Babu Banarasi Das University, Lucknow

Department of Mathematics
School of Applied Sciences
Bachelor of Science (Actuarial Science)

Evaluation Scheme

Course Category	Course Title	Course Code	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
SEMESTER I									
F	Calculus-I	BSA 1101	3	1		40	60	100	4
C	Linear Algebra	BSA 1102	3	1		40	60	100	4
F	Descriptive Statistics-I	BSA 1103	3	1		40	60	100	4
C	Business Economics I	BSA 1104	3	1		40	60	100	4
C	Business Communication	BSA 1105	3	1		40	60	100	4
SEMESTER II									
C	Calculus-II	BSA1201	3	1		40	60	100	4
C	Probability Distributions-I	BSA1202	3	1		40	60	100	4
C	Descriptive Statistics-II	BSA1203	3	1		40	60	100	4
C	Business Economics II	BSA1204	3	1		40	60	100	4
C	Financial Accounting	BSA1205	3	1		40	60	100	4
SEMESTER III									
C	Calculus-III	BSA1301	3	1		40	60	100	4
C	Probability Distributions-II	BSA1302	3	1		40	60	100	4
C	Financial Mathematics-I	BSA1303	3	1		40	60	100	4
C	Probability Theory	BSA1304	3	1		40	60	100	4
C	Principles and Practices in Insurance	BSA1305	3	1		40	60	100	4
SEMESTER IV									
C	Introduction to Mathematical Statistics	BSA1401	3	1		40	60	100	4
C	Sampling Theory of Surveys	BSA1402	3	1		40	60	100	4
C	Financial Mathematics-II	BSA1403	3	1		40	60	100	4
C	Life Contingencies-I	BSA1404	3	1		40	60	100	4
C	Programming in C++ & Numerical Methods	BSA1405	3	1		40	60	100	4

SEMESTER V									
C	Survival Models	BSA1501	3	1		40	60	100	4
C	Mathematics of Demography	BSA1502	3	1		40	60	100	4
C	Finance and Financial Reporting	BSA1503	3	1		40	60	100	4
C	Life Contingencies-II	BSA1504	3	1		40	60	100	4
GE	Elective		3	1		40	60	100	4
SEMESTER VI									
C	Stochastic Modeling	BSA1601	3	1		40	60	100	4
C	Credibility Theory and Loss Distribution	BSA1602	3	1		40	60	100	4
OE	Elective		3	1		40	60	100	4
C	Project Work	BSA1603				40	60	100	8

List of Generic Electives for Semester V

E	Mathematical Statistics	BSA E101	3	1		40	60	100	4
E	Applied Statistics	BSA E102	3	1		40	60	100	4
E	Operation Research	BSA E103	3	1		40	60	100	4
E	Graph Theory	BSA E104	3	1		40	60	100	4

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination
C Core Course
GE Generic Elective
OE Open Elective

BSA 1101 Calculus I **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. recognize functions and their properties;
2. use the algebra of limits and L' Hospital's rule to determine limits of simple expression;
3. apply the procedures of differentiation accurately, including implicit and logarithmic differentiation;
4. apply the differentiation procedures to solve related rates and extreme value problems;
5. perform accurately definite and indefinite integration, using parts, substitution;
6. understand and apply the procedures for integrating rational functions.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. recognize odd, even, periodic, increasing, decreasing functions;
2. understand the operation of composition of functions and the concept of functional inverse;
3. calculate limits by substitution and by eliminating zero denominators;
4. calculate limits at infinity of rational functions;
5. calculate limits in indeterminate forms by a repeated use of l' Hospital's rule;
6. know derivatives of power, trigonometric, exponential, hyperbolic, logarithmic and inverse trigonometric functions;
7. know the basic rules of differentiation and use them to find derivatives of products and quotients;
8. know the chain rule and use it to find derivatives of composite functions;
9. use derivatives to find intervals on which the given function is increasing or decreasing;
10. find maxima and minima, critical points and inflection points of functions and to determine the concavity of curves;
11. understand the concept of indefinite integral as anti-derivative;
12. know standard indefinite integrals and basic rules of indefinite integration;
13. evaluate integrals by substitution with and without suitable hints;
14. evaluate integrals of rational functions by partial fractions.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	**Limits and Continuity** Functions including the definitions and properties of absolute value, power, polynomial, rational, trigonometric, exponential, and logarithmic functions, Composition of functions, Definitions and calculation methods for limits. Basic	30	1

	properties of limits, Continuity, Intermediate value theorem, properties of continuous functions		
II	**Differential Calculus** Derivative, definition and geometrical interpretation, Derivative as rate of change, velocity and acceleration, Rules of differentiation, differentiation formulas for power, trigonometric, exponential and logarithmic functions, Chain rule, Implicit differentiation	30	1
III	**Applications of Derivatives** Maxima and minima, extreme value theorem, mean value theorems, Increasing and decreasing functions. Concavity, Applied maximum - minimum problems	30	1
IV	**Integral Calculus** Anti derivatives, integration formulas, Area, Definite integral and properties, Fundamental theorem of calculus, Integration by substitution	30	1

Recommended Books

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
2. Murray R. Spiegd, Theory and Problems of Advanced Calculus, Schaum Outline Series, Schaum Publishing Co., New York.
3. Gorakh Prasad, Differential Calculus, Pothishala Private Ltd, Allahabad.
4. Shanti Narayan, Differential Calculus, S. Chand and company, Delhi.
5. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd, Allahabad.
6. H. S. Hall and S. R. Knight, Higher Algebra, H. M. Publication, 1994.
7. Ayres F. Jr.: Calculus, Schaum Outline Series, McGraw Hill, 1981.

BSA 1102 Linear Algebra **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the concepts of matrix operations and their properties;
2. the concepts of Eigen values and Eigen vectors;
3. the concepts of Vector spaces and linear transformations;
4. the concepts of inner products, orthogonalization and quadratic forms.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. perform elementary matrix operations;
2. find eigen values and eigen vectors and use them in diagonalization problems and other applications;
3. identify and construct examples of elementary vector space ideas in Euclidean n-space as well as in general vector space;
4. apply Gram Schmidt-orthogonalization method.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	**Matrices** $n \times m$ matrices, sums, products, transpose, inverse of an $n \times n$ matrix, matrix equations. Determinants and their properties, cofactors, definition of the inverse.	30	1
II	**Eigen values and Eigen vectors** Eigen values and eigen vectors, characteristic polynomial, Cayley Hamilton theorem, digonalization.	30	1
III	**Vector and Linear Transformations** Vector spaces, subspaces, independence, basis and dimension, row and column space of a matrix, rank, applications, change of basis. Linear transformations, kernel and image, composition, isomorphism, linear functionals, the double dual, transpose of a linear transformation.	30	1
IV	**Inner Products** Inner product, norm, orthogonality, Gram-Schmidt process, quadratic forms.	30	1

Recommende Books

1. V. Krishnamurthy, V. P. Mainra and J. L. Arora, An Introduction to LinearAlgebra, East West Press, 1976.

2. A. R. Rao and P. Bhimasankaram, Linear Algebra, HindustanBook Agency, Delhi, 2000.
3. I. N. Herstein, Topics in Algebra, Vikas Publishing House, 1976.
4. S. Lipschutz, Linear Algebra, Schaum Outline Series, 1981.

BSA 1103 Descriptive Statistics I **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the concept of data, its different types and sources;
2. the organization and representation of data (tabulation and graphical presentation both);
3. the need for calculation of various descriptive statistics.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. understand types of data, classify them accordingly;
2. design and collect data and organize it;
3. represent data graphically, read and interpret bar graphs, histograms, frequency polygons etc;
4. analyse quantitative data, calculate measures of central tendency, dispersion
5. understand and calculate moments;
6. calculate and comment on skewness and kurtosis of frequency distribution.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	**Types of Data** Concepts of a statistical population and sample from a population, qualitative and quantitative data; nominal and ordinal data, cross sectional and time series data, discrete and continuous data, frequency and non-frequency data. Different types of scale - nominal, ordinal, ratio and interval.	30	1
II	**Collection and Scrutiny of Data** Primary data - designing a questionnaire and a schedule, checking their consistency. Secondary data - their major sources including some government publications. Complete enumeration, controlled experiments, observational studies and sample surveys. Scrutiny of data for internal consistency and detection of errors of recording. Ideas of cross-validation.	30	1
III	**Presentation of Data** Construction of tables with one or more factors of classification. Diagrammatic and graphical representation of non-frequency data. Frequency distributions, cumulative frequency distributions	30	1

	and their graphical and diagrammatic representation - column diagram, histogram, frequency polygon and ogives. Stem and leaf chart. Box plot.		
IV	**Analysis of Quantitative Data** Univariate data: Concepts of central tendency or location, dispersion and relative dispersion, skewness and kurtosis, and their measures including those based on quartiles and moments. Sheppard's corrections for moments for grouped data (without derivation).	30	1

Recommended Books:

1. B. R. Bhat, T. Srivenkatramana and K. S. RaoMadhava, Statistics: ABeginner's Text, vol. I, New Age International (P) Ltd, 1996.
2. F.E. Croxton,D. J. Cowden and S. Kelin, Applied General Statistics, Prentice Hall of India, 1973.
3. A. M. Goon, M. K. Gupta andB. D. Gupta), Fundamentals of Statistics, vol. I, World Press, Calcutta,1991.
4. A. M. Mood, F. A. Graybilland D. C. Boes, Introduction to the Theory of Statistics, McGraw Hill, 1974.
5. G. W. Snedecor and W. G. Cochran, Statistical Methods, Iowa State University Press, 1967.
6. M. R. Spiegel, Theory and Problems of Statistics, Schaum'sPublishing Series, 1967.

BSA 1201 Calculus II **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. a variety of well-known sequences and series, with a developing intuition about the behaviour of new ones;
2. some simple techniques for testing the convergence of sequences and series;
3. differential equations and their solutions;
4. methods for solving differential equations.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. recognize various sequences and series;
2. understand how the elementary functions can be defined by power series, with an ability to deduce some of their easier properties;
3. understand and be able to analyze differential equations numerically, analytically, and geometrically;
4. understand and be able to apply the fundamental ideas of systems of first-order linear equations;
5. understand and be able to apply the fundamental ideas of second-order differential equation;
6. use analytical methods such as undetermined coefficients and variation of parameters.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Sequences and series I:** Introduction of Convergence, Divergence of sequences and series. power series, Taylor's series, Maclaurin's series	30	1
II	**Sequences and series II:** Comparison test, ratio test, root test, Alternating series, Absolute convergence, Conditional convergence	30	1
III	**Differential Equations I:** Differential equations: Separable, linear first and second order, constant coefficients,	30	1
IV	**Differential Equations II:** Euler Cauchy Equations, Method of undetermined coefficients, variation of parameters, Simultaneous differential equations.	30	1

Recommende Books

1. R. S. Murray, Theory and Problems of Advanced Calculus, Schaum outline series, Schaum Publication Co. New York.
2. D. A. Murray, Introductory Course in Differential Equations, Orient Congman(India), 1967
3. D. Widder, Advanced Calculus, Prentice Hall of India, New Delhi (Second Ed.), 1979.
4. Shantinarayan, Calculus, S. Chand and Co.
5. R. G. Bartle and D. R. Sherbert,Introduction to Real Analysis (Wiley third Edition), 2000.

BSA 1202 Probability Distributions I **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the concept of probability and its applications;
2. the concept of random variables, pmf and cdf of discrete random variables;
3. various special discrete probability distributions and their acturial applications.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. understand sample space, events and probability;
2. calculate probabilities of various events;
3. definerandom variables and determine their distributions;
4. understand and recognize various discrete probability distributions;
5. apply these probability distributions in different situations to calculate probabilities;
6. understand some bivariate discrete probability distributions, calculate their joint and marginal densities;
7. calculate expectations of univariate and bivariate random variables;
8. find densities of functions of random variables.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	**Probability** Random experiment, trial, sample point and sample space, event, Operations of Events, concepts of mutually exclusive and exhaustive events. Definition of probability: classical and relative frequency approach. Discrete probability space, Properties of probability, Independence of events, Conditional probability, total and compound probability rules, Bayes' theorem and its applications.	30	1
II	**Discrete random variable (rv)** probability mass function (pmf) and cumulative distribution function (cdf). Joint pmf of several discrete rvs. Marginal and conditional pmf. Independence of rvs. Expectation of arv and its properties. Moments, measures of location and dispersion of arv. Probability generating function (pgf) and moment generating function (mgf) of arv, their properties and uses.	30	1
III	**Standard univariate discrete distributions** Degenerate, Bernoulli, discrete uniform, binomial, hypergeometric, Poisson, geometric	30	1

	and negative binomial distributions, reproductive property of standard distributions.		
IV	**Bivariate discrete distributions** Bivariate Binomial, Bivariate Poisson, Bivariate Negative Binomial, Marginal and conditional distributions. Distributions of functions of discrete rvs	30	1

Recommende Books

1. K. L. Chung, Elementary Probability Theory with Stochastic Processes, Springer International Student Edition, 1979.
2. D. Stirzaker, Elementary Probability, Cambridge University Press, 1994.
3. W. Feller, An Introduction to Probability Theory and Its Applications, Wiley, 1968.
4. R. V. Hogg and A. T. Craig, Introduction to Mathematical Statistics, Pearson Education, 2008.
5. P. Mukhopadhyay,Mathematical Statistics, New Central Book Agency,Calcutta, 1996.
6. E. Parzen, Modern Probability Theory and Its Applications, Wiley Eastern, 1960.
7. J. Pitman, Probability, Narosa Publishing House, 1993.

BSA 1203 Descriptive Statistics II **Credits: 4**

Course Objective:

The general objective of the course is to introduce

1. the concepts of matrix algebra, methods of solving system of linear equations and determine eigen values and eigen vectors of a matrix;
2. the concepts of the eigen values and eigen vectors of Hermitian, Unitary and Normal matrices differ from those of general matrices;
3. the concepts of derivatives of functions(one and several variables) and their applications;
4. the concepts of multiple integration, Beta, Gamma functions and their applications;
5. the concepts of vector calculus to expose students to mathematical applications.

Learning Outcomes:

Upon successful completion of the course, students will be able to

1. demonstrate ability to manipulate matrices, to find rank and to solve the system of linear equations;
2. find eigenvalues and eigenvectors and use them in diagonalization problems and other applications;
3. find nth derivative by using Leibnitz theorem;
4. apply partial derivatives to study extrema & expansion of functions of two variables;
5. evaluate double integrals by changing variables , changing order and triple integration to find the area and volume of given region;
6. calculate line integrals along piecewise smooth paths, interpret such quantities as work done by a force;
7. solve double and triple integrations and apply it to calculate line, surface and volume integrals;
8. apply Green's theorem to evaluate line integrals along simple closed contours on the plane, Stoke's theorem to give physical interpretation of the curl of a vector field and Divergence theorem to give physical interpretation of the divergence of a vector field.

Course Contents:

Module	Course Topics	Total Hours	Credit
I	**Analysis of Bivariate data** Scatter diagram. Product moment correlation coefficient and its properties. Coefficient of determination. Spearman's Rank correlation coefficient, Correlation ratio..	30	1
II	**Regression Analysis and Curve Fitting** Concepts of regression. Linear Regression coefficient and Regression lines. Principle of Least Squares, Curve Fitting of	30	1

	linear, Quadratic, Power, Exponential Curves.		
III	**Multivariate Data** Multiple regressions, multiple correlation and partial correlation in three variables. Their measures and related results	30	1
IV	**Scaling of Data** Motivation for scaling. Measurement for psychological traits. Scaling of items according to difficulty. Scaling of test scores. Scaling of rates and ranks. Scaling of judgments.	30	1

Recommended Books

1. A. M. Goon, M. K. Gupta and B. D. Gupta B, Fundamentals of Statistics, Volume Iand II, World Press, Calcutta, 2001.
2. F. E. Croxton, D. J. Cowden and S. Klein, Applied General Statistics Prentice Hall of India, 1973.
3. G. W. Snedecor and W. G. Cochran, Statistical Methods Iowa StateUniversity Press, 1967.
4. M. R. Spiegel, Theory & Problems of Statistics, Schaum'sPublishing Series, 1967.
5. Agreshti, An Introduction to Categorical Data Analysis, John Wiley & Sons Inc, NY, 1996.
6. S. Chatterjee and B. Price, Regression analysis by Example, John Wiley & Sons, Inc, 1991.
7. J. P. Guilford and B. Fruchter, Fundamental Statistics in Psychology and Education, McGraw Hill, 1980.