Mathematics and Elements of Probability Theory	4	-	4	3 Hrs	70	30	100
MAS-102	Probability Distributions	4	-	4	3 Hrs	70	30	100
MAS-103	Sample Survey	4	-	4	3 Hrs	70	30	100
MAS-104	Industrial Statistics	4	-	4	3 Hrs	70	30	100
MAS-105	Introduction to Ms-Office and Internet	4	-	4	3 Hrs	70	30	100
MAS-106	Practical paper-I (Practical +viva-voce) based on Paper - 101, 102,103	-	4	2	2 Hrs	70	30	100
MAS-107	Practical paper-II (Practical +viva-voce)based on Paper - 104, 105	-	4	2	2 Hrs	70	30	100
	Total	20	08	24				

Program Structure: Semester –II

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MAS-201	Statistical Inference -I	4	-	4	3 Hrs	70	30	100
MAS-202	Statistical Inference -II	4	-	4	3 Hrs	70	30	100
MAS-203	Multivariate Analysis	4	-	4	3 Hrs	70	30	100
MAS-204	Actuarial Statistics	4	-	4	3 Hrs	70	30	100
MAS-205	Computer Programming Language - "C"	4	-	4	3 Hrs	70	30	100
MAS-206	Practical paper-III (Practical +viva-voce) based on Paper - 201, 202, 203	-	4	2	2 Hrs	70	30	100
MAS-207	Practical paper IV (Practical +viva-voce) based on Paper - 204, 205	-	4	2	2 Hrs	70	30	100
	Total	20	08	24				

Program Structure: Semester -III

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MAS-301	Statistics for economics	4	-	4	3 Hrs	70	30	100
MAS-302	Operations research - I	4	-	4	3 Hrs	70	30	100
MAS-303	Econometrics	4	-	4	3 Hrs	70	30	100
MAS-304	Introduction to Statistical Softwares	4	-	4	3 Hrs	70	30	100
MAS-3051 MAS-3052 MAS-3053	Elective paper*(Any one) Database Management Systems Official Statistics Population Studies	4	-	4	3 Hrs	70	30	100
MAS-306	Practical Paper – V (Based on paper – 301, 302, 303)	-	4	2	2 Hrs	70	30	100
MAS-307	Practical - VI (Based on paper – 304, 305)	-	4	2	2 Hrs	70	30	100
	Total	20	08	24				

Program Structure: Semester –IV

Course code	Title	Teaching per week		Course credit	University Examination		Internal Marks	Total Marks
		Theory	**Practical**		**Duration**	**Marks**		
MAS-401	Design of Experiments	4		4	3 Hrs	70	30	**100**
MAS-402	Operations Research - II	4		4	3 Hrs	70	30	**100**
MAS-4031 MAS-4032 MAS-4033	Elective* (Any one) Data Mining Bio-statistics & Clinical Research Statistical Simulation	4		4	3 Hrs	70	30	**100**
MAS-404	Practical paper -VII (Practical +viva-voce) based on Paper - 401, 402,403		4	4	2 Hrs	70	30	**100**
**	Project and Seminar		4 Hr per week per group	8		140	60	200
	Project and Seminar			4		70	30	100
	Total	12	4 +project work load	28				

Course Code	**MAS-101**
Course Title	**BASIC MATHEMATICS AND ELEMENTS OF PROBABILITY THEORY**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course is to present and apply the general theory of statistical distributions as well as the standard distributions found in statistical practice.
Course Objective	To make students acquainted with concepts of probability distribution and its applications.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the concept of functions, Differentiation and Integration with application. CO2: Understand some standard series of positive terms. Concept of interpolations and its application. CO3: Understand the concept of determinant and matrices. Types of matrices and its application. PO4: Understand the concept of Permutation and Combination with some examples. CO5: Understand the concept of Probability and its applications PO6: Understand the use of discrete and continuous probability distributions, including requirements, mean and variance, and making decisions. CO7: Identify the characteristics of different discrete and continuous distributions. CO8: Identify the type of statistical situation to which different distributions can be applied. CO9: Understand the most common discrete and continuous probability distributions and their real life applications. CO10: Compute marginal and conditional distributions from joint distributions. Get familiar with transformation of univariate and bivariate distribution. CO11: Understand distribution which will help to understand the nature of data and to perform appropriate analysis.

Mapping between POs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■	■				■	
	CO2	■	■				■	
	CO3	■	■				■	
	CO4	■	■	■	■	■	■	■
	CO5	■	■	■	■	■	■	■
	CO6	■	■	■	■	■	■	■
	CO7	■	■	■	■	■	■	■
	CO8	■	■	■	■	■	■	■
	CO9	■	■	■	■	■	■	■
	CO10	■	■	■	■	■	■	■
	CO11	■	■	■	■	■	■	■

Pre-requisite	Basics concept of calculus, matrix and probability
Course Content	**UNIT I:** • Concepts of Function, Algebra of functions, Algebra of functions Polynomial and Exponential functions &Logarithmic functions. • Concept of Derivative of a function. Derivatives of xn, eX, logx. Algebra of differentiation. Interpretation of derivative as rate of change & Applications. • Integration as an inverse operation of differentiation. Definite Integral. Integral as the area under a curve. Properties of Integral. Integrals of some standard functions & its Applications. **UNIT II:** • Sums of some standard series of positive terms. • **Numerical Methods:** Solution of algebraic and transcendental equations, Numerical integration, Concept of interpolation, Simpson 1/3 rule & 3/8 rule & its Applications. **UNIT III:** • Determinants, Matrices, Algebra of matrices: Determinants & its properties. Scalar multiplication, addition and multiplication of matrices. Inverse of a square matrix. Concept of rank of a matrix. Rank determination. Linear equations, Systems of linear equations as matrix equations. Characteristic roots and vectors. **UNIT IV:** • Permutations and Combinations. • **Probability:** Sample space of a chance experiment, Elementary outcomes, Events, Representation of events as sets, Combination of events (Complements, Intersections, Unions). Probability functions over a sample space (Discrete case). Case of Equally likely, elementary outcomes: Laplace definition of probability of an event, Axioms of probability. Combinatorial problems of Probability calculation. Conditional Probability. Bayes Theorem. Independent events.
Reference Books	1. John Scheick(1997):Linear Algebra With Applications, Mcgraw-hill, ISBN: 10:0071155309, ISBN-13: 9780071155304, 2. Strang(2008):Linear Algebra And Its Applications, Cengage Learning (Thompson), ISBN: 10:8131501728,ISBN-13: 9788131501726 3. Dutta K. B.(2003) : "Matrix and Linear Algebra"; Prentice Hall India, ISBN: 10:8120306368, ISBN-13: 9788120306363 4. Thomas S. Shores(2007): Applied Linear Algebra And Matrix Analysis, Springer Verlag Publication, ISBN:10: 0387331956, ISBN-13:9780387331959, 5. S. Lang, Serge A. Lang (1997): Introduction To Linear Algebra, Springer Publication, ISBN-10: 0387962050, ISBN-13: 9780387962054 6. K.M. Abadir& J.R. Magnus (2005): Matrix Algebra. Cambridge University Press: ISBN-10: 0521822890; ISBN-13: 978-0521822893. [MR2408356] 7. Fuzhen Zhang (1999):Matrix theory: basic results and techniques:, Springer Verlag new York, ISBN: 0387986960
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	MAS-102
Course Title	**Probability Distribution**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course is to present and application of the general theory of different probability distributions to real life situations/problems.
Course Objective	To make students acquainted with concepts probability distribution and its applications.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the use of discrete and continuous probability distributions, including requirements, properties of distributions and its use in making decisions. CO2: Identify the characteristics of different discrete and continuous distributions. CO3: Identify the type of situation to which different distributions can be applied. CO4:Understand the most common discrete and continuous probability distributions and their real life applications CO5: Compute marginal and conditional distributions from joint distributions. Get familiar with transformation of univariate and bivariate distributions. CO6: Understand the distribution which helps to understand the nature of data and selection of appropriate analysis.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■		■			
CO2	■	■	■	■			
CO3	■	■	■	■		■	
CO4	■	■	■	■	■		
CO5	■	■		■			
CO6	■	■	■	■	■	■	

Pre-requisite	Basics concept of Statistics and distributions
Course Content	**UNIT I:**

UNIT I:

- **Random Variables & their Distributions :**
  Definition of random variable, Discrete and continuous random variable. Probability distribution of a random variable. Concept of Probability mass function and Probability density function, Distribution Function (d.f.) of a random variable.

- **Expectations & Moments of a Distribution :**
  Expectation of a random variable & a function of a random variable (Discrete and Continuous case). Moments, Different types of moment generating functions, Mean, Variance, Standard deviation, Skewness and Kurtosis of a random variable (distribution). Independence of variables. Linear transformation of variable, Moments under linear transformation,

	Problems on calculation of mean, variance, S.D. and other moments of a distribution.
	UNIT II:
	- **Frequency Distributions :** Frequency distribution of a discrete and continuous random variable (Grouping of data in terms of class intervals). Mean, variance and Moments of a frequency distribution. Bivariate frequency distribution, Conditional distributions and their properties.
	UNIT III:
	- **Some Common Discrete Distributions: (proofs for p.m.f., mean & variance only):** Bernoulli distribution, Binomial distribution, Poisson distribution, Hyper-geometric distribution, Negative Binomial distribution, Geometric distribution. General concept of m.g.f. & other important properties of distributions (without proof).
	UNIT IV:
	- **Some Common Continuous Distributions: (proofs for p.d.f., mean & variance only):** Uniform distribution, Normal distribution, Exponential distribution, Beta and Gamma distribution. General concept of m.g.f. & other important properties of distributions (without proof)
	- **Sampling Distributions:** χ^2 - distribution, t − distribution, F − distribution, Distribution of $\bar{x}$ and S^2 for Normal distribution
Reference Books	1. Mood A. M., Graybill F. A. and Boes D. C. (2001): "An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill. ISBN: 100070445206, ISBN-13:9780070445208. 2. Goon A. M., Gupta M. K. and Dasgupta B. : "An Outline of Statistical Theory"; Vol. 1 & 2, World press. ISBN:10- 8187567260, ISBN-13: 9788187567264, 978-8187567264 3. Valery Nevzorov, Vicki B. Galloway, V. B. Nevzorov: A Primer On Statistical Distributions ISBN: 10: 0471427985, ISBN-13: 9780471427988. 4. A.k. Md. Ehsanes Saleh Vijay K. Rohatgi(2008): An Introduction To Probability And Statistics, 2nd Ed ISBN: 10- 8126519266, ISBN-13: 9788126519262. 5. Norman L. Johnson, Adrienne W. Kemp, Samuel Kotz(2008):Univariate Discrete Distributions, Set: III-Ed., John Wiley & Sons, ISBN:10: 0470383372, ISBN-13: 9780470383377. 6. Norman L Johnson, Samuel Kotz (2004); Continuous Univariate Distributions,2e, John Wiley, ISBN:10:9812530762, ISBN-13: 9789812530769. 7. Peter Dalgaard (2008): Introductory Statistics with R Statistics and computing, II-Ed., Springer, ISBN: 0387790535, 9780387790534. 8. Julian James Faraway(2006): Extending the linear model with R: generalized linear, mixed effects and nonparametric regression models, CRC Press, ISBN: 158488424X, ISBN-13:9781584884248
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment

Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-103: SAMPLE SURVEY

Course Code	**MAS-103**
Course Title	**SAMPLE SURVEY**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course is to provide the knowledge of sample survey and sampling designs starting with the basic concepts.
Course Objective	The objective of this course is to acquaint the students about the need & merits of sampling over census, theoretical and practical applications of different probabilistic, non-probabilistic sampling techniques and point estimation & interval estimation of different parameters of interest under different sampling techniques.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the basic principles of survey design and estimation. CO2: Apply different sampling methods, like SRSWR, SRSWOR, post–stratification (stratified sampling), Systematic sampling, Cluster sampling, Two stage sampling, multistage sampling for designing and selecting a sample from population under study and estimation of parameter of interest. CO3: Have Theoretical understanding and practical applications of use of auxiliary variable at estimation stage, e.g. Ratio, product and Regression methods of estimation under different sampling techniques and use of two phase /double sampling.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	CO1	■	■	■					
	CO2	■	■	■	■		■	■	
	CO3	■		■	■		■	■	

Pre-requisite	Basic Concept of sampling
Course Content	**UNIT I:** • **Planning and Execution of Surveys :** Concept of population, sample, Advantages of sample survey, Principal steps in a sample survey and Determination of sample size, Pilot surveys, selection of enumerators, training of enumerators, supervision of enumerators, control of quality of field work, observation, reinterviews, field edit, follow-up of nonresponse, interpenetrating sub samples, time coding, tabulation, control of data processing, use of computers, report writing, general report, technical report. • **Data Collection in Selected Fields :** Surveys of agricultural area, surveys of agricultural production, demographic surveys, employment and unemployment surveys, consumer expenditure surveys, surveys of health, industrial surveys, surveys of distributive trade, sampling as an census surveys of road traffic, public opinion surveys, marketing research, payroll surveys, postal traffic surveys, sociological research. **UNIT II:** • **Simple random sampling:** Selection of sample, Estimation of population total and means, standard error and coefficient of variation of estimator. • **Stratified random sampling:**

	Estimation of mean, variance of the estimator, Estimation of the variance, Estimation of gain due to stratification from a stratified sample: finding sample sizes under proportional and optimum allocations and their comparisons for a given sample. **UNIT III:** • **Systematic Sampling :** Estimation of mean, variance of the estimator, Estimation of variance based on interpenetrating sub samples, Comparison of systematic and simple random sampling for a given population. • **Two stage sampling :** Estimation of the population mean, variance of the estimator and Estimation of the variance for first stage units of equal sizes, finding optimum values of first and second stage sample sizes for a given simple cost function.
Reference Books	1. Cochran W. G.(1977): "Sampling Techniques"; Ed.-III, John Wiley & Sons, Inc., New York, ISBN: 047116240X 2. Hansen M. H., et al.(1993): "Sample Survey Methods and Theory"; Wiley Blackwell; Volume 1 edition, **ISBN-10:** 0471309672, **ISBN-13:** 978-0471309673 3. Kish L. (1995) : "Survey Sampling"; John Wiley & Sons, Inc., New York. ISBN: 0471109495, 9780471109495 4. Murthy M. N. : "Sampling Theory and Methods"; Statistical Publishing Society, Calcutta. 5. Raj D. : "Sampling Theory"; McGraw-Hill Book co., New York. 6. Raj D. and Chandhok P. (1998): Sample Survey Theory, Sample Survey Theory, ISBN: 8173191379, 9788173191374 7. Raj D. : "The Design of Sample Surveys"; McGraw-Hill Book Co., New York. 8. Sukhatme P.V.,et al. (1997): "Sampling Theory of Surveys with Applications";III-Ed., The Iowa State Univ. Press, Ames, Iowa, USA and Indian Society of Agricultural Statistics, New Delhi. 9. Yates F.(1960) : "Sampling Methods in Censuses and Surveys"; Ed.,-III, Charles Griffin & Co. Ltd., London. 10. Goulden C. H.(2007) : "Methods of Statistical Analysis"; READ BOOKS Publisher , ISBN: 1406737070, 9781406737073 11. Snedecor G.W. and Cochran W.G.(1989): "Statistical Methods"; Ed.:VIII, Wiley-Blackwell, ISBN: 0813815614, 9780813815619 12. Poduri S.R.S. Rao (2000):Sampling Methodologies with Applications, ISBN: 9781584882145, ISBN 10: 158488214X, Chapman & Hall/CRC Texts in Statistical Science 13. Arijit Chaudhuri (2005):Survey Sampling: Theory and Methods, Ed.,-II, Horst Stenger, University of Mannheim, Germany Series: ISBN:13: 9780824757540, ISBN 10: 0824757548 14. Ranjan K. Som (1995):Practical Sampling Techniques, Ed.,-II, Series: Statistics: A Series of Textbooks and Monographs, ISBN: 9780824796761,ISBN:10: 0824796764 15. Foreman E. K. (01991): Survey sampling principles, Marcel Dekker, ISBN: 0824784073, 9780824784072
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-104: Industrial Statistics

Course Code	**MAS-104**
Course Title	**Industrial Statistics**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course is to develop scientific view to analyze the industrial problem from specific perspective. • To learn the statistical quality control techniques used in industries such as control charts, acceptance sampling plans etc. • To learn some advanced control charts, capability indices and the concept of six-sigma.
Course Objective	To make students acquainted with concepts of quality control as well as quality management.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand basic of production process monitoring and apply concept of control charts on it. CO2: Apply the acceptance and continuous sampling plans in production process. CO3: Know and apply the concept of weighted control charts, six sigma, SO: 9000 series standards and Taguchi design. CO4: Understand the concepts of quality control, chance and assignable causes of variation, control charts for variables and attributes, producer's and consumer's risk - Acceptance sampling plans. CO5: Use important lifetime distributions such as for exponential, Weibull, gamma and lognormal distributions. CO6: Use of estimation in the reliability analysis.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■	■	■	■		
CO2	■		■	■	■		
CO3	■		■	■	■		
CO4	■		■	■	■		
CO5	■	■				■	
CO6	■	■				■	

Pre-requisite	Basics of quality control management and reliability analysis

Course Content	**UNIT I:**
	• The meaning of Quality & Quality improvement
	• Introduction of statistical quality control
	• Statistical process control
	      Introduction
	      Measure of location and variability

	Process of control charts for variables & attribute
	Process of control limits
	Out of control criteria
	● Process and measurement system capability analysis
	UNIT II:
	● Cumulative sum chart
	● Statistical product control
	    Introduction
	    Standard plans for attributes
	    Plan for acceptance sampling by measurement.
	UNIT III:
	● Total Quality Management
	    Meaning and important concepts
	    Importance of quality management
	    Total quality management models
	    Six sigma and Quality management
	    Kaizen process
	    Strategic quality planning and total quality management
	    The cost of quality
	    Productivity
	    ISO 9001.
	UNIT IV:
	● Reliability
	    Basic concepts and distributions for product life, failure rate.
	    Hazard function, Reliability function for Exponential, Normal, Lognormal, Weibull and Gamma Distributions.
	    Analysis of Complete Data.
	    Linear analysis and maximum likelihood analysis of censored data for exponential distribution only.
	    System reliability.

Reference Books	1. Hopper A.G.: "Basic Statistical Quality Control"; McGraw Hill, London. 2. Gupta R.C.: "Statistical Quality Control"; Khanna Publishers, New Delhi. 3. Ryan T.P.: "Statistical Methods for Quality Improvement"; John Wiley & Sons. 4. Omachonu V.K. and Ross J.E.: "Principles of Total Quality"; S.Chand & Co., New Delhi. 12 5. Sinha S.K.: "Reliability and Life Testing"; Wiley Eastern Ltd., New Delhi. 6. Bazovksy I.: "Reliability Theory and Practice"; Prentice Hall International Series in Engineering. 7. Grant E. L. and Leavenworth R.: "Statistical Quality Control"; Tata Mc Graw Hill Publishing Co. Ltd., New Delhi. 8. Irving W.B.: "Elementary Statistical Quality Control"; Marcel Dekker, Inc., New York.

	9. Douglas C. Montgomery: Introduction to statistical quality control
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test,　quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: 105: INTRODUCTION TO MS-OFFICE AND INTERNET

Course Code	**MAS-105**
Course Title	**INTRODUCTION TO MS-OFFICE AND INTERNET**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course is to learn the development, processing and analysis of various documents that are useful in commercial on daily basis to fulfil routine task and students will able to understand basic concept of website designing.
Course Objective	To make students acquainted with word processing, spreadsheet, presentation, concept of internet and website designing.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand and prepare various types of documentation and apply formatting features using Word Processing application software. CO2: Develop an excellent Spread Sheet which includes analysing and processing of data, various statistical reports and charts and other processes related to real life examples. CO3: Expertise in preparation of Presentation by Power Point tool and its features. CO4: Develop understanding of browser, server, various internet protocols and utilities. CO5: Able to develop basic website designing using dreamweaver.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■	■	■	■		■	■
	CO2	■	■	■	■	■	■	■
	CO3	■	■	■	■		■	■
	CO4	■					■	■
	CO5	■					■	■

Pre-requisite	Concept of computer is required.

Course Content	**UNIT-I:**
	 • WINWORD
	   ➤ Typing, Editing, Proofing & Reviewing
	   ➤ Formatting Text & Paragraphs
	   ➤ Automatic Formatting and Styles
	   ➤ Working with Tables
	   ➤ Graphics and Frames
	   ➤ Mail Merge
	   ➤ Automating Your Work & Printing Documents
	 UNIT-II:
	 • EXCEL
	   ➤ Working & Editing in Worksheets
	   ➤ Creating Formats & Links
	   ➤ Formatting a Worksheet & Creating Graphic Objects
	   ➤ Creating Charts (Graphs), formatting and analyzing data

	➤ Organizing Data in a List (Data Management) ➤ Sharing & Importing Data ➤ Printing **UNIT-III:** • POWER POINT PRESENTATION ➤ Preparation of Slides, ➤ Inserting Elements into Slides, ➤ Inserting Animation ➤ Preparing Slideshows. **UNIT-IV:** • Introduction to Internet ➤ Internet Protocols: http, ftp, TCP/IP, etc. ➤ Internet Utilities: e-mail, chat, searching, etc. • Web Browsers • Web Server • HTML ➤ HTML Tags • Dreamweaver
Reference Books	1. Dienes: Work 6 for windows quick & easy reference - Mansfield - BPB ISBN: 8170292972, ISBN-13: 9788170292975 2. Layman Hart (1995):WordPerfect 6.0 For Windows/book And Quick Reference, ISBN: 0130346535, ISBN-13: 9780130346537 3. Ron Mansfield(1994):Mastering Word 6 for windows- Mansfield – BPB, ISBN: 8170292980, ISBN-13: 9788170292982 4. Townsend :Mastering Excel - 4 For Windows, - Townsend – BPB, SBN:8170292301, ISBN-13: 9788170292302 5. Mansfield R. (1994): Mastering Word 6 for windows, BPB, **ISBN:** 8170292980, **ISBN- 13:** 9788170292982 6. Mastering Excel 4 for windows - Townsend - BPB, **ISBN:** 8170292301, **ISBN-13:** 9788170292302 7. Chester T.(1994): Mastering Excel 4 for windows - BPB, **ISBN:** 8170294762, **ISBN-13:** 9788170294764 8. Shelley O*hara Janice A. Snyder Christopher `Van Buren(1994):Excel Version 5 For Windows Quick Reference , **ISBN:** 1565294580, **ISBN-13:** 9781565294585
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-106: PRACTICAL – I (BASED ON PAPER – 101, 102, 103)

Course Code	MAS-106
Course Title	PRACTICAL – I (BASED ON PAPER – 101, 102, 103)
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute mathematical examples, probability distribution and sampling problems using MS office tool excel.
Course Objective	To make students acquainted to solve real life problems using MS office tool excel.
Course Outcomes	After completing this course, the students will be able to: CO1: Solve the real life problems of various basic mathematics and process the data using excel. CO2: Develop thinking skills of calculus. CO3: Calculate the Probability, expected value and the moments. CO4: Fit the distributions to a real life data using Excel. CO5: Analyze real life data of various sampling techniques. CO6: Formulates and calculates the estimators of population mean, population total, population ratio of two variables, the percentage and the total number of units in the population that possess some characteristic.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■	■	■		■	■
CO2	■	■	■	■			
CO3	■		■	■			
CO4	■	■	■	■	■	■	■
CO5	■		■	■	■	■	■
CO6	■		■	■			■

Pre-requisite	Basics knowledge of computer, Basics of mathematics and Statistics.
Course Content	Based on theory paper MAS-101 to MAS-103
Reference Books	Reference book mention in theory paper MAS-101 to MAS-103
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS-107: PRACTICAL – II (BASED ON PAPER – 104, 105)

Course Code	MAS-107
Course Title	PRACTICAL – II (BASED ON PAPER – 104, 105)
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2007
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute industrial statistics data using MS office tool excel.
Course Objective	To make students acquainted to solve real life problems using MS office tool excel.
Course Outcomes	After completing this course, the students will be able to: CO1: Solve the real life problems of different variable and attribute charts using excel. CO2: Solve the real life problems of different acceptance sampling plans using excel. CO3: Identify the different components of the Excel worksheet CO4: Construct formulas to manipulate numeric data in an Excel Worksheet CO5: Access and manipulate data using the database functions of Excel.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	▓	▓		▓	▓		▓
CO2	▓	▓		▓	▓		▓
CO3	▓	▓		▓		▓	
CO4	▓	▓	▓			▓	
CO5	▓	▓	▓	▓		▓	

Pre-requisite	Concept of basic knowledge of SQC, MS. Office and internet.
Course Content	Based on theory paper MAS-104 and MAS-105
Reference Books	Reference book mention in theory paper MAS-104 and MAS-105
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS-201: STATISTICAL INFERENCE – I

Course Code	**MAS-201**
Course Title	**STATISTICAL INFERENCE – I**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns itself with point estimation, types of estimation and interval estimation. From this paper the students are expected to build a foundation on inferential statistics which is the basis of higher level mathematical statistics.
Course Objective	To make students acquainted with estimation and decision theory.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the concept of estimator with different properties CO2: Demonstrate and understanding the concept of unbiasedness and biasedness CO3: Become aware of statements of different theorem based on estimators and applies it in suitable situations. CO4: Describe the concept of BAN, MVUE, MVBUE, and UMVUE. CO5: Have the knowledge methods of obtaining minimum variance unbiased estimators. CO6: Learn the methods for interval estimation for small and large size confidence internal

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	■	■	■	■			■	
CO2	■	■	■	■			■	
CO3	■	■	■	■			■	
CO4	■		■	■			■	
CO5	■		■	■			■	
CO6	■	■	■	■			■	

Pre-requisite	Basic concept of estimation and decision theory
Course Content	**UNIT I:** • **Estimation & Properties of Point estimator:** Theoretical finite and infinite population, parameter, parametric space, statistic, estimation of a parameter, Problem of Criterion of selecting a good estimator, Properties of closeness, Unbiasedness, Consistency, Efficiency and Sufficiency. Jointly sufficient statistics, Statement and application of factorization theorem. Minimal sufficient statistics, Complete sufficient statistics, BAN estimator. **UNIT II:** • Minimum variance unbiased estimator, Lower bound of variance of an estimator, Statements & application of Cramer- Rao inequality, condition of existence of uniformly minimum variance bound unbiased estimator, difference between MVUE and MVBUE. Uniformly minimum variance unbiased estimator, statement and applications of Rao-Blackwell theorem and Lehnam-scheffe theorem, Location and scale invariance estimator and parameter. Pitman's estimator for location and scale

	parameter.
	UNIT III:
	• **Methods of estimation**:
	(i) Method of maximum likelihood, Properties of maximum likelihood estimator, (ii) Method of moments, (iii) Method of scoring, (iv) Method of minimum chi-square, (v) Method of modified minimum chi-square, (vi) Method of least squares.
	• **Interval Estimation:**
	Introduction to confidence interval, Definition of confidence interval, Pivotal quantity, Pivotal quantity method.
	(i) Confidence interval for mean and variance when sampling is done from normal population. (ii) Confidence interval for large samples.
	UNIT IV:
	• **Elementary Decision Theory:**
	Decision problem, basic components and spaces associated with the decision problem, Decision rules, Risk function, Minimax-decision rule, prior and posterior distribution, Bayes risk, Bayes Rule, Value of information.
Reference Books	1. Mood A.M., Graybill F.A. and Boes D.C. (2001) : **"**An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill, **ISBN:** 0070445206, **ISBN-13:** 9780070445208, 978-0070445208
	2. Goon A. M., Gupta M. K. and Dasgupta B. (2000) : "An Outline of Statistical Theory" Vol.1, 2; The World Press Private Limited, **ISBN:** 8187567260 **ISBN-13:** 9788187567264, 978-8187567264
	3. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley& Sons Incorporated, ISBN-10:0471731358,ISBN-13:9780471731351
	4. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta.
	5. Mukhopadhyay Parimal (2000): "Topics in Survey Sampling", Springer-verlag, **ISBN:** 0387951083, **ISBN-13:**9780387951089, 978-0387951089.
	6. Rao C. R. (2001) : "Linear Statistical Inference and its Applications"; 2nd Edition, Wiley-Interscience,. **ISBN-10:** 0471218758, **ISBN-13:** 978-0471218753
	7. Casella G. and Berger R. L. (2001): "Statistical Inference"; 2nd Revised edition Duxbury Press. **ISBN-10:** 0534243126 , **ISBN-13:** 978-0534243128
	8. Zaven A. Karian and Edward J. Dudewicz (2010): "Handbook of Fitting Statistical Distributions with R"; Chapman and Hall/CRC, **ISBN:** 9781584887119, **ISBN10:** 1584887117
	9. Zaven A. Karian and Edward J. Dudewicz (2000): "Fitting Statistical Distributions: The Generalized Lambda Distribution and Generalized Bootstrap Methods"; Chapman and Hall/CRC, **ISBN:** 9781584880691, **ISBN10:** 1584880694
	10. Mukhopadhyay Nitis (2006) : "Introductory Statistical Inference"; Chapman and Hall/CRC, **ISBN:** 9781574446135, **ISBN10:** 1574446134

Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	**MAS-202**
Course Title	**STATISTICAL INFERENCE – II**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course is to define steps of testing of hypothesis, to develop scientific view develop test statistic and to test the significance of means, variances and proportions, to differentiate between large and small sample tests, test the goodness of fit and differentiate between parametric and non parametric tests
Course Objective	To make students acquainted with testing of hypothesis and draw inferences
Course Outcomes	After completing this course, the students will be able to: CO1: Get the knowledge about formulating and testing a hypothesis, using critical values to draw conclusions and determining probability of making errors in hypothesis tests. CO2: Get the knowledge about large sample tests and its applications CO3: Get the knowledge about small sample tests, Chi-square test, t-test and F-test. CO4: Understand and analyze various methods of Non-parametric tests CO5: Get the knowledge to discriminate parametric and non parametric test CO6: Understand the situation for applying suitable test.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	▓	▓	▓	▓			▓
	CO2	▓	▓	▓	▓	▓		▓
	CO3	▓	▓	▓	▓	▓		▓
	CO4	▓	▓	▓	▓	▓		▓
	CO5	▓	▓	▓	▓	▓		▓
	CO6	▓	▓	▓	▓	▓		▓

Pre-requisite	Basics concept of testing of hypothesis and decision theory
Course Content	**UNIT I:** • **Testing of Hypotheses:** Concepts of hypothesis, statistical hypothesis, simple and composite hypothesis, Null and Alternative hypothesis. One sided and two sided hypothesis. Test of hypothesis, critical region or region of rejection, acceptance region. Types of errors. Sizes of the errors, Level of significance, Size of the test, power function of the test, Two-tail and one tail tests, most powerful test, Likelihood Ratio Test & Test of significance as its particular case. UNIT **II:**

	• **Parametric tests:** i) Large sample test for mean, variance, proportion and correlation ii) Small sample tests: χ_2, t, F & Z-transformation iii) ANOVA **UNIT III:** • **Nonparametric tests:** Sign, Median, Run, Mann Whitney, Wilcoxen, K-S tests, K-W.Test. **UNIT IV:** • **SPRT:** Wald's sequential probability ratio test, its properties and applications.
Reference Books	1. Mood A.M., Graybill F.A. and Boes D.C. (2001) : "An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill, ISBN: 0070445206, ISBN-13: 9780070445208, 978-0070445208 2. Goon A. M., Gupta M. K. and Dasgupta B. (2000) : "An Outline of Statistical Theory" Vol.1, 2; The World Press Private Limited, ISBN: 8187567260 ISBN-13: 9788187567264, 978-8187567264 3. Lehmann, E.L.(1986): "Testing Statistical Hypothesis"; John Wiley & Sons, New York. 4. Lehmann. E.L. and Joseph P. Romano (2005): "Testing Statistical Hypothesis"; 3rd Edition, Springer, ISBN 0-387-98864-5. 5. Gibbons, J. D. (1985): "Nonparametric Statistical Inference", 2nd Edition, Marcel Dekker, New York. 6. Gibbons J.D. and Pratt J.W. (1981): "Concepts of Nonparametric Theory"; Springer-Verlag, ISBN: 0387905820, ISBN-13: 9780387905822, 978-0387905822. 7. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley& Sons Incorporated, ISBN-10:0471731358,ISBN-13:9780471731351 8. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta. 9. Mukhopadhyay Parimal (2000): "Topics in Survey Sampling", Springer-verlag, ISBN: 0387951083, ISBN-13:9780387951089, 978-0387951089 10. Rao C. R. (2001) : "Linear Statistical Inference and its Applications"; 2nd Edition, Wiley-Interscience,. **ISBN-10:** 0471218758, **ISBN-13:** 978-0471218753 11. Daniel W.W. (1990):"Applied Nonparametric Statistics"; PWS-KENT publishing Co., Boston. 12. Daniel W.W. (1989): "Applied Nonparametric Statistics"; 2nd Edition, Wadsworth Publishing Company, Belmont, California, U.S.A., ISBN-10: 0534919766, ISBN-13: 978-0534919764 13. Wald A. (2004):"Sequential Analysis"; Dover Pubns, ISBN: 0486439127, ISBN-13: 9780486439129, 978-0486439129 14. Wald A. (1947): "Sequential Analysis"; John Wiley and Sons, New York. 15. Conover, W. J. (1980): "Practical Nonparametrics Statistics", John Wiley & Sons, Inc., New York. 16. Peter Sprent, Nigel C. Smeeton (2007): "Applied Nonparametric Statistical Methods"; 4th Edition, Taylor & Francis Ltd, **ISBN:** 9781584887010, **ISBN 10:** 158488701X

	17. Gibbons J. D., Subhabrata Chakraborti (2003): "Nonparametric Statistical Inference"; 4th Revised Edition, CRC Press (Taylor & Francis Ltd), **ISBN:** 9780824740528, **ISBN 10:** 0824740521. 18. David J. Sheskin (2007) : "Handbook of Parametric and Nonparametric Statistical Procedures"; 19. David J. Sheskin (2007) : "Handbook of Parametric and Nonparametric Statistical Procedures"; Chapman & Hall; 4th Edition, **ISBN:** 9781584888147, **ISBN 10:** 1584888148
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-203: MULTIVARIATE ANALYSIS

Course Code	MAS-203
Course Title	**MULTIVARIATE ANALYSIS**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	In multivariate analysis students learn how to deal with the data analysis of several variables simultaneously. Necessary theoretical deductions of different multivariate techniques and deduction of multivariate probability distributions are the learning objectives of this paper.
Course Objective	To understand the extensions of univariate techniques to multivariate frameworks and learn to apply dimension reduction techniques used in the data analysis with the use of probability distributions
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the concept of multinomial and multivariate normal distribution with their properties. CO2: Understand the idea of partial and multiple correlation coefficient with testing of hypothesis CO3: Demonstrate Hotelling T^2 statistic and their various application in real life problems CO4: Demonstrate the knowledge and understanding of the basic ideas behind classification and discriminant analysis CO5: Understand concept of data reduction technique like factor analysis and principal component
Mapping between COs with PSOs	(see table below)
Pre-requisite	Concept of univariate, testing of hypothesis
Course Content	(see units below)

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■			■			■
CO2	■			■			■
CO3	■		■	■			■
CO4	■		■	■	■		■
CO5	■	■		■			■

Course Content

UNIT I:
- Concept and need of multivariate analysis, Concept of multinomial distribution and multivariate Normal distribution – its properties (without proof).

UNIT II:
- Concept of Hotelling T_2 distribution (without derivation) & its applications.
- Comparisons of several multivariate means: multivariable analysis of variances.

UNIT III:
- Partial correlation and multiple correlations.
- Multiple linear regression model, least square estimation, inference.

UNIT IV:
- Concept and application of (i) Factor analysis (ii) Principal Component analysis and (iii) Canonical Correlation analysis.

	• Discrimination and classification: Separation and classification of populations, classification of multivariate populations. Fisher's discriminant function, Classification of several populations. Fisher's method of discriminating among several populations.
Reference Books	1. Anderson T. W. (2003): "An Introduction to Multivariate Statistical Analysis"; 3rd Edition, Wiley-interscience, **ISBN:** 0471360910, **ISBN-13:** 9780471360919 2. Johnson R.A. and Wichern D.W. (2008) : "Applied Multivariate Statistical Analysis"; Pearson Education(singapore) Pte. Ltd., **ISBN:** 8131722228, **ISBN-13:** 9788131722220 3. Stephen E. Fienberg, Jobson J. D., Ingram Olkin (1994): "Applied Multivariate Data Analysis: Volume Ii: Categorical and Multivariate Methods"; Springer, ISBN**:** 0387978046, **ISBN-13:** 9780387978048, 978-0387978048 4. Khirsagar A.M. (1972): Multivariate Analysis. Marcel Dekker, New York. 5. Kent J. T. , J. M. Bibby, K. V. Mardia (1980) : "Multivariate Analysis (probability And Mathematical Statistics)"; Academic Press, **ISBN:** 0124712525, **ISBN-13:** 9780124712522 6. Morrison D.F. (1990): "Multivariate Statistical Methods"; Mcgraw-hill Professional, **ISBN:** 0071008152,**ISBN-13:** 9780071008150, 978-0071008150 7. Morrison D.F. (2004): "Multivariate Statistical Methods"; Thomson Brooks/cole, ISBN**:** 0534387780, **ISBN-13:** 9780534387785 8. George A. Marcoulides, Scott L. Hershberger and Marcoulide (1997) : "Multivariate Statistical Methods: A First Course"; Lawrence Erlbaum Associates, **ISBN:** 080582572X, **ISBN-13:** 9780805825725 9. Muirhead R.J. (2005): "Aspects of Multivariate Statistical Theory"; Wiley-interscience, ISBN**:** 0471769851, ISBN-13**:** 9780471769859 10. Seber G.A.F. **(**1984**): "**Multivariate Observations"; John Wiley & Sons Inc., ISBN 10: 047188104X , ISBN 13: 9780471881049 11. Gnanadesikan R. (1997): "Methods For Statistical Data Analysis Of Multivariate Observations"; Wiley-interscience, **ISBN:** 0471161195,ISBN-13**:** 9780471161196 12. Srivastava and Khatri (1979): "An Introduction to Multivariate Statistics"; North Holland, New York. 13. Srivastava M.S. (2002): "Methods of Multivariate Statistics"; John Wiley and Sons Inc., New York. 14. Dillon W.R. and Goldstein M. (1984): "Multivariate Analysis: Methods and Applications"; John Wiley and Sons Inc., New York. **ISBN:** 0471083178, **ISBN-13:** 9780471083177 15. Rohatgi V. K., A. K. Md. Ehsanes Saleh (2008): "An Introduction To Probability And Statistics"; 2nd Ed, Wiley, **ISBN:** 8126519266, **ISBN-13:** 9788126519262 16. Wolfgang Hardle, Zdenek Hlavka (2007): "Multivariate Statistics: Exercises And Solutions"; Springer Verlag, **ISBN:** 0387707840, **ISBN-13:** 9780387707846
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class

	test, quiz, assignment, seminar, internal examination, etc. External based on semester end University examination	70%

Course Code	MAS-204
Course Title	ACTUARIAL STATISTICS
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	To learn the life tables used in insurance products. • To learn the concept of interest, different life insurance products, life annuities, net premiums. • To motivate students to prepare for exams required for employment in the actuarial science profession.
Course Objective	To make students acquainted with actuarial science and implementation of statistics in actuarial science
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the utility theory, insurance products and life tables. CO2: Understand the concept of interest. CO3: Understand the concept of life insurance and the existing insurance products of different insurance company. CO4: Have the knowledge of life annuities, net premium and net premium reserves.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	CO1	███	███	███	███				
	CO2	███	███	███	███				
	CO3	███	███	███	███				
	CO4	███	███	███	███				

Pre-requisite	Basics of actuarial statistics and insurance policy planning
Course Content	**UNIT I:** • Basics of Probability & Interest: Theory of Interest, Variable interest rates, continuous time payment streams. • Interest & Mortality: Annuities, Loan Amortization and Mortgage Refinancing, Mortality and Analytical models. **UNIT II:** • Life Tables: Concepts of Life Tables, Assumptions related to life tables, columns of life tables, Complete and Abridged life tables, Construction of life tables, Estimation from life table data **UNIT III:** • Expected present values of payments, Continuous contracts & residual life, Premium calculations, m-payment net single premiums • Population functions and indicator notations, Stationary population concepts **UNIT IV:** • Risk models: Proportional Hazard models, excess risk models, Multiple decrement models, death rate estimators, causes specific life insurance premiums
Reference Books	1. Barcley G.W. (1970). Techniques of Population Analysis. John Wiley, New York. 2. Borowiak, D.S., and A. F. Shapiro. (2013). Financial and Actuarial Statistics: An Introduction, Second Edition. CRC Press.

	3. Donald, D.W.A. (1970). Compound interest and annuities, Second Edition, The Institute of Actuaries and the Faculty of Actuaries at the University Press. 4. Spurgeon, E.T. (2011), Life Contingencies, Third Edition, Cambridge University Press. 5. Eric V. Slud (2001): Actuarial Mathematics and Life Table Statistics (Mathematics Department, University of Maryland)
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: 205: COMPUTER PROGRAMMING LANGUAGE – 'C'

Course Code	MAS-205
Course Title	**COMPUTER PROGRAMMING LANGUAGE – 'C'**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	**2008**
Purpose of Course	The purpose of the course is to make the student capable of implementing the concepts, methods, and debugging tools of programming and learn their implementation.
Course Objective	To make students acquainted with knowledge of programming using C language.
Course Outcomes	After completing this course, the students will be able to: CO1: Understand the basic concepts and fundamentals of programming such as algorithm and flowchart. CO2: Understand the basic C fundamentals such as data types, operators etc. CO3: Design programs involving control statements such as conditional and unconditional statements. CO4: Implement advanced programming approach such as modular programming along with parameter passing techniques. CO5: Understand the concept of different data structures such as array, structure and union. CO6: Develop the programs that deal with various operations on data files.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
CO1	■		■				■	
CO2	■				■		■	
CO3	■	■		■	■		■	
CO4	■	■	■	■	■	■	■	
CO5	■	■	■	■	■	■	■	
CO6	■	■	■	■	■	■	■	

Pre-requisite	Basic knowledge of computer and typing skill is essential.

Course Content	**UNIT I:**
	• Introduction
	  ➢ Algorithms and Flowchart
	  ➢ Types of Language
	  ➢ Introduction to C Language
	• C Fundamentals
	  ➢ Identifiers
	  ➢ Data Types
	  ➢ Constants and Variables
	  ➢ Arrays
	• Operators and Expressions
	  ➢ Arithmetic Operators
	  ➢ Unary Operators
	  ➢ Relations Operators
	  ➢ Logical Operators
	  ➢ Assignment Operators
	  ➢ Conditional Operators

	➤ Library Functions
	➤ Expressions
	➤ Evaluation of Expression
	UNIT II:
	  • Data Input and Output
	    ➤ Single Character input and output
	    ➤ The scanf function
	    ➤ The printf function
	    ➤ Gets and Puts functions
	  • Control Statements
	    ➤ The While Statement
	    ➤ do-while statement
	    ➤ for statement
	    ➤ if - else statement
	    ➤ switch statement
	    ➤ break statement
	    ➤ continue statement
	    ➤ goto statement
	UNIT III:
	  • Functions
	    ➤ Introduction to functions
	    ➤ Function definition
	    ➤ Accessing function
	    ➤ Passing arguments to function
	    ➤ Recursive function
	  • Data Files
	UNIT IV:
	  • Arrays
	    ➤ Defining an array
	    ➤ Processing an array
	    ➤ Multi dimensional arrays
	    ➤ Passing array to a function
	    ➤ Arrays and Strings
	  • Structures and Unions
	    ➤ Defining a structure
	    ➤ Processing a structure
	    ➤ Unions

Reference Books	1. Karnighan B. W. and Ritchie D. M. (1978) : "C programming Language"; Prentice Hall- Gale, **ISBN:** 0131101633, **ISBN-13:** 9780131101630 2. VijayMukhi: "The C Odyssey -vol. 6: Windows"; Bpb, **ISBN:8170291682**, **ISBN-13:** 9788170291688 3. Stephan G. Kochan (2001) : "Programming In C" ; CBS Publishers & Distributors, ISBN PB : CBS0000031 4. Stephen G. Kochan (2004): **"**Programming in C"; 3rd Edition, Sams, **ISBN-10:**0672326663, **ISBN-13:** 978-0672326660 5. Kelly Stan and Bootle (1988): "Mastering turbo C"; BPB Publications 6. Stan Kelly Bootle (1988): "Mastering Turbo C"; Wiley John & Sons Incorporated, ISBN-13: 9780895884626 , ISBN: 0895884623 7. Kanetkar Yashwant (2006) : "Let us C" ; 9th Edition , BPB, **ISBN:**

	8183331637, **ISBN-13:** 9788183331630,
	8. E Balaguruswamy (2007) : "Programming In C#"; Tata Mgraw Hill, **ISBN:** 0070667578 **ISBN-13:** 9780070667570, 978-0070667570
	9. Robert Lafor (2001) : "Object - Oriented Programming in C" ; Sams , 4th Edition, **ISBN:** 0672323087, **ISBN-13:** 9780672323089, 978-0672323089
	10. Robert Lafore (1995) : "Object Oriented Programming in C++"; Galgotia Publications.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS- 206: PRACTICAL – III (BASED ON PAPER – 201, 202, 203)

Course Code	MAS-206
Course Title	PRACTICAL – III (BASED ON PAPER – 201, 202, 203)
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course is concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute problems of estimation, testing and multivariate techniques using MS office tool excel.
Course Objective	To make students acquainted to solve real life problems using MS office tool excel.
Course Outcomes	After completing this course, the students will be able to: CO1: Compute estimators of various distributions. CO2: Obtain estimators using estimation methods such as Maximum likelihood, method of moments, method of scoring, Properties of maximum likelihood estimator. CO3: Understand and solve the problems of statistical inference, problem of testing of hypothesis for parametric and non parametric test using excel. CO4: Construct SPRT in case of Binomial, Poisson, and Normal Distribution using excel. CO5: Solve the problem of multivariate data using excel. CO6: Carry out and apply commonly used multivariate data analysis techniques, and interpret results

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■			■			■
	CO2	■			■			■
	CO3	■	■	■	■	■	■	■
	CO4	■	■	■	■	■	■	■
	CO5	■	■	■	■	■	■	■
	CO6	■	■	■	■	■		■

Pre-requisite	Basics knowledge of estimation, testing of hypothesis and multivariate analysis.
Course Content	Based on theory paper MAS-201 to MAS-203
Reference Books	Reference book mention in theory paper MAS-201 to MAS-203
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS- 207: PRACTICAL - IV (BASED ON PAPER – 204, 205)

Course Code	**MAS-207**
Course Title	**PRACTICAL - IV (BASED ON PAPER – 204, 205)**
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute problems of actuarial statistics and "C" programming language
Course Objective	To make students acquainted to solve real life problems of actuarial statistics using excel and "C" programming language
Course Outcomes	After completing this course, the students will be able to: CO1: Solve life table data using excel. CO2: Compute actuarial and financial mathematics data using excel. CO3: Develop thinking skills of interest theory, insurance policy and loan using practical knowledge. CO4: Perform statistical formula using C programming CO5: Develop the Ability to define and manage data structures based on problem subject domain, textual information, characters and strings, arrays of complex objects

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	▓	▓	▓	▓	▓		▓
CO2	▓	▓	▓	▓	▓		▓
CO3	▓	▓	▓	▓	▓		▓
CO4	▓	▓	▓	▓		▓	▓
CO5	▓	▓	▓	▓		▓	▓

Pre-requisite	Basics knowledge of actuarial statistics, Programming language "C"
Course Content	Based on theory paper MAS-204 and MAS-205
Reference Books	Reference book mention in theory paper MAS-204 and MAS-205
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS-301: STATISTICS FOR ECONOMICS

Course Code	MAS-301
Course Title	**STATISTICS FOR ECONOMICS**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and analysis of specific economic data. It helps us understand and analyze economic theories and denote correlations between variables such as demand, supply, price, output etc.
Course Objective	To make students acquainted with economic theory and time series analysis and index number.
Course Outcomes	After completing this course, students will be able to: CO1: Understand and apply the concept of stationarity to the analysis of time series data in various contexts (such as actuarial studies, climatology, economics, finance, geography, meteorology, political science, and sociology); CO2: Run and interpret time-series models and regression models for time series CO3: Use the Box-Jenkins approach to model and forecast time-series data empirically; CO4: Develop fundamental research skills (such as data collection, data processing, and model estimation and interpretation) in applied time series analysis. CO5: Develop the concept of various method of generating indices and apply them to solve practical problem.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	CO1	■	■	■	■	■	■	■	
	CO2	■	■		■	■	■	■	
	CO3	■	■		■	■	■	■	
	CO4	■	■	■	■	■	■	■	
	CO5	■	■	■	■	■	■	■	

Pre-requisite	Concept of economics time series and index number.
Course Content	**UNIT I:** • **Analysis of Time Series :** ➤ Definition and importance of time series analysis, Components of a Time series, Different methods for determination of trend, their merits and demerits, Methods for elimination of seasonal components, Determination of cyclic components, Variate difference method. ➤ Stationary Time series, Box-Jenkins Models, Introduction to Autoregressive (AR) Models, Moving Average (MA) Models, Mixed Autoregressive Moving Average (ARMA) Models, Autoregressive Integrated Moving Average (ARIMA) Models, Properties of these models, Forecasting Techniques. UNIT **II:** • **Index Numbers :** ➤ Importance of Index Numbers, Various Formulae: Ratio of Simple Aggregate, Ratio of Weighted Aggregate, Unweighted average of price

	relatives, Choice of base period, Different tests of a good index number, Cost of Living Index Number and Various Official Index Numbers, HDI (Human Development Index). **UNIT III:** • **Demand Analysis :** ➢ Concept related to demand and supply, price elasticities of demand and supply, Methods of determining demand and supply curves for cross section data and time series data, Leontief's method, Pigou's Method, Engels Curves, Pareto's Law of Income Distribution. **UNIT IV:** • Input-Output Analysis : Leontief's Static Model for Inter-industry relations. • Growth Models Concepts of multiplier and accelerator, Hicks-Smauelson's Model, Harrod-Domar and Solow's Growth Models
Reference Books	1. Croxton E.F., Cowden D.J.and Klein S. (1967): "Applied General Statistics"; III-Ed Prentice-Hall (Englewood Cliffs, N.J). 2. Karmel P.H. (1963): "Applied Statistics for Economics"; 2nd ed., Pitman (Melbourne) 3. Kendall M.(1976) : "Time Series", 2nd ed., Charles Giffin & Co., 4. Chatfield C. (1975): "Analysis of Time Series: Theory and Practice"; Chapman & Hall, London 5. Chatfield Chris(2003) :"The Analysis Of Time Series: An Introduction"; Sixth Edition, Chapman & Hall/crc, ISBN: 1584883170, ISBN-13: 9781584883173 6. Sen A.K. (1970): "Growth Economics" : Penguin Modern Economic Reading Edition. 7. Pillai S.(1973) : "Economic & Business Statistics"; Progressive Corporation Pvt. Ltd. 8. Mukhopadhyay P. (2009) : "Applied Statistics"; Books & Allied (p) Ltd , ISBN: 8187134380, ISBN-13: 9788187134381 9. Gupta S.C. and Kapoor V.K.(2006) : " Fundamentals of Applied Statistics"; Sultan Chand & Sons, ISBN: 8170141516, ISBN-13: 9788170141518
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-302: OPERATIONS RESEARCH – I

Course Code	MAS-302
Course Title	**OPERATIONS RESEARCH – I**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns itself with studying analytical method of Operations research, problem-solving and decision-making that is useful in the management of organizations
Course Objective	To learn the mathematical formulation of complex decision-making problems and arrives at optimal or near-optimal solutions using different techniques of operations research
Course Outcomes	After completing this course, students will be able to: CO1: Understand the basics and formulation of linear programming problems, solve linear programming problems using graphical method, simplex, two-phase and Big-M method. CO2: Become aware about transportation problem with their properties, methods and real life applications. CO3: Understand concept about the assignment problem with real life situations. CO4: Understand the concept of duality, their properties and method CO5: Develop the concept of simulation, their type and applications CO6: Understand the concept of inventory management system with EOQ model with different scenario like probabilistic and deterministic

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■	■	■	■			■
	CO2	■	■	■	■			■
	CO3	■	■	■	■			■
	CO4	■	■	■	■			■
	CO5	■	■	■	■			■
	CO6	■	■	■	■			■

Pre-requisite	Concept of liner algebra, basic mathematical operations
Course Content	**UNIT I:** • **Linear Programming:** ➢ Definition of linear programming problem (LPP) ➢ Formulation of LPP . ➢ Solution of LPP by Graphical and Simplex Method (including Big-M and Two-phase method) **UNIT II:** • **Transportation and Assignment Problems:** ➢ Definition of Transportation Problem (TP) ➢ Special structure of TP ➢ Methods for getting basic feasible solution to TP ➢ Methods for getting optimum solution to TP ➢ Unbalanced TP ➢ Definition of Assignment Problem (AP) ➢ Algorithm for solving an AP ➢ Unbalanced AP ➢ Routing Problem

	UNIT III:
	• **Duality:**
	  ➢ Definition of Dual Problem.
	  ➢ Rules for converting any Primal into its Dual
	  ➢ Properties of Duality
	  ➢ Dual-Simplex Method
	• **Simulation**
	  ➢ Introduction & definitions
	  ➢ Types of simulation
	  ➢ Uses & limitation
	  ➢ Phases of simulation Model
	  ➢ Even type simulation
	  ➢ Monte-Carlo Simulation & its applications
	  ➢ Advantages and Disadvantages
	• **Dynamic Programming**
	  ➢ Introduction
	  ➢ The recursive Equation Approach
	  ➢ Characteristics of Dynamic Programming
	  ➢ Dynamic Programming Algorithm
	  ➢ Solution of Discrete D.P.P.
	  ➢ Some APPLICATION
	  ➢ Solution of L.P.P. By Dynamic Programming
	UNIT IV:
	• **Inventory Management Systems:**
	  ➢ Definition
	  ➢ Costs involved in Inventory Problems
	  ➢ Classical EOQ Models without and with shortages
	  ➢ Multi-item Deterministic Models
	  ➢ Probabilistic Inventory Models
	  ➢ Inventory Models with Price Breaks
	• **Sequencing:**
	  ➢ Definition, Notations and Assumptions
	  ➢ Solution of sequencing problem.
	  ➢ Problems with n-jobs and 2-machincs
	  ➢ Problems with n-jobs and 3-machines
	  ➢ Problems with 2-jobs and m-machines

Reference Books	1. K. Swarup, Gupta P.K. and Man Mohan(2008): "Operations Research"; S.Chand & Co., New Delhi, ISBN: 8180545350, ISBN-13: 9788180545351 2. G. Hadley (2002): "Linear Programming"; Narosa Book Distributors Pvt Ltd, ISBN: 8185015910, ISBN-13: 9788185015910 3. Murthy K.G.(1988): Linear complementarity, linear and nonlinear programming, Heldermann Verlag, ISBN: 3885384035, 9783885384038 4. Kasana H.S. and Kumar K.D.(2005) : "Introductory Operations Research: Theory & Applications"; Springer Verlag , ISBN: 8181282827, 9798181282827. 5. Kapoor V.K. (2006) : "Operations Research"; 7th Edition, Jain Book Depot, **ISBN :** 8170148286. 6. Sharma S.D.(2005):Operations Research"; 15th Ed., Kedar Nath Ram Nath & Co. Publishers, Meerut, 7. Hira,D.S., Gupta,P.K.(2007): OPERATIONS RESEARCH, S.Chand & Co., New Delh, ISBN: 81-219-0281-9
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment

Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-303: ECONOMETRICS

Course Code	MAS-303
Course Title	ECONOMETRICS
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of econometrics is to quantify and verify predictions from economic theory. The purpose of econometrics is how to convert real-world data to statistical trials and then compares the findings against the theory or theories being tested for similar patterns.
Course Objective	To make Students acquainted with test existing economic hypotheses and try to predict future trends.
Course Outcomes	After completing this course, students will be able to: CO1: Develop a way of thinking in quantitative terms and use some econometrics model future research. CO2: Understand concepts and techniques in econometrics, with a special focus on the classical linear regression model. CO3:Understand the assumptions upon which different econometric methods are based and their implications CO4: Interpret and critically evaluate applied work and econometric findings CO5: Understand the concept of various assumptions of econometrics model solve the violation of the assumptions such as autocorrelation, multi co linearity, auto correlation and simultaneous system.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■	■	■	■			■
	CO2	■	■	■	■			■
	CO3	■	■		■			■
	CO4	■	■		■	■	■	■
	CO5	■	■		■	■		■

Pre-requisite	Concept of regression modelling and drawing inferences of economic phenomenon.
Course Content	**UNIT I:** • Introduction to Econometrics and Methodology of an Econometrics study. • Multivariate Linear regression model : Three variable case : Introduction to OLS estimation, Coefficient of multiple correlations, Interpretation of regression coefficients, Partial correlation coefficients. • Multivariate Linear regression model: The general Model. The General form of model, Gauss-Markoff Theorem, OLS estimators and their properties, Coefficient of determination, Normality assumptions about error term, Statistical inference under normality assumption.. UNIT **II:** • **Multicolinearity :** Introduction, Three variable cases, General case, Perfect and imperfect (near) multicolinearity, Tests for detecting the presence of

	multicolinearity, Methods for handling multicolinearity. • **General Linear Model:** General form of the model with assumptions and their implication. Estimation of Parameters (Aitken estimator), Scalar Predictor (Goldberger Predictor) Particular Cases: (a) Heteroschedasticity (b) Autocorrelation). **UNIT III:** • **Hetroscedasticity:** The problem of hetroscedasticity, Consequence of hetroscedasticity, Tests for detecting the presence and nature of hetroscedasticity, Methods for handling hetroscedasticity. • **Autocorrelation:** The problem of autocorrelation, Consequences of applying OLS method when here is autocorrelation, Tests for detecting presence of autocorrelation, Estimation of parameters when autocorrelation exists. **UNIT IV:** • **Simultaneous equations models:** Introduction and need for simultaneous equations models, General form and reduced form equations, Problem of identification, Conditions for identification, Methods of estimation, Indirect Least Square method and Two-stage Least Square (2-SLS) method.
Reference Books	1. Samprit Chatterjee, Ali S. Hadi(2006): Regression analysis by example, IV-Ed., John Wiley and Sons, ISBN: 0471746967, 9780471746966 2. Apte P. G.(1990): " Text book of Econometrics"; Tata McGraw Hill, ISBN: 0074515217, 9780074515211 3. Chatterjee, Hadi S. A. & Price B.(2000): "Regression Analysis by Example"; III-Ed.,John Wiley & Sons. ISBN: 0471319465. 4. Cramer J. S. (1971): "Empirical Econometrics"; II-Ed.,North Holland. 5. Gujarati D. N.(2003): "Basic Econometrics"; IV_Ed.,McGraw Hill, ISBN: 0072335424, 9780072335422 6. Michael D. Intriligator(1981): "Econometric models, techniques, and applications"; II_Ed.,North-Holland Publishing Co.,ISBN: 0471029955, 9780471029953 7. John Johnston, John DiNardo(1997): "Econometrics Methods"; IV-Ed.,McGraw Hill,ISBN: 0079131212, 9780079131218 8. George G. Judge(1982): "Introduction to the theory and practice of econometrics"; ISBN: 0471082775, 9780471082774 9. Draper, N.R. and Smith, H (1981). Applied Regression Analysis, II-Ed.,John Wiley, New York.ISBN: 0521325706, 9780521325707 10. Montgomery, D. C.; Peck, E. A. and Vining G. G. (2006). Introduction to Linear Regression Analysis. Wiley India Pvt. Ltd., ISBN: 8126510471, 9788126510474 11. Seber, G. A. F and Lee Alan J. (2003). Introduction to Linear Regression Analysis, Wiley-interscience, and ISBN: 0471415405, ISBN-13: 9780471415404
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70%

	External based on semester end University examination

Course Code	**MAS-304**
Course Title	**INTRODUCTION TO STATISTICAL SOFTWARES**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	This is a course after studying which students can perform different statistical computations using statistical package and can think a career on data analysis and even get self-employed as a data analyst.
Course Objective	To learn statistical techniques and their implementation using comprehensive SPSS software and R
Course Outcomes	After completing this course, students will be able to: CO1: Get familiar with SPSS software and understand SPSS environment. CO2: Create and edit the data files, plot graphs using SPSS. CO3: Compute descriptive statistics using SPSS. CO4: Perform inferential statistical analysis through SPSS. CO5: Understand basics of R environment. CO6: Perform various operations on data in R. CO7: Do descriptive statistical analysis in R. CO8: Perform different computational facilities provided in the package.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	✓	✓	✓	✓		✓	✓
	CO2	✓	✓	✓	✓		✓	✓
	CO3	✓	✓	✓	✓	✓	✓	
	CO4	✓	✓	✓	✓	✓	✓	
	CO5	✓	✓	✓	✓		✓	✓
	CO6	✓	✓	✓	✓		✓	✓
	CO7	✓	✓	✓	✓	✓	✓	
	CO8	✓	✓	✓	✓		✓	✓

Pre-requisite	Basic concept of Progarmming language, excel, SPSS and R.
Course Content	**UNIT I:** • **SPSS:** ➢ SPSS Introduction ➢ Starting SPSS ➢ Types of Data ➢ Levels of Measurement ➢ Missing Values ➢ Important Files // database files • **Data Management** ➢ Selecting Cases ➢ Standardizing Data ➢ Transformation of Data ➢ Split File ➢ Variable and Value Labels ➢ Recode Variables/Visual Binning ➢ Random Sample of the Data ➢ Creating a Population Variable ➢ Multi Response ➢ Time Saving Features / SPSS MACRO

UNIT II:
- **Basic Data Analysis**
  - Descriptive Statistics
  - Frequency Tables/Cross Tabs
  - Independent T test
  - Paired T Test
  - One-Way ANOVA
  - Correlation / Regression
- **Interpret the Results**

  Presentation with live data

UNIT III:

R:
- **Introduction to R**
  - Background and resources
  - Installing R.
  - R console.
  - R commander
  - Command and syntax
  - Packages and libraries
  - Help in R
  - Workspace in R
- **Data Structures**
  - Introduction to data structure
  - Vectors
  - Matrices
  - Arrays
  - Lists
  - Factors
  - Data frames
  - Importing and Exporting data
  - Data types
- **Frequencies & Descriptive Statistics**
  - Frequency
  - Measure of central tendency
  - Measure of Dispersion
  - Measure of skewness
  - Box and Whisker part
- **Data management**
  - Split
  - Find and replacement
  - Manipulations with alphabets
  - Evaluation of strings
  - Data frames.

UNIT IV:
- **Graphical Analysis**
  - Creating a simple graph
  - Modifying the points and line of graph
  - Modifying title and subtitle of a graph
  - Modifying axes of the graph
  - Adding additional elements to graph
  - Adding legend on a graph
  - Special graph
  - Multiple plots

	- **Comparing Populations**
	   ➤ Cross tabulation
	   ➤ One sample t test
	   ➤ Independent sample t test
	   ➤ Paired sample t test
	   ➤ One way ANOVA
	- **Bivariate Data Analysis**
	   ➤ Correlation
	   ➤ Simple linear regression
	   ➤ Multiple linear regression
	- **Conditional executions and loops**
	   ➤ If loop
	   ➤ While loop
	   ➤ For loop

Reference Books	1. Miller R. L., Ciaran Acton and Fullerton D. A., John Malthy (2009), "SPSS for Social Scientists"; 2nd Edition, Palgrave Macmilan. ISBN: 9780230209930. 2. Wagner W. E. III (2006): "Using SPSS for Social Statistics and Research Methods"; SAGE Publications, ISBN-13: 9781412940771. 3. Einsprucho E. L.: "An Introductory Guide to SPSS for Windows"; ISBN:1-412904153. 4. Pandya K. and Bulsari S.: "Enjoy Statistics with SPSS for Windows"; Popular. 5. Gaur A. S. and Gaur S. S(2009).: "Statistical Methods for Practice and Research- A guide to data analysis using SPSS"; 2nd Ed., Sage Publications, New Delhi. 6. George: "SPSS For Windows: Step By Step"; 8th Ed., Pearson, ISBN: 8131724298, 9788131724293. 7. Sudha G. Purohit, Sharad D. Gore, and Shailaja R. Deshmukh (2008), "Statistics using R, Second edition" , Narosa Publishing House, ISBN-978-81-8487-455-6 8. Dr. Mark Gardener (2015), "Beginning R: The statistical programming language", Wiley, ISBN-978-81-265-4120-1 9. Jared P. Lander (2014), "R for everyone advance analytics and graphics", Addison Wesley data & analytics series, Dorling Kindersley (India) Pvt. Ltd., ISBN-978-93-325-3924-2 10. Yanchang Zhao and Yonghua Cen (2014), "Data mining application with R",Elsevier, ISBN-978-93-5107-218-8 11. Nina Zumel and John Mount (2015), "Practical data science with R", Dreamtech Press, ISBN-978-93-5119-437-8 12. Paul D. Lewis (2010), "R for medicine and biology", Jones and Bartlett Publishers, ISBN-978-0-7637-5808-0.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: 3051: DATABASE MANAGEMENT SYSTEMS

Course Code	**MAS-3051**
Course Title	**DATABASE MANAGEMENT SYSTEMS**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course is to prepare the students to be capable of doing any kind of data management that will further help them to perform various activity of data science. The core objective of this course is to identify different database systems, their models and to perform various data management task such as retrieval, insertion and removal of data using it's tool.
Course Objective	To make students familiar with database management theory and give practical exposure to manage data using query language.
Course Outcomes	After completing this course, students will be able to: CO1: Understand and apply the concept of database management system by comparing them with traditional data management techniques; CO2: Perform data definition, data manipulation, data control and transaction control using Query language CO3: Learn fundamental data models and its application in real world domain. CO4: Extend the procedural structural query language using various concept such as Procedures, Functions, Cursor and Triggers

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■			■		■	
	CO2	■	■	■			■	
	CO3			■				
	CO4						■	

Pre-requisite	Fundamental of computer programming

Course Content	**UNIT I:**
	• Overview of Database Management System
	  ➢ Introduction to Database Languages
	  ➢ Advantages of DBMS over file processing systems.
	• Relational Database Management System
	  ➢ Entity relationship model
	  ➢ Mapping constraints
	  ➢ Primary Keys
	  ➢ Foreign Keys
	  ➢ Structural Constraints
	  ➢ ER notations & ER model
	  ➢ Enhanced Entity Relationship Model
	
	UNIT II:
	• Database System
	  ➢ Database Structure
	  ➢ Levels of abstraction in DBMS
	  ➢ View of data
	  ➢ Role of Database users and administrators

	➤ Database Structure: DDL, DML, DCL,TCL
	UNIT III:
	 • Types of Data Models
	  ➤ Hierarchical databases
	  ➤ Network databases
	  ➤ Relational databases
	  ➤ Object oriented databases
	UNIT IV:
	 • PL/SQL
	  ➤ Stored Procedure
	  ➤ Concepts Procedure, Functions, Cursors ,Triggers

Reference Books	1. An Introduction to Database System- C. J. Date-Narosa 2. Database System Concepts-Henry F. Korth & Abraham Silberschatz-McGraw-Hill 3. Principles of Database System-J. Ullman-Galgotia Pub. 4. Introduction to database system - Bipin C. Desai - Galgotia pub. 5. Fundamentals of Database System-Elmasri Navathe, Addison Wesley 6. Introduction to Databased Management- Navin Prakash - TMH 7. Oracle PL/SQL Programming-Feuerstein & Pribyl, O'Reilly, Shroff Publishers & Distributors Pvt. Ltd. 8. Manual of RDBMS
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	**MAS-3052**
Course Title	**OFFICIAL STATISTICS**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of this course is to understand official statistics and its role in framing policies in Economics and Business and the system of official statistics in India
Course Objective	To make students competent in theories and practices of official statistics.
Course Outcomes	After completing this course, students will be able to: CO1: Understand Indian Statistical systems, its role, functions and activities i.e. understand the role of MoSPI, CSO, NSSO, National Statistical Commission. CO2: Appreciate and use techniques of quantitative analysis in social work research CO3: Discuss the scope and contents of population census of India. CO4: Identify Statistics related to industries, foreign trade, balance of payment, cost of living inflation, educational and social statistics etc. CO5 : Understand economic development and national income estimation CO6: Discuss the measures of inequality in income and measures of incidence and intensity.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	CO1	■							
	CO2	■	■			■	■	■	
	CO3	■							
	CO4	■	■		■	■	■	■	
	CO5	■	■	■	■	■	■	■	
	CO6	■		■	■	■	■	■	

Pre-requisite	Concept of economics, time series and index number, CSO, NSSO , MOSPI
Course Content	**UNIT I:** • Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO). **UNIT II:** • Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance. **UNIT III:** • National Income – Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India. **UNIT IV:** • Measurement of income inequality: Lorenz curves, Application of Pareto and Lognormal as income distribution. • Organization of large scale sample surveys. General and special data dissemination systems.
Reference Books	1. Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.

	2. Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, Harper Collins Publishers India (P) Ltd., New Delhi. 3. C. S. O. (1990). Basic Statistics Relating to the Indian Economy. 4. C.S.O. (1995). Statistical System in India. 5. C. S. O. (1999). Guide to Official Statistics. 6. C. S. O. (2016). Guide to Official Statistics. 7. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World Press, India. 8. Mukhopadhyay P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India. 9. Asthana, B.N. and Srivastava, S.S.(1984): Applied Statistics of India, Chaitanya Publishing House, Allahabad.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS- 3053: POPULATION STUDIES

Course Code	MAS-3053
Course Title	**POPULATION STUDIES**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course tends to develop a basic understanding of demographic theory and its application to various aspects of the economy. The course will also help in presenting mortality, fertility and economic argument and develop analytical abilities of different demographic concepts in quantitative terms.
Course Objective	To make students acquainted with Gain a sound command over the basic tenets of demography as well as key demographic issues and illustrations in the context of a large and diverse country like India.
Course Outcomes	After completing this course, students will be able to: CO1: Apply demographic concepts and population theories to explain past and present population characteristics. CO2: Comprehend the basic components of population (fertility, mortality, migration) CO3: Study established theories of population. CO4: Get a better understanding of the current demographic profile of India CO5: Acquire skills to use life tables and calculate survival rates CO6: : Be familiarize with the methods of Population projection

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	■		■	■			■
	CO2	■		■	■			■
	CO3	■		■	■			■
	CO4	■		■	■			■
	CO5	■		■	■	■		■
	CO6	■		■	■	■		■

Pre-requisite	Basic concept of population studies and census
Course Content	**UNIT I:** • **Introduction:** The nature of demography, demographic view of population, techniques of population studies. Basic demographic measures, sex-ratio, child-women ratio, crude rates, specific rates. • **Life Tables :** Concepts of Life Tables, Assumptions related to life tables, The columns of life tables, Complete and Abridged life tables, Construction of life tables. **UNIT II:** • **Mortality :** Infant Mortality, Neonatal mortality, Perinatal mortality, Maternal mortality, death rates, standardized death rates. • **Fertility and Reproduction :** Crude Birth Rate (CBR), General fertility rate (GFR), Age specific fertility rate, Total fertility rate (TFR), Gross reproduction rate

	(GRR), Net reproduction rate (NRR). Marriage rates, divorce rates, age pattern of marriage, types of migration, migration rates, migrant components, migrant streams, internal migration, international migration. **UNIT III:** • **Growth of Population and Models of Population :** Introduction, Simple Birth and Death Process, Stationary population models, Stable population models, intrinsic rate of growth, intrinsic age distribution, Quasi stability. • **Population Estimates and Projections :** Inter - censal and Post - censal estimates, population projections, mathematical methods, component methods, mortality basis for projections, fertility basis for projections, migration basis for projections. **UNIT IV:** • **Census and Sample Surveys :** Definition of Census and its features, Organizing the Census, methods of enumeration, Census in India, Indian Census in 1991 and 2001. Defining the objectives and scope of sample surveys. Questionnaire design, sample design, organization of field work, collecting and processing the data, reporting.
Reference Books	1. Barkley G.W. (1958): "Techniques of Population Analysis"; John Wiley & Sons Inc; First Edition, ISBN-10: 0471048186 ,ISBN-13: 978-0471048183 2. Pathak K. B. and F. Ram (1998) : "Techniques of Demographic Analysis"; 2nd Edition, Himalaya Publishing House, ISBN : 81-7493-472-3 3. R. Ramakumar (1986): "Technical Demography"; Wiley Eastern Ltd., ISBN: 0852267436 4. H. Raj (1986): "Fundamentals of Demography"; Surjeet Publication. **ISBN:** 8122903363, **ISBN-13:** 9788122903362 5. Cox. P.R. (1970): "Demography"; Cambridge University Press. 6. Keyfitz N. and Caswell H. (2005): "Applied Mathematical Demography"; 3rd Edition, Springer. 7. Keyfitz N. and Beekman J. A.(1984) : "Demography through Problems"; Springer-Verlag, New York, **ISBN10:** 0387908366, **ISBN13:** 9780387908366
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS- 306: PRACTICAL – IV (BASED ON PAPER – 301, 302, 303)

Course Code	**MAS-306**
Course Title	**PRACTICAL – IV (BASED ON PAPER – 301, 302, 303)**
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute problems of statistics for economics, operation research and econometrics data using MS excel, SPSS and R.
Course Objective	To make students acquainted to solve real life problems using MS excel, SPSS and R.
Course Outcomes	After completing this course, students will be able to: CO1: Analyze time series data in various contexts (such as economics, finance, and sociology) using excel, SPSS and R. CO2: Run and interpret time-series models and regression models for time series. CO3: Solve the problem of simplex, duality, transportation and assignment problems. CO4: Solve the problem Inventory Management Systems and Sequencing using excel. CO5: Fit different econometrics model to real life data using Excel, SPSS and R. CO5: Develop the skills of interpretation and report writing.
Mapping between COs with PSOs	(see table below)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■	■	■	■	■	■
CO2	■	■	■	■	■	■	■
CO3	■	■	■	■	■		■
CO4	■	■	■	■	■	■	■
CO5	■	■	■	■	■	■	■

Pre-requisite	Basic concept of statistics for economics, operation research and econometrics data.
Course Content	Based on theory paper MAS-301 to MAS-303
Reference Books	Reference book mention in theory paper MAS-301 to MAS-303
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS-307: PRACTICAL - VI (BASED ON PAPER – 304, 305)

Course Code	**MAS-307**
Course Title	**PRACTICAL - VI (BASED ON PAPER – 304, 305)**
Credit	2
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and computing problems of specific data. It helps students to understand and compute problems of database management systems, solve the real life problems of official statistics and population studies data using MS excel, to increase knowledge and requisite skills of participants on the use of SPSS and R language to enable them make the most of this powerful software package while allowing them to work independently with SPSS and R language on their own data and provide a solid foundation for advanced data analysis work.
Course Objective	To make students acquainted to solve real life problems using MS excel, SPSS and R.
Course Outcomes	After completing this course, students will be able to: CO1: Design and implement properly structured databases that match the standards based under realistic constraints and conditions. CO2: Designs SQL queries to add data to the database, edit existing data, and to delete data from the database. CO3: Experience how to manage data by establishing a database connection over the current programming languages. CO4: Understand the basic practice of statistics by using SPSS and R language, CO5: Understand the use of advanced SPSS for analyzing project data for reporting purposes. CO6: Analyze the data of official statistics and population studies using excel and software.

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							
	CO6							

Pre-requisite	Basic concept of data base management system, official statistics, population studies and statistical softwares.
Course Content	Based on theory paper MAS-304 and MAS-305
Reference Books	Reference book mention in theory paper MAS-304 and MAS-305
Teaching Methodology	Class work, Lab work, Discussion, Self-Study, practical session, live demo, hands on training.
Evaluation Method	30% Internal assessment based on class attendance, journal, internal practical examination, VIVA etc. 70% External based on semester end University examination

Course: MAS-401: DESIGN OF EXPERIMENTS

Course Code	MAS-401
Course Title	**DESIGN OF EXPERIMENTS**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course is to learn the applications of different designs in agriculture, medical and industry.
Course Objective	To make students acquainted with various techniques of design of experiment.
Course Outcomes	After completing this course, students will be able to: CO1: Understand the concept of design and conduct experiments efficiently and effectively CO2: Analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed. CO3: Develop the concept of various designs CRD, RBD, LSD, BIBD, Factorial and Confounded designs. CO4: Understand the difference between various designs of experiments. CO5: Particular attention will be paid to understanding the process of designing an experiment including factorial and confounding designs.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	▓		▓		▓	▓	▓
CO2	▓	▓	▓	▓	▓	▓	▓
CO3	▓	▓	▓	▓	▓	▓	▓
CO4	▓		▓	▓	▓	▓	▓
CO5	▓		▓		▓	▓	▓

Pre-requisite	Basic concept of experimental designs and drawing inferences
Course Content	**UNIT I:** • Concept and history of Design of experiments. • The need for Designed experiments. • Elementary ideas of blocking and randomized block design. • Elementary idea of treatment structure and Basic principles of Design of experiments • Concept of complete and incomplete block designs. Completely Randomized Design(CRD), Randomized Block Design(RBD), Latin square design(LSD), their analysis with applications. Missing plot technique for RBD, LSD with their applications. **UNIT II:** • Concept of BIBD and its properties. Intra block analysis of BIBD, construction of BIBD, Missing plot technique for BIBD. **UNIT III:** • Analysis of Covariance: Analysis of covariance for CRD, RBD and LSD, Youden square design, Cross over design, split-plot designs. **UNIT IV:** • Factorial Experiments : Characterization of experiments, factorial experiments, factorial experiments with factors at two levels, grouping for interaction contrasts, confounding, confounding in more

	than two blocks, experiments with factors at three levels each, analysis of factorial experiments.
Reference Books	1. Montgomery, D. C. (1997): "Design and Analysis of Experiments"; 4th edition, John Wiley & Sons, New York
	2. Montgomery, D. C. (2006): "Design and Analysis of Experiments"; 5th Ed, Wiley (India), **ISBN:** 812651048X, **ISBN-13:** 9788126510481, 978-8126510481
	3. R. Mead. (1990): "The Design of Experiments: Statistical Principles for Practical Application"; Cambridge Uni. Press. ISBN-10: 0521287626, ISBN-13: 978-0521287623
	4. Cochran W.G. and Cox G.M. (2003): "Experimental Designs"; 2nd Edition, John Wiley (wie) **ISBN:** 9971513110, **ISBN-13:** 9789971513115, 978-9971513115.
	5. Cochran W.G. and Cox G.M. (1957): "Experimental Designs"; 2nd Edition, John Wiley & Sons Inc., New York, **ISBN:** 0471162035, **ISBN-13:** 9780471162032
	6. Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi.
	7. Das M.N. and Giri N.C.(1999) : "Design and Analysis of Experiments"; 2nd Edition, New Age International Publishers Ltd, **ISBN:** 0852269145, **ISBN-13:** 9780852269145.
	8. Federer W.T. (1993) : "Statistical Design And Analysis For Intercropping Experiments"; Springer-verlag, **ISBN:** 0387979239, **ISBN-13:** 9780387979236, 978-0387979236
	9. Federer, W. T. (1955): "Experimental Design: Theory and Application"; The Macmillan Co., New York.
	10. Klaus Hinkelmann, Kempthorne Oscar (2005): "Design and Analysis of Experiments"; Wiley-interscience, **ISBN:** 0471551775, **ISBN-13:** 9780471551775
	11. Kempthorne, O. (1952), The Design and Analysis of Experiments, John Wiley & Sons, New York
	12. Fisher R. A. (2005): "Statistical Methods for Research Workers"; Cosmo Publications, **ISBN:** 8130701332, **ISBN-13:** 9788130701332, 978-8130701332
	13. Panse, V.G. and Sukhatme, P.V. (1978): "Statistical methods for agricultural workers"; ICAR, New Delhi.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-402: OPERATIONS RESERACH – II

Course Code	MAS-402
Course Title	**OPERATIONS RESERACH – II**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns itself with studying analytical method of Operations research, problem-solving and decision-making that is useful in the management of organizations
Course Objective	To develop the optimization techniques that will be useful in the personal and professional life.
Course Outcomes	After completing this course, students will be able to: CO1: Understand basic concept of sensitivity analysis with changes in objective function, vector b and matrix A. Also discuss the cases for addition and deletion of variable and constrains with example CO2: Construct integer programming problems with different types to discuss the solution techniques. CO3: Select the best sequence through different machine to different jobs to minimize time CO4: Understand the concept of PERT/CPM and their real life application CO5: Be aware of the concept of replacement problems with fixed money and variable money effect. Comparison of group and individual policy CO6: Explain the concept of Goal programming problem, their formulation method and example

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1	▓		▓	▓	▓	▓	▓
	CO2	▓		▓	▓	▓	▓	▓
	CO3	▓		▓	▓	▓		▓
	CO4	▓	▓	▓	▓	▓		▓
	CO5	▓	▓	▓	▓	▓		▓
	CO6	▓	▓	▓	▓	▓	▓	▓

Pre-requisite	Concept of liner algebra, basic mathematical operations
Course Content	**UNIT I:** • Sensitivity Analysis: ➢ Basic concepts ➢ Changes in the coefficient of objective function ➢ Changes in the components of vector b and of Matrix A ➢ Addition / Deletion of variable in the problem ➢ Addition / Deletion of constraint in the problem **UNIT II:** • Integer Programming: ➢ Introduction ➢ All and mixed integer programming (IPP) problems ➢ Gomory's al1-IPP algorithm ➢ The branch and bound technique

	➢ Zero - one programming
	
	UNIT III:
	    • PERT / CPM:
	        ➢ Basic concepts .
	        ➢ Construction and Time Calculation of the Network
	        ➢ Determination of Float and of the Critical Path
	        ➢ Crashing a Project
	        ➢ Scheduling a Project
	        ➢ Resource Analysis and Allocation
	        ➢ Application of PERT/ CPM
	
	UNIT IV:
	    • Replacement Theory:
	        ➢ Types of Replacement Problem
	        ➢ Replacement of Items that Deteriorate
	        ➢ Replacement of Items that fails completely and that of Staff
	    • Goal Programming:
	        ➢ Definitions and Concepts
	        ➢ Formulation of Goal Programming Problem (GPP)
	        ➢ Solution of GPP by Graphical and Extended Simplex Methods

Reference Books	1. K. Swarup, Gupta P.K. and Man Mohan(2008): "Operations Research"; S.Chand & Co., New Delhi, **ISBN:** 8180545350, **ISBN-13:** 9788180545351 2. G. Hadley (2002): "Linear Programming"; Narosa Book Distributors Pvt Ltd, **ISBN:** 8185015910, ISBN-**13:** 9788185015910 3. Murthy K.G.(1988): Linear complementarity, linear and nonlinear programming, Heldermann Verlag, ISBN: 3885384035, 9783885384038 4. Kasana H.S. and Kumar K.D.(2005) : "Introductory Operations Research: Theory & Applications"; Springer Verlag , ISBN: 8181282827, 9798181282827. 5. Kapoor V.K. (2006) : "Operations Research"; 7th Edition, Jain Book Depot, **ISBN :** 8170148286. 6. Sharma S.D.(2005):Operations Research"; 15th Ed., Kedar Nath Ram Nath & Co. Publishers, Meerut, 7. Hira,D.S., Gupta,P.K.(2007): OPERATIONS RESEARCH, S.Chand & Co., New Delh, ISBN: 81-219-0281-9
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: 4031: DATA MINING

Course Code	MAS-4031
Course Title	**DATA MINING**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course concerns itself with the collection, processing, and analysis of specific data. It helps us understand and analyse data mining theories and real world problem solution using various data mining techniques such as Supervised Learning, Unsupervised Learning and optimization
Course Objective	To make students aware with different data mining techniques theory and provide its practical exposure for real world problem solution.
Course Outcomes	After completing this course, students will be able to: CO1: Understand data mining process, its various types and introduce its applied domain CO2: Learn fundamental data mining technique and become skilled at a Supervised Learning techniques with its implementation in real world problem CO3: Study fundamental data mining technique and become skilled at an Un-supervised Learning techniques with its implementation in real world problem CO4: Understand optimization problem and develop fundamental skills using optimization techniques such as Neural Network and Genetic Algorithm. Also develop the concept of graphical evaluation method for data mining techniques.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■					
CO2	■		■	■	■	■	■
CO3	■		■	■	■	■	■
CO4	■		■	■	■	■	■

Pre-requisite	Concept of Data Processing
Course Content	**UNIT I:** • Introduction to Data Mining ➢ Process of data mining ➢ Types of data used for data mining ➢ Application of data mining **UNIT II:** • Supervised Learning ➢ Exploratory Data Analysis (EDA) ➢ Multiple Regression/Stepwise Regression ➢ Logistic Regression/Multi-Nomial regression ➢ K-nearest neighbors (KNN) ➢ Linear Discriminant Analysis (LDA) ➢ Quadratic Discriminant Analysis (QDA) ➢ Bayes classifier ➢ Nearest neighbor classifier ➢ Tree based methods like boosting or random forest **UNIT III:**

	• Unsupervised Learning
	  ➢ Clustering procedures- k-means hierarchical
	  ➢ Self-organizing map
	  ➢ EM algorithm
	  ➢ Feature selection: principal component analysis
	  ➢ Association rules
	
	UNIT IV:
	• Optimization
	  ➢ Neural Network
	  ➢ Genetic Algorithm
	• Graphical evaluation of classification, Association rules
	• Imputation of missing data

Reference Books	1. Jiawei Han, Micheline Kamber(2006) : "Data Mining"; II-Ed., Morgan Kaufmann Publishers, ISBN: 1558609016, 9781558609013 2. Hillol Kargupta, Jiawei Han, Philip S. Yu(2008): Next Generation of Data Mining, CRC Press, ISBN: 1420085867, 9781420085860 3. Margaret H. Dunham: "Data Mining - Introductory and Advance Topics"; Pearson Edu., ISBN: 8177587854, 9788177587852
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: MAS-4032: BIO-STATISTICS AND CLINICAL RESEARCH

Course Code	MAS-4032
Course Title	**BIO-STATISTICS AND CLINICAL RESEARCH**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of this course is to train students to utilise their knowledge of Statistics for the research related to health / biological/ medical fields.
Course Objective	Biostatistics is one area of Applied statistics that deals with drawing statistical inference from the research data related generated from planned experiments/trails for health / biological/ medical fields.
Course Outcomes	After successful completion of this course, student will be able to: **CO1.** Plan study design and do data analysis for the health / biological/ medical sciences. **CO2**. Understand how the basic principles of probability are useful for biostatistics. **CO3.** Do survival Analysis/ failure analysis for the health / biological/ medical sciences. **CO4.** Estimating the risk of one type of failure after removing others **CO5.** Evaluate, from simple datasets, evidence for linkage disequilibrium and disease associations using basic association tests **CO6:** planning, analysing and interpreting statistical out puts of different phases of clinical trials, including deciding sample size.

Mapping between COs with PSOs							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■						
CO2	■						
CO3	■	■	■		■		
CO4	■	■	■	■	■		
CO5	■	■	■	■	■	■	
CO6	■	■	■	■	■	■	■

Pre-requisite	Concept of descriptive statistics, inferential statistics, medical science.
Course Content	**UNIT I:** • Introduction to Bio-statistics, Sources of medical uncertainties, managing medical uncertainties. Applications and uses of Bio-statistics as a science. • Clinical trials: the need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multi-center trials. Data management: data definitions, data collection systems for good clinical practice, protocol definition. **UNIT II:** • Design of clinical trials : parallel vs. cross-over designs, cross-sectional vs. longitude designs, review of factorial designs, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage Phase II trials, design and monitoring of Phase III trials with sequential stopping, design of bioequivalence trials. **UNIT III:**

	• Reporting and analysis: analysis of categorical outcomes from Phase I - III trials, analysis of survival data from clinical trials. Interim analysis method, motivating intent- to-treat analysis. **UNIT IV:** • Determining sample size. Surrogate endpoints: selection and design of trials with surrogate endpoints, analysis of surrogate endpoint data.
Reference Books	1. Prem Narayan, Bhatia & Malhotra (1979): Handbook of Statistical Genetics, IASRI, New Delhi. 2. Jain, J.R. (1982): Statistical techniques in quantitative genetics, Tata Mcgraw Hill. 3. Govindarajulu, Z. and Kargar, S. (2000): Statistical Techniques in Bioassay. 4. Finney, D.J (1971): Statistical Method In Bioassay, Griffin. 5. Finney, D.J (1971): Probit Analysis (3rd Edition), Griffin. 6. Weatherile, G.B. (1966): Sequential Methods in Statistics, Griffin. 7. Piantadosi, S. (1977): Clinical: A Methodologic Perspective. Wiley and Sons. 8. Jennison, C. and Turnbull, B.W (1999): Group Sequential Methods with Applications to Clinical Trials, CRC Press. 9. Flesis, J.L (1989): The Design and Analysis of Clinical Experiments. Wileyand Sons. 10. Marubeni, E. and Valsechhi, M.G (1994): Analyzing Survival Data From Clinical Trials and Observational Studies. Wiley and Sons. 11. Friendman,L.M., Furbery, C.D. and Demets, D.L.(1998): " Fundamental of clinical Trials " Springer Publication,3rd ed., Springer. 12. Duolaowang, A. B. (2006): Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Published by Remedica, USA. 13. A. Indrayan and L. Satyanarayana : Biostatistics for medical, nursing and pharmacy students, Eastern Economy Edition, Prentice hall India, ISBN 81-203-3054. 14. B. K. Mahajan: Method in Biostatistics for medical students and research work, Sixth edition, Jaypee Brothers medical publisher LTD. ISBN 81-7179-520-X.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	MAS-4033
Course Title	**STATISTICAL SIMULATION**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	Students are expected to choose proper models for a given research in applied problem and apply the theory to model real phenomena and solve several problems concerning random behaviour in different fields of applied science.
Course Objective	To develop an ability to analyse run simulation model to real world problem.
Course Outcomes	After completing this course, students will be able to: CO1: Generate random numbers CO2:Generate random numbers from probability distribution CO3: Use simulation for statistical inference CO4: Apply Jackknife and Bootstrap methods in different types of populations

Mapping between COs with PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	
	CO1	▓	▓		▓		▓		
	CO2	▓			▓		▓		
	CO3	▓	▓	▓	▓	▓	▓		
	CO4	▓	▓	▓	▓	▓	▓	▓	

Pre-requisite	Concept of probability distributions, sampling techniques, optimization techniques, statistical inference
Course Content	**UNIT I:** • Statistic simulations: generating random variables, simulating normal, gamma and beta random variables. Comparison of algorithms to generate random variables. Generating random variables from failure rates. **UNIT II:** • Simulating multivariate distributions, MCMC methods and Gibbs sampler, simulating random fields, simulating stochastic process. Variance reduction technique: importance sampling for integration, control variates and antithetic variables. **UNIT III:** • Simulating a non-homogeneous Poisson process, Optimization using Monte Carlo methods, simulated annealing for optimization. Solving differential equations by Monte Carlo methods. **UNIT IV:** • Jackknife and Bootstrap: Bootstrap methods, re-sampling paradigms, bias and standard errors, Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation, bootstrapping in regression and sampling from finite populations.
Reference Books	1. Fishman, G.S. (1996) Mante Carlo: Concepts, Algorithms and

	Applications. (Springer).
	2. Rubinstein, R.Y. (1981); Simulation and the Monte Carlo Method. (Wiley). 3. Ripley, B.D. (1987) Stochastic Simulations (Wiley). 4. Ross, S. M. (2002) Simulation (Third Edition) (Academic). 5. Efron,B. and Tibshirani. R.J. (1993); An introduction to the Bootstrap. 6. Davison, A.C. and Hinkley,D.V. (1997) Bootstrap methods and their applications (Chapman and Hall). 7. Sho.J and Tu,D (1995); The Jackknife and the Bootstrap. Springer Verlag.
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: Project and Seminar

Course Code	
Course Title	**Project and Seminar**
Credit	8
Teaching per Week	4 Hrs per week per group
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2008
Purpose of Course	The purpose of the course concerns to allow the students to apply the different statistical procedure learned by them during the PG Program to solve real life problems. The students pick up a research problem, set the objectives, collect necessary data, clean the data, analyze it using appropriate statistical tool, reach to conclusion and prepare a report on it.
Course Objective	The objective of this course is to train the students to undertake projects in randomly selected group. The projects shall enable the students to take up their own statistical study and to understand the application of statistical methods that they learned during the course.
Course Outcomes	CO1: Students select the topic from the course into some theme of practical use. CO2: Search primary or secondary dataset and collect the data for analysis. CO3: Students shall conduct their own independent statistical research, from start to finish. CO4: Apply the statistical techniques in the project which they had learned in the theory. CO5: They are expected to use statistical software for computational purpose. CO6: Represent their work through power point presentation and submit hard copy. CO7: For the project each group shall work under the supervision of a faculty member. CO8: Demonstrate capacity to lead and manage change through collaboration with others
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

Pre-requisite	Basic concept of testing of hypothesis, time series analysis, econometrics, statistics for economics, softwares.
Course Content	Based on all theory papers included in whole syllabus
Reference Books	All reference book included in whole syllabus
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and Project review
Evaluation Method	30% internal assessment based on presentation and submission of project report and 70% during the end semester examination students shall present the same, whereby they shall be evaluated by an external examiner.