SIES College of Arts, Science & Commerce
(Autonomous)

Department of Statistics

Faculty: Science
Program: B.Sc.
Course: Statistics

Syllabus for S.Y.B.Sc.
(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

SEMESTER III

THEORY

TITLE OF COURSE	PROBABILITY DISTRIBUTIONS			
COURSE CODE	**UNIT**	**TOPICS**	**LECTURES/WEEK**	**CREDITS**
PAPER I SIUSSTA31	**I**	**UNIVARIATE RANDOM VARIABLES (DISCRETE AND CONTINUOUS)**	**1**	**2**
	II	**STANDARD DISCRETE PROBABILITY DISTRIBUTIONS**	**1**	
	III	**BIVARIATE PROBABILITY DISTRIBUTIONS**	**1**	
TITLE OF COURSE	**THEORY OF SAMPLING**			
COURSE CODE	**UNIT**	**TOPICS**	**LECTURES/WEEK**	**CREDITS**
PAPER II SIUSSTA32	**I**	**CONCEPTS OF SAMPLING & SIMPLE RANDOM SAMPLING**	**1**	**2**
	II	**STRATIFIED SAMPLING**	**1**	
	III	**RATIO & REGRESSION ESTIMATION AND SAMPLING METHODS**	**1**	
TITLE OF COURSE	**OPERATIONS RESEARCH I**			
COURSE CODE	**UNIT**	**TOPICS**	**LECTURES/WEEK**	**CREDITS**
PAPER III SIUSSTA33	**I**	**LINEAR PROGRAMMING PROBLEM**	**1**	**2**
	II	**TRANSPORTATION PROBLEM**	**1**	
	III	**ASSIGNMENT PROBLEM & SEQUENCING**	**1**	

PRACTICALS

COURSE CODE	PRACTICALS BASED ON	LECTURES/ WEEK	CREDITS
SIUSSTAP3	**SIUSSTA31**	**3**	**3**
	SIUSSTA32	**3**	
	SIUSSTA33	**3**	

SEMESTER IV

THEORY

TITLE OF COURSE	PROBABILITY AND SAMPLING DISTRIBUTIONS			
COURSE CODE	UNIT	TOPICS	LECTURES/ WEEK	CREDITS
PAPER I SIUSSTA41	I	STANDARD CONTINUOUS PROBABILITY DISTRIBUTIONS	1	2
	II	NORMAL DISTRIBUTION	1	
	III	EXACT SAMPLING DISTRIBUTIONS	1	
TITLE OF COURSE	ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS			
COURSE CODE	UNIT	TOPICS	LECTURES/ WEEK	CREDITS
PAPER II SIUSSTA42	I	ANALYSIS OF VARIANCE	1	2
	II	DESIGN OF EXPERIMENTS	1	
	III	LATIN SQUARE DESIGN & FACTORIAL EXPERIMENTS	1	
TITLE OF COURSE	OPERATIONS RESEARCH II			
COURSE CODE	UNIT	TOPICS	LECTURES/ WEEK	CREDITS
PAPER III SIUSSTA43	I	CPM AND PERT	1	2
	II	GAME THEORY	1	
	III	DECISION THEORY	1	

PRACTICALS

COURSE CODE	PRACTICALS BASED ON	LECTURES/ WEEK	CREDITS
SIUSSTAP4	SIUSSTA41	3	3
	SIUSSTA42	3	
	SIUSSTA43	3	

SYBSc SYLLABUS UNDER AUTONOMY
SEMESTER III

PAPER I

Objectives:

- To study characteristics of discrete and continuous distributions.
- To learn R software to study distributions.

Course Code	Title	Credits
SIUSSTA31	**PROBABILITY DISTRIBUTIONS**	**2Credits(45 lectures)**
UNIT I: UNIVARIATE RANDOM VARIABLES (DISCRETE AND CONTINUOUS) Moment Generating Function, Cumulant generating Function and Characteristic function-Definition and properties: Effect of change of origin and scale, MGF, CGF and Characteristic function of sum of nindependent random variables, moments from MGF, CGF and Characteristic function. Relationship between moments and cumulants. Transformation of univariate random Variable.		**15 Lectures**
UNIT II:STANDARD DISCRETE PROBABILITY DISTRIBUTIONS Degenerate, Uniform,Two point, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Truncated Binomial, Truncated Poisson (point of truncation 0) distributions. The following aspects (wherever applicable) of the above distributionsto be discussed: Probability mass function, Cumulative distribution function, Mean, Mode and Standard deviation. Moment Generating Function, Cumulant Generating Function, Additive property, Recurrence relation for Central Moments, Skewness and Kurtosis, Limiting distribution,Fitting of Distribution.		**15 Lectures**
UNIT III: BIVARIATE PROBABILITY DISTRIBUTIONS Joint Probability mass function for Discrete random variables**,** Joint Probability density function for continuous random variables and properties. Marginal and conditional Distributions. Independence of Random Variables. Conditional Expectation & Variance. Regression Function. Coefficient of Correlation. Transformation of Random Variables and Jacobian of transformation.		**15 Lectures**

SEMESTER III: PRACTICALS BASED ON COURSE SIUSSTA31

1. Moment Generating Function,
2. Cumulant Generating Function, Characteristic Function,
3. Standard Discrete Distributions.
4. Fitting of Standard Discrete Distributions.
5. Bivariate Probability Distributions.
6. Transformation of univariate random variables.
7. Transformation of bivariate continuous random variables.
8. Use of R.

REFERENCES:

1. Goon A.M., Gupta M.K & Dasgupta B. (2013). *An Outline of Statistical Theory*,
2. Gupta S.C.&Kapoor V.K. (2007).*Fundamentals of Mathematical Statistics*: Sultan Chand & Sons
3. Hoel P. G. (1966). *Introduction to Mathematical Statistics*, Fourth Edition : John Wiley & Sons Inc.
4. Hogg R. V.&CraigA.T.(2012). *Introduction to Mathematical Statistics*, Seventh Edition: Collier McMillan Publishers.
5. Hogg R. V.&Tannis E. A. (1988). *Probability and Statistical Inference*, Third Edition: Collier McMillan Publishers.
6. Kapur J. N.&SaxenaH.C.*Mathematical Statistics*, Fifteenth Edition : S. Chand & Company Ltd.
7. Medhi J. (2013). *Statistical Methods*; *An Introductory Text*, SecondEdition: Wiley Eastern Ltd.
8. Miller I., Miller M.& Freund J.E.(1999)*John E. Freund's Mathematical Statistics*, Sixth Edition: Pearson Education Inc.
9. MoodA. M., GraybillF.A., &BoyesD. C. (2001). *Introduction to the theory of Statistics*, Third Edition: McGraw-Hill Book Company.

   Vol. 1, Third Edition: The World Press Pvt. Ltd.

PAPER II

Objectives:

- To learn different methods of data collection.
- To analyse the collected data using sampling techniques.

Course Code	Title	Credits
SIUSSTA32	**THEORY OF SAMPLING**	2Credits(45 lectures)
UNIT I: CONCEPTS OF SAMPLING & SIMPLE RANDOM SAMPLING Population, Population unit, Sample, Sample unit, Parameter, Statistic, Estimator, Bias, Unbiasedness, Mean square error & Standard error. Census survey, Sample Survey. Steps in conducting a sample survey,Designing appropriate Questionnaire. Sampling and Non-sampling errors. NSSO, CSO and functions.Methods of Probability and Non Probability sampling. Definition, Sampling with & without replacement (WR/WOR).Lottery method & use of Random numbers to select Simple random sample.Estimation of population mean & total. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR).Estimation of population proportion and total. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR).Estimation of Sample size based on a desired accuracy in case of SRS for variables & attributes. (WR/WOR).		**15 Lectures**
UNIT II: STRATIFIED SAMPLING Need for Stratification of population. Definition of Stratified Sample. Advantages of Stratified Sampling. Estimation of population mean & total in case of Stratified Random Sampling (WOR within each strata). Expectation & Variance of the unbiased estimators, Unbiased estimators of variances of these estimators. Proportional allocation, Optimum allocation with and without varying costs. Comparison of Simple Random Sampling, Stratified Random Sampling using Proportional allocation &Neyman allocation. Estimation of population proportion & total in case of Stratified Random Sampling (WOR within each strata).		**15 Lectures**
UNIT III: RATIO & REGRESSION ESTIMATION AND SAMPLING METHODS Ratio Estimators for population Ratio, Mean & Total. Expectation & MSE of the Estimators. Estimators of MSE. Regression Estimators for population Mean & Total. Expectation & Variance of the Estimators assuming known value of regression coefficient 'b'. Estimation of 'b'. Resulting variance of the estimators. Comparison of Ratio, Regression & mean per unit estimators. Introduction to Systematic sampling, Cluster sampling & Two Stage sampling.		**15 Lectures**

SEMESTER III: PRACTICALS BASED ON COURSE SIUSSTA32

1. Designing of Questionnaire.
2. Simple Random Sampling for Variables.
3. Simple Random Sampling for Attributes.
4. Estimation of Sample Size in Simple Random Sampling.
5. Stratified Random Sampling.
6. Ratio Estimation.
7. Regression Estimation.

REFERENCES:

1. Cochran.W.G. (1978). *Sampling Techniques*, Third Edition: WileyEastern Limited
2. Daroga Singh&F.S.Chaudhary. (1986).*Theory and Analysis of Sample Survey Design :* Wiley Eastern Ltd
3. Des Raj. (1968).*Sampling Theory*:McGraw Hill Series in Probability and Statistics.
4. Gupta S.C.&Kapoor V.K. (2007).*Fundamentals of Mathematical Statistics*: Sultan Chand & Sons
5. Mukhopadhyay P. (1998). *Theory and Methods of Survey Sampling*: Prentice Hall of India
6. Murthy M.N.(1967).*Sampling Theory and methods*:Statistical Publishing Society.
7. P.V. Sukhatme&B.V. Sukhatme. (1984). *Sampling Theory of Surveys with Applications,* Third Edition: Iowa State University Press.

Pvt. Ltd.

8. Sampath S.(2005). *Sampling Theory and Methods,*Second Edition: Narosa PublishingHouse

PAPER III

Objectives:

- To understand typical industry problems like transportation, assignment etc.
- To learn MS Excel to solve problems related to optimization.

Course Code	Title	Credits
SIUSSTA33	**OPERATIONS RESEARCH I**	**2Credits (45 lectures)**
UNIT I: LINEAR PROGRAMMING PROBLEM Mathematical Formulation: Maximization & Minimization. Solution, Feasible Solution, Basic Feasible Solution, Optimal solution. Graphical Solution for problems with two variables. Simplex method of solving problems with two or more variables. Big M method. Concept of Duality. Its use in solving L.P.P. Relationship between optimum solutions of Primal and Dual. Economic interpretation of Dual.		**15 Lectures**
UNIT II: TRANSPORTATION PROBLEM Mathematical Formulation, Solution, Feasible Solution. Initial Basic Feasible Solution by North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method. Optimal Solution by MODI Method. Optimality test, Improvement procedure. Variants in Transportation Problem: Unbalanced, Maximization, Prohibited route type.		**15 Lectures**
UNIT III: ASSIGNMENT PROBLEM & SEQUENCING Assignment: Mathematical Formulation. Solution by Complete Enumeration Method and Hungarian method.Variants in Assignment Problem: Unbalanced, Maximization type, Restricted (prohibited) route. Travelling Salesman Problem. Sequencing Problem: Processing n Jobs through 2 and 3 Machines & 2 Jobs through m Machines.		**15 Lectures**

SEMESTER III: PRACTICALS BASED ON COURSE SIUSSTA33

1. Formulation and Graphical Solution of L.P.P.
2. Simplex Method.
3. Duality.
4. Transportation.
5. Assignment.
6. Sequencing.
7. Use of TORA&MS Excel Solver

REFERENCES:

1. Bronson R. (1997). *Schaum Series book in Operations Research.* Second edition: Tata McGraw Hill Publishing Company Ltd.
2. Kantiswaroop&Gupta M. (2010). *Operations Research,* Twelfth Edition: S Chand & Sons.
3. Sasieni M., Yaspan A.&Friedman L. (1959).*Operations Research; Methods and Problems*: John Wiley & Sons.
4. Sharma J. K. (1989). *Mathematical Models in Operations Research*:Tata McGraw Hill Publishing Co. Ltd.
5. Sharma J.K. (2001). *Quantitative Techniques for Managerial Decisions*: MacMillan India Ltd.
6. Sharma S.D. *Operations Research*. Eleventh Edition: KedarNath Ram Nath& Company.
7. TahaH. A.(2010). *Operations Research*. Ninth Edition: Prentice Hall of India.
8. Wagner H. M. (1970). *Principles of Operations Research with Applications to Management Decisions,* Second Edition : Prentice Hall of India Ltd.

SYBSc SYLLABUS UNDER AUTONOMY
SEMESTER IV
PAPER I

Objectives:

- To study normal distribution and its applications.
- To use sampling distributions in testing equality of means, independence of attributes, goodness of fit, etc.

Course Code	Title	Credits
SIUSSTA41	**PROBABILITY AND SAMPLING DISTRIBUTIONS**	2Credits (45 lectures)

UNIT I: STANDARD CONTINUOUS PROBABILITY DISTRIBUTIONS Rectangular, Triangular with parameters (a, b, c), Exponential,Gamma (with one & two parameters), Beta (Types I & II). Cauchy (with one & two parameters) The following aspects of the above distributions(wherever applicable) to be discussed: Mean, Median, Mode & Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). Fitting of Distribution. Interrelations between the distributions.	**15 Lectures**
UNIT II: NORMAL DISTRIBUTION Mean, Median, Mode, Standard deviation, Moment Generating function, Cumulant Generating function, Moments & Cumulants (up to fourth order). Recurrence relation for central moments, skewness & kurtosis, Mean absolute deviation. Distribution of linear function of independent Normal variables. Fitting of Normal Distribution. Central Limit theorem for iid random variables. Log Normal Distribution: Mean, variance, distribution of product of independent log normal variables.	**15 Lectures**
UNIT III: EXACT SAMPLING DISTRIBUTIONS Chi-Square Distribution: Concept of degrees of freedom. Mean, Median, Mode & Standard deviation. Moment generating function, Cumulant generating function. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution (without proof).Applications of Chi-Square: Confidence interval for the variance of a Normal population, Test of significance for specified value of variance of a Normal population. Test for goodness of fit, Test for independence of attributes, Yates' correction.	**15 Lectures**

t-distribution: Derivation of p.d.f. of t ,Mean, Median, Mode & Standard deviation.. Asymptotic properties.Students's t, Applications of t: Confidence interval for: Mean of Normal population, difference between means of two independent Normal populations having the same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations (based on independent samples with equal variances & dependent samples). F-distribution: Mean, Mode & Standard deviation. Distribution of Reciprocal of an F variate, Ratio of two independent Chi-squares divided by their respective degrees of freedom. Interrelationship of F with t-distribution, Chi-square distribution & Normal distribution.Applications of F.Confidence interval for ratio of variances of two independent Normal populations. Test for equality of variances of two independent Normal populations.	

SEMESTER IV: PRACTICALS BASED ON COURSE SIUSSTA41

1. Standard Continuous Distributions.
2. Fitting of Standard Continuous Distributions.
3. Normal Distribution
4. Fitting of Normal distribution, Central Limit Theorem.
5. Chi Square distribution.
6. t distribution.
7. F distribution.

REFERENCES:

1. Goon A.M., Gupta M.K&Dasgupta B. (2013). *An Outline of Statistical Theory*. Vol. 1, Third Edition: The World Press Pvt. Ltd.
2. Gupta S.C.& Kapoor V.K. (2007). *Fundamentals of Mathematical Statistics*: Sultan Chand & Sons
3. Hoel P. G. (1966). *Introduction to Mathematical Statistics*, Fourth Edition : John Wiley & Sons Inc.
4. Hogg R. V. &Tannis E. A. (1988). *Probability and Statistical Inference*, Third Edition: Collier McMillan Publishers.
5. Hogg R. V. &Craig A.T. (2012) *Introduction to Mathematical Statistics*.Seventh Edition: Collier McMillan Publishers.
6. Kapur J. N.&Saxena H.C. *Mathematical Statistics*, Fifteenth Edition : S. Chand & Company Ltd.
7. Medhi J. (2013). *Statistical Methods*: *An Introductory Text*. Second Edition: Wiley Eastern Ltd.
8. Miller I., Miller M., Freund J.E. (1999) *John E. Freund's Mathematical Statistics*, Sixth Edition: Pearson Education Inc.
9. Mood A. M., Graybill F.A.&Boyes D. C. (2001). *Introduction to the theory of Statistics.*Third Edition: McGraw-Hill Book Company.

PAPER II

Objectives:

- Todesign an experiment for specified objectives.
- To evaluate the data collected using ANOVA techniques.

Course Code	Title	Credits
SIUSSTA42	**ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS**	**2Credits (45 lectures)**
UNIT I: ANALYSIS OF VARIANCE Introduction, Cochran's Theorem (Statement only). One way classification with equal & unequal observations per class, Two way classification with one observation per cell. Mathematical Model, Assumptions, Expectation of various sum of squares, F- test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard Error and Confidence limits for elementary treatment contrasts.		**15 Lectures**
UNIT II: DESIGN OF EXPERIMENTS Experiment, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. Principles of Design of Experiments: Replication, Randomization & Local Control. Efficiency of design D1 with respect to design D2. Choice of size, shape of plots & blocks in agricultural &non agricultural experiments. Completely Randomized Design (CRD) & Randomized Block Design (RBD): Mathematical Model, Assumptions, Expectation of various sum of squares, F-test, Analysis of variance table, Advantages. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of RBD relative to a CRD. Missing plot technique for one missing observation in case of CRD and RBD.		**15 Lectures**
UNIT III: LATIN SQUARE DESIGN& FACTORIAL EXPERIMENTS: Latin Square Design: Mathematical Model, Assumptions, Expectation of various sum of squares, F-test, Analysis of variance table, Advantages. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. Efficiency of the design relative to RBD, CRD. Missing plot technique for one missing observation in case of LSD Factorial Experiments:Advantages. 2^2, 2^3 Experiments. Definition of Orthogonal Contrast, Calculation of Main & Interaction Effects. Yates' method. Analysis of 2^2& 2^3 factorial Experiments.		**15 Lectures**

SEMESTER IV: PRACTICALS BASED ON COURSE SIUSSTA42

1. One way Analysis of Variance.
2. Two way Analysis of Variance.
3. Completely Randomized Design.
4. Randomized Block Design.
5. Latin Square Design.
6. Missing Observations in CRD, RBD & LSD.
7. Factorial Experiments.
8. Use of R

REFERENCES:

1. CochranW.G.&CoxG.M.(1992). *Experimental Designs*, Second Edition: John Wiley and Sons.
2. Das M.N.&Giri N.C. (1986). *Design and Analysis of Experiments.* Second Edition: New Age International (P) Limited.
3. FedererW.T.(1955). *Experimental Design, Theory and Application*: Oxford & IBH Publishing Co. Pvt. Ltd.
4. GuptaS.C.&Kapoor V. K. (2001) *Fundamentals of Applied Statistics*, Third Edition: Sultan Chand and Sons.
5. Kempthorne O.(1994). *The Design and Analysis of Experiments*: John Wiley and Sons.
6. MontgomeryD.C.(2012).*Design and Analysis of Experiments*, Sixth Edition :John Wiley & Sons.
7. WinerB.J. (1962). *Statistical Principles in Experimental Design* :McGraw Hill Book Co.

PAPER III

Objectives:

- To understand planning and evaluation of project.
- To acquire skills in strategy planning and decision making.

Course Code	Title	Credits
SIUSSTA43	**OPERATIONS RESEARCH II**	**2Credits(45 lectures)**
UNIT I: CPM AND PERT Objective and Outline of the techniques. Diagrammatic representation of activities in a project: Gantt Chart and Network Diagram. Slack time and Float times. Determination of Critical path. Probability consideration in project scheduling. Project cost analysis. Updating.		**15 Lectures**
UNIT II: GAME THEORY Definitions of twoperson zero sum game, saddle point, value of the game, pure and mixed strategy, optimal solution of two person zero sum game, dominance property, derivation of formulae for 2x2 game. Graphical solution of (2 x n) and (m x 2) game. Reduction of game theory to LPP.		**15 Lectures**
UNIT III: DECISION THEORY Decision making under uncertainty: Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwitz α criterion, Minimax Regret criterion. Decision making under risk: Expected Monetary Value criterion, Expected Opportunity Loss criterion, Expected Payoff of Perfect Information (EPPI), Expected Value of Perfect Information (EVPI). Bayesian Decision rule for Posterior analysis. Decision tree analysis along with Posterior probabilities.		**15 Lectures**

SEMESTER IV: PRACTICALS BASED ON COURSE SIUSSTA43

1. Gantt chart and CPM
2. PERT
3. Project cost analysis
4. Updating
5. Game Theory I
6. Game Theory II
7. Decision Theory I
8. Decision Theory II
9. QM for windows

REFERENCES:

1. Bronson R. (1997).*Schaum Series book in Operations Research.* Second edition: Tata McGraw Hill Publishing Company Ltd.
2. Kantiswaroop&Gupta M. (2004). *Operations Research*. Fourth Edition: S Chand & Sons.
3. Sasieni M., Yaspan A.&Friedman L. (1959).*Operations Research; Methods and Problems*: John Wiley & Sons.
4. Sharma J. K. (1989). *Mathematical Models in Operations Research:* Tata McGraw Hill Publishing Co. Ltd.
5. Sharma J.K. (2001). *Quantitative Techniques for Managerial Decisions*: MacMillan India Ltd.
6. Sharma S.D. *Operations Research*, Eleventh Edition: KedarNath Ram Nath& Company.
7. Srinath L. S. (2001). *PERT and CPM, Principles and Applications*. Third Edition: East-West Press Pvt. Ltd.
8. Taha H. A. (2010). *Operations Research*.Ninth Edition: Prentice Hall of India.

EXAMINATION PATTERN

Internal Assessment of Theory per Course per Semester

1. Class Test 20 Marks.
2. Project / Assignment / Presentation etc. 20 Marks.

Semester End Theory Examination per Course

At the end of the semester, examination of 2 hours duration and 60 marks based on the three units shall be held for each course.

Pattern of Theory questionpaper:
There shall be four compulsory questions of 15 marks each (with Internal Option).
Question 1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III.Question 4 based on all three units.

Semester End Practical Examination per Course

1. Journal 10 Marks.
2. Practical Examination 40 Marks.

At the end of the semester, practical examination of2 hours duration and 40 marks shall be held for each course.

Pattern of Practical question paper:
There shall be four compulsory questions of 10 marks each (with Internal Option).
Question 1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III.Question 4 based on all three units.