Tribhuvan University

Institute of Science and Technology

SCHOOL OF MATHEMATICAL SCIENCES

Syllabus

Bachelor in Mathematical Sciences (B.Math.Sc.)

with Major Actuarial Science - **FIRST SEMESTER**

Course Structure (New Course)

Semester	Papers	Credit
First	BMS 101 Calculus with Analytic Geometry I	3
	BMS 102 Actuarial Statistics I	3
	BMS 103 Programming with C	3
	BMS 104 Communication Practice	3
	BMS 105 Linear Algebra with Applications	3
Total		15

Program: Bachelor in Mathematical Sciences(B.Math.Sc.) *Full Marks*: 75

Paper: **Calculus with Analytic Geometry I** *Code No.*: **BMS 101**

Nature: Theory *Credit*: 3

Course Description:

This course includes limits, continuity, differentiation and integration of algebraic and transcendental functions, and their applications.

Learning Objectives:

After successful completion of this course the student will be able to

1. acquire elementary knowledge of calculus and analytical geometry.
2. solve limit, continuity, differentiation and integration problems.
3. apply the techniques of calculus to solve real life problems.

Mode of Delivery:

The course will be taught by lecture method, problem solving and class discussion. Students will be encouraged to utilize the computer whenever possible and wherever applicable.

Contents:

Unit 1 Limits and Continuity of Functions 8 hrs

Limit of a function at a point, Computing limits of algebraic functions by definition, Limits at infinity, Continuity at a point, Asymptotes: horizontal, vertical and oblique.

Unit 2 Derivatives 10 hrs

Derivatives and their rules, Linear approximations and differentials, Indeterminate forms and L'Hospital's rule, Higher order derivatives.

Unit 3 Application of Derivatives 10 hrs

Monotonic functions, Optimization problems, Marginal analysis, Roll's theorem and Mean value theorem, Sketching curve using calculus, Newton's method.

Unit 4 Integrals 10 hrs

Definite integral, Fundamental theorems of calculus, Indefinite integrals and their properties, Properties of definite integrals, Numerical methods of integration.

Unit 5 Application of Integration 10 hrs

Areas between curves, Volumes, Volumes by cylindrical shells, Average value of a function, Arc length, Area of a surface of revolution, Applications in economics.

Textbook:

1. Stewart J., *Calculus: Early Transcendental Functions*, 7th edition, Thomson Brooks/Cole.

Reference Books:

1. Larson, et al, *Calculus: Early Transcendental Functions*, Houghton Mifflin, 2011.

2. Robert A. Adams, *Christopher Essex, Calculus: A Complete Course*, Pearson, 2010.

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Program: Bachelor in Mathematical Sciences(B.Math.Sc.) *Full Marks*: 75

Paper: **Actuarial Statistics I** *Code No*.: **BMS 102**

Nature: Theory *Credit*: 3

Course Description:

This course focuses on fundamental statistical techniques that are of particular relevance to actuarial work. The course covers exploratory data analysis, moments, skewness and kurtosis, correlation and regression analysis, probability, random variable and mathematical expectation, some discrete and continuous probability distributions.

Learning Objectives:

After successful completion of the course the student will be able to

1. understand and use the descriptive statistical tools used in actuarial work.
2. provide summaries of data using appropriate descriptive statistical analysis and graphical presentation.
3. describe the essential features of statistical distributions.
4. calculate and interpret the meaning of correlation coefficient to measure the strength of relationship between two numerical variables.
5. calculate and interpret the meaning of coefficient of determination to measure the predictive power of the simple as well as multiple regression.

Mode of Delivery:

The course will be taught by lecture method, problem solving and class discussion. Students will be encouraged to utilize the computer whenever possible and wherever applicable.

Contents:

Unit 1 Data Summarization **10 hrs**

Summarization of set of data using a table or frequency distribution, Histogram, Frequency curve and polygon, Cumulative frequency curve, Stem-and-leaf display, Measures of central tendency, Measures of dispersion, Raw and central moments, Relation between raw and central moments, Properties of moments, Skewness and it's types, Methods of measuring skewness, Five number summary, Box-plot, Kurtosis, Types and methods of measuring kurtosis, Solving numerical problems related to actuarial science.

Unit 2 Correlation and Regression Analysis **8 hrs**

Correlation and its types, Assumptions, Scatter plot and Karl Pearson's correlation coefficient, Spearman's and Kendall's rank correlation coefficient, Response and explanatory variables in regression, Simple and multiple linear regressions, Assumption of linear regressions model, Lines of regressions, Fitting of regression model using ordinary least square method, Interpretation of intercept and slope, residual analysis, Relation between correlation and regression, Measures of variation in regression analysis, Coefficient of determination, Solving numerical problems related to actuarial science.

Unit 3 Probability **4 hrs**

Review of fundamental concepts of probability, Laws of probability, Conditional probability, Pair-wise and mutually independence, Bayes' theorem and its application, Prior and posterior probability, Solving numerical problems related to actuarial science.

Unit 4 Random Variables **6 hrs**

Random variables and their properties, Types of random variables: qualitative (Categorical) and quantitative; discrete and continuous random variables, Probability distribution, Probability mass function, Probability density function and its properties, Functions of

random variable, Linear and non-linear transformation, Joint probability distribution function, Joint probability mass function, Joint probability density function, Conditional probability mass function and conditional probability density function, Solving numerical problems related to actuarial science.

Unit 5 Mathematical Expectation **7 hrs**

Mathematical expectation of a random variable, Properties of mathematical expectation, Addition and multiplicative theorems of expectation, Covariance and correlation, Conditional expectation, Conditional variance, Variance of linear combination of random variables, Moments of random variables, Raw and central moments, Generating functions: moment generating function, Characteristic function, Probability generating function, Cumulant generating function with their properties, Solving numerical problems related to actuarial science.

Unit 6 Discrete Probability Distribution **6 hrs**

Binomial distribution, Poisson distribution, Negative binomial distribution, Geometric distribution, Hyper-geometric distribution; their mass functions, Distribution functions, Mean, Variance, Moment generating functions, Characteristic functions and properties, Solving numerical problems related to actuarial science.

Unit 7 Continuous Probability Distribution **7 hrs**

Normal distribution, Standard normal distribution, Lognormal distribution, Exponential distribution, Gamma distribution, Beta distribution, Uniform distribution; their density functions, Distribution functions, Mean, Variance, Moment generating functions, Characteristic Functions, Properties and uses, Normal distribution as an approximation of Binomial and Poisson distribution, Solving numerical problems related to actuarial science.

Reference Books:

1. John E. *Freund's Mathematical Statistics with Applications*, 8th ed. Miller, I. and Miller, M.; [Freund, J. E.] Prentice Hall International, 2013
2. Knuth, D.E. Stanford CA, *Literate Programming*, Centre for the Study of Language and Information, 1992.
3. Frees, E.W., *Regression Modelling with Actuarial and Financial Implications*, Cambridge University Press, 2010.
4. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying YE, *Probability and Statistics for Engineers and Scientists*, Pearson, 2012.

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Program: Bachelor in Mathematical Sciences(B.Math.Sc.) *Full Marks*: 75
Paper: **Programming with C** *Code No.*: **BMS 103**
Nature: Theory+Practical *Credit*: 3

Course Description:

This course introduces the both theoretical and practical concepts of C programming language including basic concepts, data types, operators, handling input and output, control statements, arrays, functions, pointers, structures, unions, and file handling.

Course Objective:

The main objective of this course is to familiarize students both theoretical and practical concepts of C programming language.

Mode of Delivery:

The course will be taught by implementing interactive teaching methods using computer technologies in the class room. There will be a project and students will prepare a model as per the instructor/lecturer.

Contents:

Unit 1 Introduction **3 hrs**

Program and programming language, Types of programming languages, Program design tools (Algorithm, Flowchart, and Pseudocode), History of C programming, Structure of C program, Compiling and executing C programs, Debugging.

Unit 2 Basic Elements of C **4 hrs**

C standards, C character set, C tokens, Escape sequence, Delimiters, Variables, Data types, Constants/Literals, Symbolic constant, Expressions, Statements, Writing comments, Library functions and Pre-processor directives.

Unit 3 Data Input and Output **3 hrs**

Input/output operations, Conversion specifications, Formatted I/O and unformatted I/O.

Unit 4 Operators and Expression **5 hrs**

Unary and binary operators, Arithmetic operator, Relational operator, Boolean operator, Assignment operator, Ternary operator, Bitwise operator, Increment or decrement operator, Conditional operator, Special operators(size of operator), Evaluation of expression, Operator precedence and associativity, Type conversion.

Unit 5 Control Statements **6 hrs**

Branching statements (if and switch), Looping statements (for, while, and do-while), Nested control structures, Break and continue statements, Exit function.

Unit 6 Arrays and Strings **6 hrs**

Introduction to array, Types of array (Single dimensional and multidimensional), Declaration and memory representation of array, Initialization of array, Character array and strings, Reading and writing strings, Null character, String library functions.

Unit 7 Functions **6 hrs**

User defined functions, Library functions vs. User defined functions, Function prototype, Function call and Function definition, Nested and recursive function, Function arguments and return types, Passing arrays to function, Passing strings to function, Passing arguments by value, Passing arguments by address, Local and global variable, Scope visibility and lifetime of a variable, Macros.

Unit 8 Pointers **6 hrs**

Introduction to pointers, Advantages and disadvantages of pointer, The & and * operator, Declaration of pointer, Pointer to pointers (Chain of Pointers), Pointer arithmetic, Pointers and arrays, Pointers and character strings, Array of pointers, Pointers as function arguments, Function returning pointers, Dynamic memory allocation.

Unit 9 Structure and Union **5 hrs**

Introduction, Declaration, Initialization, Array of structure, Passing structure to function, Passing array of structure to function, Nested structure, Pointers and structures, Introduction to union, Structure vs union.

Unit 10 File Handling in C **4 hrs**

Concept of file, Types of file (Text and binary files), Modes of file, Opening and closing of file, Input output operations in file, Random access in file.

Laboratory Works:

Laboratory work includes writing C programs to implement all the concepts of C programming studied in each unit of the course.

Text Books:

1. Byron Gottfried, *Programming with C*, Fourth Edition, McGraw Hill Education.
2. Brian W. Keringhan, Dennis M. Ritchie, *The C programming Language*, Second edition, PHI Publication.

Reference Books:

1. Al Kelley, Ira Pohl: *A Book on C*, Fourth edition, Pearson Education.
2. Yeshvant Kanetkar, *Let Us C* , 17 th edition, BPB publication, 2020.
3. Herbert Schildt, C Complete Reference, Fourth edition, Osborne/McGraw- Hill Publication.
4. King K.N., *C Programming*: *A Modern Approach*, Second edition
5. Balagurusamy E., *Programming in ANSI C*, Eigth edition, TMH publication, 2019

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Program: Bachelor in Mathematical Sciences(B.Math.Sc.) *Full Marks*: 75
Paper: **Communication Practice** *Code No*.: **BMS 104**
Nature: Theory *Credit*: 3

Course Description:

This course aims to help students develop their professional communication skills. As a pre-professional, learning some essential ways to develop appropriate, timely, and persuasive documentation prepares students for the fast-paced demands of an employer, colleagues, and clients. This course seeks to expose students to the professional and technical situations they may encounter in a workplace setting. The course prepares students to perform audience analysis, usability testing, persuasive communication, tailored documentation, and most importantly to involve in professional communication with clarity, concision, style and appropriate tone. Moreover, the course also aims to familiarize students with the native speakers' pronunciation through the use of audio-visual aids.

Course Objectives:

After the successful completion of this course, students will be able to

1. identify appropriate forms of written communication.
2. analyze audience for an intended message.
3. prepare persuasive technical documents.
4. design and revise technical documents for clarity, concision, style, and tone.
5. produce native speaker's pronunciation or speak the way they do.

Mode of Delivery:

The course will be taught by lecture and group discussion. Audio visual aids and Power point presentations are encouraged for effective teaching learning.

Contents:

Unit 1 Foundations of Professional Communication 10 hrs

Introduction to communication, Communication process, Analyzing audience, Communication channels, Crafting your message with plain language, Non-verbal and cross-cultural communication, From shotgun to boomerang: using feedback.

Unit 2 Understanding the Technical Communication Environment 10 hrs

Introduction to technical communication, Objectives in technical communication, Nature and scope of technical communication, Understanding ethical and legal considerations.

Unit 3 Writing Business Messages and Documents 10 hrs

Writing notice and minutes, Writing business letters, The job search: writing letter of application and creating resume.

Unit 4 Persuasive Communication 10 hrs

Communicating persuasively, Emphasizing important information, Creating graphics, designing print and online documents, A picture is worth thousand words: using visuals, Writing advertisements, Writing leaflets

Unit 5 Developing Oral Communication Skills **8 hrs**

Effective listening, Meetings and conferences, Making presentations, Group discussion, Interviews.

Practice

S.N.	Topics	Activity
1.	Listening	1. General instruction on effective listening, factors influencing listening, and note-taking to ensure attention.
		2. Listening to recorded authentic instruction and description followed by exercises.
		3. Listening to recorded authentic conversation followed by exercises.
2.	Speaking	1. General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids.
		2. Making students express their individual views on the assigned topics or topics of their choice and making them deliver talk individually and in group.
		3. Getting students to participate in group discussion on the assigned topics.

Equipment Required: Laptop, multimedia, projector and speaker.

Textbooks

1. Burt, Salley, and Gabi, Nudelman. *Professional Communication*, 4th ed., edited by Jane English, Oxford University Press, 2018
2. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication Process and Product*.8th ed., Prentice Hall Press, 2012.

Reference Books

1. Bailey, Edward P. JR, *The Plain English Approach to Business Writing*, Oxford University Press, 1997.
2. Markel, Mike, and Stuart A. Selber, *Technical Communication*, 12thed., Bedford/St. Martin's Publisher, 2017.
3. Markel, Mike ,*Practical Strategies for Technical Communication*. Bedford/St. Martin's Publisher, 2016.
4. Raman, Meenakshi and Sangeeta Sharma, *Technical Communication Principles and Practices*, Oxford University Press, 2015.

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Program: Bachelor in Mathematical Sciences(B.Math.Sc.) *Full Marks*: 75
Paper: **Linear Algebra with Applications** *Code No.*: **BMS 105**
Nature: Theory *Credit*: 3

Course Description:

This course emphasizing topics useful in other disciplines covers fundamental algebraic tools involving matrices and vectors to study linear systems of equations and linear transformations, eigenvalues and eigenvectors and their wide range of applications.

Learning Objectives:

After successful completion of this course the student will be able to

1. use matrix and determinants to solve various mathematical and real life problems.
2. acquire knowledge of vectors spaces.
3. apply eigenvalues and eignvectorsin solving various problems.

Mode of Delivery:

The course will be taught by lecture method, problem solving and class discussion. Students will be encouraged to utilize the computer whenever possible and wherever applicable.

Contents:

Unit 1 Matrix and Determinants **10 hrs**

Algebra of matrices, Determinants and its properties, Application of determinants, Complex matrices, Rank of matrices, System of linear equations and its matrix form, Row reduction and echelon forms, Applications of linear system and LU factorization.

Unit 2 Vectors Spaces **12 hrs**

Points in n-space, Algebra of points in n-space, Scalar and dot product, Norm and its properties, Distance, Angle between two vectors, Orthogonality, Scalar and vector projections, Cosines of lines, Projections, Vector spaces and subspaces, Linear combination, dependence and independence, Span, basis and dimension.

Unit 3 Linear Transformations **8 hrs**

Linear transformations, Kernel and image, Algebra of linear transformations, Matrix representation of a linear transformations, Four fundamental subspaces, Applications to difference equations, Applications to Markov chains.

Unit 4 Orthogonality **8 hrs**

Orthogonal vectors and sets, Orthogonal bases and Gram-Schmidt, QR-factorization, Least squares method.

Unit 5 Eigenvalues and Eigenvectors **10 hrs**

Eigenvalues and Eigenvectors, Cayley- Hamilton theorem and its application, Eigenvalue decomposition, Diagonalization of a matrix, Difference equations and powers A^k, Singular value decomposition.

Textbook:

1. David C. Lay, *Linear Algebra and its Applications*, Pearson Education, 2012,

Reference Books

1. Gilbert Strang, *Introduction to Linear Algebra*, 4th Edition, Wellesley- Cambridge Press.
2. Howard Anton, Chris Rorres, *Elementary Linear Algebra*: *Applications Version*, Wiley, 2014.

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