B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Note: Students have to choose elective subject either MTH310E or STA310E

Course Title : Optimization ***Semester-V***
Course Code : MTH301C
Credit hrs. : 4

Course Objective: The aim of the course is to give knowledge to students to use quantitive methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

UNIT-I: Linear programming; concept and uses of linear programming, formulation of linear programming problem. Solution of LP problem- graphical method, simplex method. Duality in Linear Programming, Properties of the primal-dual pair- Dual simplex Method.

UNIT II: Transportation and Assignment problems: Formulation of transportation and assignment problems as linear programs. Methods of obtaining the initial basic feasible solution to a transportation problem. Solution of the Transportation problem by MODI Method. Unbalanced transportation problems and their solutions. Degeneracy in Transportation problem and its resolution. Solution of Assignment Problem by Hungarian Method. Traveling salesman problem as an assignment problem (Formulation only).

UNIT III: Sequencing problems- problems with n jobs and 2 machines, problems with n jobs and k machines. Games and Strategies: Two person zero-sum games, Maximin-Minimax Principle, Mixed Strategies, Solution of 2×2 and $m\times n$ games.

UNIT IV: Deterministic Inventory Systems: The components of an inventory system, Demand and replenishment pattern. The Problem of EOQ with uniform demand and several production runs of unequal length. The problem of EOQ with finite rate of replenishment. The problem of EOQ with shortages.

UNIT-V: Concept of PERT/CPM networks, estimating the activity time, determination of earliest expected and latest allowable times, determination of critical path Drawing network diagram, probability consideration in PERT networks PERT/CPM- cost analysis, applications of PERT/CPM. Simulation: meaning & uses; Monte Carlo method, random number generation, waiting line simulation model.

Books Recommended:

- Gass, S.I.: Linear Programming-Methods & Applications.
- Hillier & Liberman: Introduction to Operations Research, Mc. Graw Hill Book Co.
- Taha, H.A.: Operations Research-An introduction, Pentice Hall of India Pvt. Ltd. New Delhi. (7th Edition-2003)
- Swaroop K, Gupta, P.K. & Mohan, M.: Operations Research, Sultan Chand & Sons, New Delhi.
- Vohra, N D: 'Quantitative Techniques in Management' Tata McGraw Hill
- Sharma S.D.: 'Operational Research', Kedar Nath Ram Nath and Co., Meerut
- Kothari C R: 'Quantitative Techniques' Vikas Publishing House.
- Bicrman, H., C.P. Bonini & W.H. Hausman: 'Quantitative Analysis for Business Decisions, Homewood, Illions: Rechard D, Irwin Inc.
- Gordon, R.L. and I. Pressman: 'Quantitative Decisions making for Business', Prentice Hall Inc.
- Kwas, N.K.: 'Mathematical Programming with Business Applications', McGraw Hill, New York.

B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Course Title : Numerical Methods ***Semester-V***
Course Code : MTH302C
Credit hrs. : 4

Course Objective: Introduces students the analysis of numerical methods as well as the design and use of algorithms for scientific computing. The course introduces the students applications of numerical methods in a large number of engineering subjects which require solutions of linear systems, finding eigen values, eigenvectors, interpolation and applications, solving ODEs, PDEs

Unit I: Solutions of equations, Newton's method, interpolation, Lagrange interpolation; Divided differences, interpolation formulas using differences, Numerical differentiation and integration

Unit II: Ordinary differential equations: Euler method, single-step methods, Runge-Kutta's method; multi-step methods, methods based on numerical integration and differentiation, boundary value problems.

Unit III: Approximations: Different types of approximations, least squares polynomial approximation; polynomial approximation, approximation with trigonometric functions, exponential functions, rational functions.

Unit IV: Monte Carlo Methods: Random number generation; statistical tests of pseudo-random numbers; random variate generation, inverse transform method, composition method, acceptance rejection method, generation of exponential, normal, binomial and Poisson variates, examples of applications.

Textbooks: Numerical Methods, Problems and Solutions by Jain, Iyengar and Jain

Supplementary texts:

- Introduction to numerical Analysis by C.E. Froberg
- Numerical Analysis – A Practical Approach by M. Maron
- Simulation and Monte Carlo Methods by R.Y. Rubenstein
- Numerical Methods by Burda and Faires. Thomson Brooks/Cole

B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Course Title : Abstract Algebra ***Semester-V***
Course Code : MTH303C
Credit hrs. : 4

Course Objective: The course introduces the students basic concepts of modern algebra. Topics include the nature of proofs, sets and equivalence relations, binary operations, groups and subgroups, cyclic groups, groups of permutations and Polynomial Rings.

Unit I: Groups, subgroups, examples, cyclic groups and their subgroups, cosets and Lagrange's theorem, product of two subgroups

Unit II: Normal subgroups, quotient groups, homomorphism and isomorphism and related theorems, permutation groups, even and odd permutations, symmetric groups, alternating groups, Cayley's theorem

Unit III: Rings and fields, examples, subrings and subfields, ring homomorphism, ideals and quotient rings

Unit IV: Polynomial rings, characterization of a ring, prime and maximal ideal and their characterization in terms of the associated quotient ring.

Textbook: Topics in Algebra by I.N. Herstein

Supplementary texts:

- Elements of Modern Abstract Algebra by Kenneth Miller
- Algebra by Serge Lang
- Topics in Algebra by I.N. Herstein
- Modern Algebra by Frank Ayres, Schaum's Outlines Series
- A Textbook of Modern Algebra by Shanti Narayan
- Modern Algebra by Q. Zameer-u-din & S. Singh
- Introduction to Abstract Algebra by Fraleigh , Addison Wesley
- Introduction to Abstract Algebra by Gallian , Houghton Mifflin Harcourt (HMH)

B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Course Title : Introduction to SPSS ***Semester-V***
Course Code : STA390C
Credit hrs. : 2

Course Objectives:

• To introduce statistical package (SPSS) for data analysis.

• To train students in analysis of large scale data using SPSS

Syllabus:

1. Introduction to SPSS-facilities, creating database structure, data entry, specifying scales, validation of data entry, importing and exporting data.

2. Data Manipulation – recoding creating new variable, sorting, filtering and selection of specific data, generating simple frequencies, use of syntax editor.

3.Frequency tables, Using frequency tables for analyzing qualitative data, Explore, Graphical representation of statistical data: histogram (simple vs. clustered), boxplot, line charts, scattorplot. 4. Measures of central tendencies and variability, working examples using SPSS.

5. Measures of Skewness and Kurtosis, working examples using SPSS.

6. Correlation and regression analysis – interpretation and regression diagnostic test using SPSS

7. Hypothesis testing: z test for comparison of means and proportions (large samples) , working examples using SPSS

8. T-tests: One sample t-test, T-tests with more than two samples (related measure t-test, independent groups t-test), practical examples using SPSS.

9. Analysis of variance, ANOVA for one-way and two-way classified data, practical examples using SPSS

10. Non-parametric inference, one-sample and two sample Sign Test

11. Wilcoxon-Signed rank test

12 Kolmogrove Smirnov test (one-sample and two-sample tests)

13. Wilcoxon-Mann- Whitney Test, Median test.

References:

1. Sheridan J Coakes: SPSS 12.0 version for Windows , Wiley.

2. Cromley, Ellen K. and McLafferty, Sara L., (2002): GIS and public health. Guilford Press, New York.

3. SPSS 14.0 Brief Guide – SPSS Inc.

4. SPSS regression models 14.0 - SPSS Inc.

5. SPSS advanced models 14.0 - SPSS Inc.

B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Course Title : Introduction to Sampling Theory ***Semester-V***
Course Code : STA310E
Credit hrs. : 4

Course Objective: The aim of the course is to give students in-depth knowledge of sampling theory and its practical usage in various applied fields. The course covers the most commonly used sampling designs: simple random sampling, stratified sampling and systematic sampling, and to some limited extent non-random sampling designs. The course provides useful knowledge about planning and assessing different types of surveys designs.

Unit I: Concept of population, sampling unit, sample and sampling frame, sampling design. Random (probability) and Non-random (non-probability) sampling with examples. Sampling v/s complete enumeration. Advantages of sample survey over census. Principles of sample survey. Sampling and non-sampling errors.

Unit II: Simple Random sampling (SRS) with and without replacement. Merits and demerits of simple random sampling (SRS). Methods of selecting SRS. Estimation of mean, its variance and estimate of its variance. Unbiased estimate of population mean square. Determination of sample size.

Unit III: Stratified random sampling: estimation of mean, its variance. Need for stratification. Advantage of stratified sampling over simple random sampling. Allocation of sample size under proportional and optimum allocation. Comparison of stratified sampling over SRS system of sampling and its use. Systematic sampling, estimation of mean and sampling variance, comparison of systematic sampling with stratified and S.R.S.

Unit IV: Cluster sampling, estimation of mean and its variance for equal and unequal clusters. Two-stage sampling: (a) Equal first stage unit; estimation of population mean and its variance and estimates of variance. Comparison with one stage sampling. (b) Unequal first stage unit; estimation of population mean. Expected values and variance of different estimates including the case of probability proportional to size. Quota sampling, its merits and demerits.

References:

- Sukhatme, P.V., Sukhatme, B.V., Sukhatme,S. and Asok, C. (1984): Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.
- Cochran, W. G: Sampling Techniques, 3rd edition, John Wiley and Sons.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
- Des Raj & Chandak(1998): Sampling Theory, Narosa.
- Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
- S.C. Gupta and V.K. Kapoor (1984): Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

B.Sc. ACTUARIAL AND FINANCIAL MATHEMATICS

Course Title : Complex Analysis ***Semester-V***
Course Code : MTH 310E
Credit hrs. : 4

Course Objective: Introduces students the basic complex analysis and its applications in branches of mathematics, including algebraic geometry, number theory, analytic combinatorics and applied mathematics.

Unit I: Complex numbers, algebraic and geometric properties of complex numbers, the complex plane, functions of complex variables, limits, continuity,

Unit II: Differentiation, Cauchy-Riemann Equations, sufficient conditions for differentiability, analytic functions, exponential function, logarithmic function, trigonometric function, derivatives

Unit III: Contour integrals, Cauchy's theorem and Cauchy's integral formula, Liouville's Theorem, Fundamental Theorem of Algebra, Maximum Modulus Principle, Schwarz Lemma,

Unit IV: Power series, regions of convergence, Taylor and Laurent series, classification of singularities, residues, poles, Cauchy's Residue Theorem

Text Books: Complex Variables and Application by J. Brown and R. Churchill

- Introduction to Complex Analysis, 2nd ed by H.A. Priestley, Oxford Publications
- Complex Variables by Spiegel, Lipschutz, Schiller and Spellman
- Complex Analysis by Lars V. Ahlfors
- Functions of a Complex Variable by John B. Conway
- Complex Variables: Introduction and Applications by M. J. Ablowitz & A. S. Fokas, 2nd ed. Cambridge University Press.