Restructured Syllabus (CBCS Pattern as per NEP 2020)

To be implemented from Academic Year: 2024-25

Faculty	**Science and Technology**
Program	**B.Sc.**
Class	**F.Y.B.Sc.**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	MTS-101-TH	Minor	Algebra and Calculus I	Theory	02	02

Course Objectives: This course aims

1. To provide a first approach to Algebra, a basic pillar of mathematics.
2. To cover the basic knowledge of integers and polynomials.
3. To study the theory of integers and polynomials.
4. To establish the fundamental theorem and applications of single variable functions.
5. To understand real numbers and its properties.
6. To understand the concept of limiting process, and continuity in terms of limit.
7. To develop mathematical thinking and skills.

Course Outcomes: After successful completion of this course, studentsare expected to

1. To know the concept of divisibility in integers.
2. To find Greatest Common Divisor of integers using the Euclidean algorithm.
3. To understand the concept of Fermat's theorem and Euler's phi function.
4. To understand the method of finding roots of polynomials and relationship between roots and coefficients of a polynomial.
5. To classify real numbers and recognize various properties of real numbers.
6. To understand the concept of limit and continuity.
7. To draw the graphs of algebraic and transcendental functions considering

limits and continuity.

8. To apply the concept of limit and continuity for advanced study of different mathematics courses, and in physical, chemical and biological sciences.

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Integers** 1.1 Well Ordering Principle and Principle of Mathematical Induction (First Principle). 1.2 Divisibility in integers (Z) -Definition and elementary properties, Division algorithm, Greatest Common Divisor (GCD), Least Common Multiple (LCM) of integers, basic properties of GCD, Euclidean Algorithm, relatively prime integers. 1.3 Prime numbers- Definition, fundamental theorem of Arithmetic, Euclid's lemma, Theory of Congruences, basic properties, Fermat's theorem, Euler's phi function, Euler's theorem.	09
2	**Polynomials** 2.1 Definition of a polynomial, degree of a polynomial, algebra of polynomials, division algorithm (Statement only) and examples, Greatest Common Divisor (GCD) of two polynomials (Definition and examples). 2.2 Synthetic division, Remainder theorem, Factor theorem. 2.3 Relation between roots and co-efficient of a polynomial.	06
3	**Real Numbers** 3.1 Number system - N, Z, Q, R, Algebraic and Order properties of R. 3.2 Absolute Value of a real number, geometrical meaning, Absolute value properties of R, triangle inequality, examples on absolute value of R. 3.3 Boundedness of R -Neighbourhood of a point on real line, Intervals, Lower bound, Upper bound and examples, Well Ordering Principle of N, Supremum and Infimum of a subset of R and examples, Completeness property of R.	06
4	**Limits and Continuity** 4.1 Limit of Real valued function-Definitions and examples, Algebra of limits and examples.	09

	4.2 Limit theorems- Squeeze theorem and some results, one sided limits and limits at infinity and examples. 4.3 Continuity - Definition of deleted neighborhood of a point, Continuity of a function at a point - Definitions and examples, Algebra of continuous functions, properties, Continuity on an interval - Definition and examples, Bounded function, Boundedness theorem (Statement only), Absolute maximum and minimum of a function - definition, Maximum-Minimum theorem (statement only), Location of roots theorem statement only), Bolzano's theorem (statement only) the intermediate value theorem	

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Program	**B.Sc.**
Class	**F.Y.B.Sc.**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	MTS-102-PR	Minor	Practical based on Algebra and Calculus I	Practical	02	04

Course Objectives: This course aims

1. To provide a first approach to Algebra, a basic pillar of mathematics.
2. To cover the basic knowledge of integers and polynomials.
3. To establish the fundamental theorem and applications of single variable functions.
4. To understand real numbers and its properties.
5. To understand the concept of limiting process, and continuity in terms of limit.
6. To develop mathematical thinking and skills.

Course Outcomes: After successful completion of this course, students are expected to:

1. To know the concept of divisibility in integers.
2. To find Greatest Common Divisor of integers using the Euclidean algorithm
3. To understand the concept of Fermat's theorem and Euler's phi function
4. To understand the method of finding roots of polynomials and relationship between roots and coefficients of a polynomial

5. To classify real numbers and recognize various properties of realnumbers.
6. To understand the concept of limit and continuity.
7. To draw the graphs of algebraic and transcendental functions consideringlimits and continuity.
8. To apply the concept of limit and continuity for advanced study of different mathematic courses, and in physical, chemical and biological sciences.

Practical	Title and Contents	No. of lectures in Clock Hours
1	Principle of Mathematical Induction (First Principle).	04
2	Greatest Common Divisor (GCD), Least Common Multiple (LCM) of integers and Problems using Euclidean Algorithm.	04
3	Euclid's lemma, Theory of Congruences.	04
4	Fermat's theorem, Euler's phi function, Euler's theorem	04
5	Division algorithm and Greatest Common Divisor (GCD)of two polynomials.	04
6	Synthetic division, Remainder theorem, Factor theorem.	04
7	Remainder theorem, Factor theorem.	04
8	Relation between roots and coefficient of a polynomial.	04
9	Number system - N, Z, Q, R, Algebraic and Order properties of R.	04
10	Triangle inequality, examples on absolute value of R.	04
11	Boundedness of R -Neighborhood of a point on real line and Problems on Lower bound, Upper bound and Supremum and Infimum.	04
12	Limit of Real valued function, Algebra of limits.	04
13	Limit theorems- Squeeze theorem, one sided limits and limits at infinity.	04
14	Continuity, Continuity of a function at a point, Continuity on an interval, Bounded function.	04
15	Continuity on an interval, Bounded function.	04

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	SEC-101-MTS-PR	SEC	Python-I	Practical	02	04

Course Objectives: This course aims

1. To know about python IDE.
2. To write, test, and debug simple Python programs.
3. To implement Python programs with conditionals and loops statements.
4. To understand the syntax of strings in Python.
5. To understand the concept of function.
6. To understand the concept of list, tuples and its operation.

Course Outcomes: After successful completion of this course,studentsare expected to:

1. To write python programs and develop a small application.
2. To develop logic for problem solving.
3. To be familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
4. To be familiar with string and its operation.
5. To develop basic concepts of function and terminology.
6. To determine the methods to create and develop Python programs by utilizing the data structures like lists and tuples.

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Python Basics and IDE** 1. Introduction of Python. 2. Installing Python 3. Running Simple Program. 4. Removing Keys. 5. Traversing a Dictionary. Practical 1 based on unit 1.	04
2	**Basics of Python** 1. Data type of Python. 2. Variable declaration rule. 3. Python Identifier and reserved words. 4. Input Output Function. 5. Operator of Python. 6. Advanced Python operator (Membership and identity). 7. Comments in Python. 8. Line and Indentation. Practical 2, Practical 3 based on unit 2.	08
3	**Conditional structure** 1.if Statements 2.if -else and statement 3.Nested if 4.if-elif-else ladder Practical 4 and Practical 5 based on unit 3.	08
4	**Iteration statement** 1. Loop Control Structure. 2.While loop 3.For loop 4.Nested loop 5.Break Statement 6.Continue Statement 7.Pass Statement Practical 6, Practical 7 and Practical 8 based on unit 4.	12
5	**String and Function** 1. String Basics. 2. Accessing and updating String. 3. Built-in String Methods. 4. Function in Python.	12

	5. Declaration and Calling function. 6.Function Argument 7.Anonymous Functions Practical 9, Practical 10 and Practical 11 based on unit 5.	
6	**List and Tuple** 1. Python Lists. 2. Accessing and updating List. 3. Basic List Operation. 4. Built-in List Methods. 5. Python Tuple. 6. Accessing and updating tuple. 7. Basic tuple operation. 8. Built-in tuple Method. Practical 12 to Practical 15 based on unit 6.	16

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	OE-101-MTS-TH	OE	Basic Mathematics	Theory	02	02

Course Objectives: This course aims

1. To understand basic concepts of Mathematics.
2. To be able to use the language, symbols, and notation of Mathematics.
3. To develop Mathematical curiosity and acquire skills in problem solving.
4. To develop an appropriate understanding of how to use mathematics in real-world problems.
5. To cultivate the right understanding and regain numerical aptitude.
6. To develop a logical approach toward analytical approach data.

Course Outcomes: After successful completion of this course,studentsare expected to:

1. To understand the concepts of numbers and integers and able to develop skills in basic operations of integers to cultivate the right understanding and regain numerical aptitude.
2. To understand the concepts of numbers and integers and able to develop skills in basic operations of integers to cultivate the right understanding and regain numerical aptitude.

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3. To understand concepts of H.C.F. and L.C.M. of numbers, square root and cube Root and ability to apply in real-world problems.
4. To understand concepts of ratio, proportion, percentage and be able to cultivate the right understanding regaining numerical aptitude.
5. To understand concepts of average, profit and loss develop a logical approach toward analytical approach to real-world problems
6. To provide a platform for the students to build the fundamentals of Basic Mathematics for competitive examination preparation strategy
7. To establish a framework for the students to help acquire the knowledge and expertise necessary to secure employment opportunities in the government sector

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Integer** 1.1 Introduction to integer, basic operation of integer. 1.2 Hights common faction (H.C.F), Least common multiple (L.C.M). 1.3 Squar root and cube root.	12
2	**Ratio, proportion and percentage.** 2.1 Introduction to ratio and proportion. 2.2 Finding ratio and proportion. 2.3 Type of ratio.	**08**
3	**Average** 3.1 Introduction to average 3.2 Finding the average	04
4	**Profit and Loss** 4.1 Introduction to profit and loss 4.2 Finding profit and loss	06

Restructured Syllabus (CBCS Pattern as per NEP 2020)

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	MTS-151-TH	Minor	Algebra and Calculus II	Theory	02	02

Course Objectives: This course aims

1. To study matrix properties, algebraic properties, and methods for finding the inverse of a matrix.
2. To explore the solution of systems of linear equations and evaluate determinants by row reduction.
3. To learn the properties of determinants and study the applications of matrices and determinants.
4. To learn how to find the derivative of a function using limits, and understand the geometrical and physical significance of derivatives.
5. To explore methods to find the n th derivatives of functions.
6. To generalize the comprehensive study of combined algebra and calculus.

Course Outcomes: After successful completion of this course, students are expected to:

1. Understand the various types of matrices, their properties, and how to convert matrices to echelon form using elementary row operations.
2. Learn methods to solve systems of linear equations, understand the concept of determinants, evaluate determinants by different methods, and solve problems using properties of determinants.
3. Apply the concept of matrices and determinant to the problems in chemistry, electronics, cryptography, etc.
4. Understand differentiation and fundamental theorem in differentiation.

5. Apply Mean Value Theorems and its applications

6. Explore the combined application of algebra and calculus to various mathematical problems.

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Systems of Linear Equations and Matrices:** 1.1 Matrices, Matrix Notation, Size of Matrix and Types Matrix [Definitionsand Examples] 1.2 Matrix Operations 1.3 Inverses; Algebraic Properties of Matrices. 1.4 Elementary Matrices and a Method for Finding A^{-1} 1.5 Diagonal, Triangular, and Symmetric Matrices [Definitions and examplesonly] 1.6 Introduction to Systems of Linear Equations 1.7 Solution of Systems of Linear Equations using Invertible Matrices. 1.8 Gaussian Elimination Method and examples	08
2	**Determinants** 2.1 Determinants [Definitions and examples only] 2.2 Evaluating Determinants by Row Reduction. 2.3 Properties of Determinants. 2.4 Determinants by Cofactor Expansion; Cramer's Rule (Without Proof). 2.5 Applications to find Area and Volume 2.6 Applications towards Balancing Chemical Equations. 2.7 Applications in Cryptography	07
3	**Differentiation** 3.1 The Derivative as a Function. 3.2 Differentiation Rules 3.3 The Derivative as a Rate of Change 3.4 Derivatives of Trigonometric Functions 3.5 The Chain Rule 3.6 Applications	06
4	**Mean Value Theorems** 4.1 Extreme Values of Functions. 4.2 The Mean Value Theorem 4.3 Cauchy's Mean Value Theorem 4.4 L'Hospital's Rule (without proof)	09

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	MTS-152-PR	Minor	Practical based on Algebra and Calculus II	Practical	02	04

Course Objectives: This course aims

1. To study the methods for finding the inverse of a matrix.
2. To explore the solution of systems of linear equations and evaluate determinants by row reduction.
3. To study the applications of matrices and determinants.
4. To learn how to find the derivative of a function using limits, and understand the geometrical and physical significance of derivatives.
5. To explore methods to find the n th derivatives of functions.
6. To generalize the comprehensive study of combined algebra and calculus

Course Outcomes: After successful completion of this course, students are expected to:

1. Understand how to convert matrices to echelon form using elementary row operations.
2. Learn methods to solve systems of linear equations, understand the concept of determinants, evaluate determinants by different methods, and solve problems using properties of determinants.
3. Apply the concept of matrices and determinant to the problems in chemistry, electronics, cryptography, etc.
4. Understand differentiation and fundamental theorem in differentiation.
5. Apply Mean Value Theorems and its applications

Practical	Title and Contents	No. of lectures in Clock Hours
1	Matrix Operations	04
2	Elementary Matrices and Finding Inverse of Matrix.	04
3	Systems of Linear Equations and Solution of Systems of Linear Equations	04
4	Determinants and Determinant by row reduction method.	04
5	Determinants by Cofactor Expansion and Cramer's Rule	04
6	Determinants by Cramer's Rule	04
7	Applications of Determinants.	04
8	The Derivative as a Function and Differentiation Rules	04
9	Derivative as a Rate of Change and Derivatives of Trigonometric Functions	04
10	Derivatives of Trigonometric Functions	04
11	Chain Rule and Applications of Differentiation.	04
12	Applications of Differentiation.	04
13	Extreme Values of Functions and the Mean Value Theorem	04
14	Cauchy's Mean Value Theorem.	04
15	L′ Hospital′ s Rule	04

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	SEC-151-MTS PR	SEC	Python-II	Practical	02	04

Course Objectives: This course aims

1. To give students an advanced introduction to Programming.
2. To learn and understand Python programming and paradigm.
3. To implement python program with dictionary and turtle
4. To understand the concept of 2D graphics
5. To understand the concept of files
6. To prepare the program for matrix and operations on it.

Course Outcomes: After successful completion of this course,students are expected to:

1. To write python program and develop maps using dictionary
2. To develop logic for 2D graphics
3. Demonstrate the use of Python in mathematics such as matrix algebra.
4. To be familiar about basic math built in functions such as sine,cosine, etc.
5. To be familiar with complex numbers
6. To write Python programs to handle matrices and vectors usingNumPy

Unit	Title and Contents	No. of lectures in Clock Hours
1	Dictionaries 1.1 Dictionary Literals 1.2 Adding Keys and Replacing Values 1.3 Accessing Values 1.4 Removing Keys 1.5 Traversing a Dictionary Practical 1 and Practical 2 based on unit 1.	08
2	**Simple Graphics** 2.1 Overview of Turtle graphics 2.2 Turtle operations 2.3 Setting up a turtle.cfg file and running IDLE. 2.4 Object instantiation and the turtle module 2.5 Drawing two dimensional shapes 2.6 Examining an object's attributes 2.7 Manipulating a Turtle's screen 2.8 Taking a random walk 2.9 Colours and the RGB system -Practical 3, Practical 4 and Practical 5 based on unit 2.	12
3	**Complex Numbers in Python** 3.1 Introduction to complex numbers 3.2 Complex numbers with Python -Practical 6 and Practical 7 based on unit 3.	08
4	**File Handling** 4.1 Opening Files: File Modes 4.2 The basic file methods 4.2.1 Reading and Writing 4.2.2 Piping output 4.2.3 Reading and writing lines 4.2.4 Closing files 4.2.5 Using the basic files methods 4.3 Iterating over file content 4.3.1 One character at a time 4.3.2 One line at a time 4.3.3 Reading everything 4.3.4 Lazy line iteration with file input 4.3.5 File iterators -Practical 8 and Practical 9 based on unit 4.	08

5	**NumPy** 5.1 NumPy basics 5.2 NumPy arrays 5.3 Copying / Sorting 5.4 Array manipulation 5.5 Mathematics Basic Statistics -Practical 10, Practical 11 and Practical 12 based on unit 5.	12
6	**Matrix Algebra in Python** 6.1 Vectors 6.2 Matrices 6.3 Linear Algebra 6.4 Matrix addition 6.5 Matrix subtraction 6.6 Matrix multiplication 6.7 Transpose of a matrix. 6. 8 Determinant. 6.8 Inverse matrix Practical 13 and Practical 14 based on unit 6. Practical 15 is based on unit 5 and 6	12

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	OE-151-MTS-PR	OE	Applied mathematics.	Practical	02	

Course Objectives: This course aims

1. To develop a strong understanding of Geometry.
2. To becomes Master of basic operations on numbers in different way.
3. To gain proficiency in working with mean.
4. To understand the concept of time, work, speed and distance.
5. To learn the simulation of data.
6. To develop problem-solving skills by applying operations.

Course Outcomes: After successful completion of this course, students are expected to:

1. Enhance mathematical reasoning and critical thinking
2. Easily present the data graphically
3. Have the knowledge of geometrical shapes and their equations
4. Have Skills of comparison through diagrams and charts.

5. Got the business ability
6. Achieve the techniques of finding area and volume

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Time, speed and distance.** 1.1 Average speed and relative speed. 1.2 Botas and streams. 1.3 Circular motion. 1.4 Clock and calendar. 1.5 Time, work and distance.	08
2	**Arithmetic** 2.1 Arithmetic Mean, 2.2 Geometric Mean, Harmonic Mean, 2.3 Simple and Compound Interest, 2.4 Partnership, Brokerage, (True) Discount,	08
3	**Data Interpretation** 3.1 Tabulation, missing data problem. 3.2 Graphs and Charts - Table, Line, Bar and Pie.	06
4	**Mensuration** 4.1 Perimeter of circle, triangle, square and rectangle. 4.2 Area of circle, square, rectangle and triangles. 4.3 Surface area of cylinder, sphere, cube and cuboid. 4.4 Volume of cube, cuboid, sphere, hemisphere, cylinder and cone.	08

Restructured Syllabus (CBCS Pattern as per NEP 2020)

To be implemented from Academic Year: 2024-25

Faculty	**Science and Technology**
Program	**B. Sc. (Computer Science)**
Class	**F. Y. B. Sc. (Computer Science)**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	MTS-1101-TH	Subject 2 (Minor)	Matrix Algebra	Theory	02	02

Course Objectives:

1. A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies
2. A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
3. A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical

Course Outcomes:

1. Understand the concept of matrix, its types and operations on matrices, problemsolving using LU factorization of matrix.
2. Understand the concept of determinants of matrices and its properties, solvevarious problems with application by using determinants.
3. Understand the concept of Inverse of matrices and to find inverse of matrix byusing Row Reduction and Adjoint method.

4. Understand the concept of matrix, its types and operations on matrices, problem solving
5. Construct Systems of linear equations and solve the problems by using Gausselimination method, Cramer's Rule and Application of LU decomposition to solve System of linear equation.

Unit	Title and Contents	No. of lectures in Clock Hours
1	**Matrices** 1.1 Matrix Operations 1.2 Elementary Matrices, Elementary Row operations 1.3 Row reduction and echelon forms 1.4 LU factorization of a matrix	1 0
2	**Determinants** 2.1 Introduction to determinants 2.2 Properties of determinants. 2.3 Determinant by Row reduction 2.4 Determinant by Cofactor expansion along any row or column.	05
3	**Invertible matrices** 3.1 The inverse of a matrix 3.2 Characterization of invertible matrices 3.3 To find inverse of a matrix by Row reduction 3.4 To find inverse of a matrix by Adjoint Method	05
4	**Linear Equations** 4.1 System of Linear equations. 4.2 The matrix equation Ax=b. 4.3 Gauss elimination method 4.4 Cramer's Rule 4.5 Application of LU decomposition to solve system Ax=b	10

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	MTS-1101-PR	Subject 2 (Minor)	Mathematics Practical I	Practical	02	04

Course Objectives:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.
5. To learn how to use indexing and slicing to access data in Python programs.
6. To define the structure and components of a Python program.
7. To learn how to write loops and decision statements in Python.
8. To learn how to write functions and pass arguments in Python.
9. To learn how to build and package Python modules for reusability

Course Outcomes:

1. Install, debug and run a Python program, differentiate between brackets, braces,and parentheses, define variables, identify keywords, Operators and Operands, Expressions, perform type conversion, use if, if-else, for, while loops
2. Use function calls and definitions, math functions, composition, variables and parameters, , recursion, a string as a sequence, traversal, string slices, searching,string methods, the in operator, string comparison, string operations.
3. Access elements in lists, traverse a list, delete elements from list, perform concatenation, repetition, In operator, built-in list, tuple and dictionary functions,methods and operators, basic tuples operations, updating, deleting elements from dictionary, dictionary keys, operations, file, directories and exception handling.
4. Use the sympy module to represent the matrix and create the program to get thesolution.

Practical	Title and Contents	No. of lectures in Clock Hours
1	**Practical 1: Introduction to Python** 1. Installation of Python 2. Values and Types : int , float, str etc 3. Variables : assignment statements , printing variable values , types of variables 4. Boolean operators, Logical operators 5. Mathematical functions from math ,cmath,modules.	04
2	**Practical 2: Python Strings** 1. Accessing values in strings 2. Updating strings 3. String special operators 4. Concatenation 5. Repetition	04
3	**Practical 3 : Python List and Python Tuple** 1.Accessing Values 2.Updating 3.Delete elements 4.Basic operations 5.Indexing, Slicing	04

	6. Built-in Functions	
4	**Practical 4: Python Set** 1. To create a set 2. To change a set in Python 3. To remove elements from a set 4. Python Set Operations 5. Built-in Functions with Set.	04
5	**Practical 5: Python Dictionary** 1. To create a Dictionary 2. To change a Dictionary in Python 3. To remove elements from a Dictionary 4. Python Dictionary Operations 5. Built-in Functions with Dictionary.	04
6	**Practical 6: Decision making Statements** 1. IF statement 2. IF...ELIF...ELSE Statements: 3. Nested IF statements: 4. While loop 5. For loop	04
7	**Practical 7: Use SymPy for basic Operations On Matrices** 1. Addition , Subtraction , Multiplication , power etc 2. To Accessing elements, Row, Column of Matrix. 3. To create some standard Matrices.	04
8	**Practical 8: Use SymPy for Operations on Matrices** 1. To insert an element in any row or column 2. To insert matrix into matrix 3. To delete any row or column	04
9	**Practical 9: : Use SymPy for Row Operation on Matrices** 1. Elementary row operations	04
10	**Practical 10: Use Sympy to obtain** 1. The determinants of Matrix 2. The rank of Matrix 3. The transpose Of Matrix 4. The reduced row echelon form of Matrix	04
11	**Practical 11: Use Sympy to obtain** 1. The inverse of a matrix 2. The inverse of a matrix by Row reduction	04
12	**Practical 12: Use Sympy to obtain**	04

	1. The minor and co factors of matrix 2. The inverse of a matrix by Adjoint Method	
13	**Practical 13: Use Sympy to obtain** 1. Lower triangular matrix 2. Upper triangular matrix 3. LU decomposition of matrix	04
14	**Practical 14: Use SymPy to solve System of Linear equations-I** 1. Cramer's Rule 2. Gauss Elimination Method	04
15	**Practical 15: Use SymPy to solve System of Linear equations-II** 1. Gauss Jordan Method 2. LU decomposition Method	04

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Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	MTS-1151-TH	Subject 2 (Minor)	An Introduction to graph theory	Theory	02	02

Course Objectives: This course aims

1. A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies.
2. A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
3. A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical

Course Outcomes: After successful completion of this course, students are expectedto:

1. Convert real life problems into graph theoretical models.
2. Check whether two graphs are isomorphic or not.
3. Apply basic operations on graphs and connected graphs.
4. Identify Eulerian and Hamiltonian graphs.
5. Applying Fleury's algorithm to construct Eulerian graph and Applying Kruskal's algorithm to construct minimum spanning tree.
6. Applying Dijkstra's algorithm to find Shortest path.

Unit	Title and Contents	No. of lectures in Clock Hours
1	**An Introduction to graph** 1.1 Definitions, Basic terminologies and properties of graph. 1.2 Special types of graphs, some applications of special types of graph. 1.3 Matrix representation and elementary results, Isomorphism of graphs 1.4 Subgraphs, Induced subgraphs,Vertex deletion, Edge deletion 1.5 Complement of a graph and self-complementary graphs 1.6 Union, Intersection and Ring sum and Product of graphs.	1 0
2	**Connected graph** 2.1 Walk, trail, path, cycle, more definitions and elementary properties of connectedness. 2.2 Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity, definitions and properties. 2.3 Shortest path problem, Dijkstra's algorithm.	07
3	**Euler and Hamilton path**	05

	3.1 The Konigsberg bridge problem, Euler trail, path, circuit and tour, elementaryproperties and examples, Fleury's algorithm 3.2 Hamilton path, circuit, definitions, elementary properties and examples	
4	**Tree** 4.1 Definitions, basic terminologies, properties and applications of trees. 4.2 Weighted graph, definition and properties of spanning tree, shortest spanning tree, Kruskal's algorithm, Prim's algorithm 4.3 Binary tree, definitions and properties, tree traversal: preorder, inorder, postorder, infix, prefix, and postfix notations and examples.	08

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Program	**B. Sc. (Computer Science)**
Class	**F. Y. B. Sc. (Computer Science)**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	MTS-1151-PR	Subject 2 (Minor)	Mathematics Practical II	Practical	02	04

Course Objectives:

1. To solve problems depending on contents in Graph theory.

Course Outcomes: On completion of the course, student will be able to:

1. Understand the theoretical concepts in Graph theory.
2. Apply this knowledge in various courses of Computer Science.

Practical	Title and Contents	No. of lectures in Clock Hours
1	**Practical 1: Using network from python do the following** 1. Generate graph G with vertex(node) set {1,2,3,4,5} and the edge set {(1,5), (1,3),(1,2),(2,3),(2,4), (3,4), (4,5)} . Draw graph G. 2.Generate graph G1 with vertex set { 'a','b','c','d'} and the edge set {x=('a','d'), y=('b','c'), z=('b',"d'),	04

	w =(‘a’,’c’)}. Draw graph G1 showing labeled vertices and edges. 3.Generate graph G2 with vertex set {1,2,3,4,5} and edge set {(4,5),(5,3), (2, 2),(2,3),(2,4), (3,4), (1,5)} . Draw graph G2 with vertices in red color and edges in green. 4. Find the number of vertices, number of edges and degrees of all vertices in above graphs. Verify Hand shaking lemma for above graphs.	
2	**Practical 2: Using networks from python do the following** 1.Draw a regular graph on 4 vertices with degree 2. 2.Draw a regular graph on 5 vertices with degree 3. 3.Draw the star graphs on 4, 7 and 8 vertices 4.Draw the Petersen graph . Determine whether G is 2_regular. Is it 3_regular graph	04
3	**Practical 3: Using networks from python do the following** 1. Find adjacency matrix and incidence matrix of each of above graphs. 2. Find the number of vertices, number of edges and degrees of all vertices of graphs(Practical No 2)	04
4	**Practical 4: Using network from python do the following** 1. Draw the null graphs different number of vertices for example N_7, N_{17},N_{12} etc. 2. Draw the complete graphs for example K_5, K_{30}, K_{45} etc. 3. Draw the cycle graphs such as C_8, C_{12}, C_{20}, C_{35} etc. 4. Draw the wheel graphs for such as W_5, W_{10}, W_{21}, W_{30} 5. Draw the complete bipartite graphs $K_{4,3}$, $K_{1,8}$, $K_{5,9}$ etc.	04
5	**Practical 5: Using networks from python do the following** 1. Draw a directed graph D1 with vertex set V= {1, 2, 3, 4,5} and directed edge setE = {(1,4) , (2,3), (1,2),	04

	(5,3), (5,1), (4,1), (3,2),(5,2), (5,4)}. Draw underlying graph of D1, Find in degrees and out degrees of all vertices in D1. 2. Draw a directed graph D2 with vertex set V= {1, 2, 3, 4 } and directed edge seti.{(2,4) , (2,3), (1,3), (4,1), (3,2),(1,2)}. Draw underlying graph of D2, Find indegrees and out degrees of all vertices in D2 3. Draw a directed graph D2 with vertex set V= {1, 2, 3, 4 } and directed edge set.{(1,2) , (1,3), (2,4), (3,2), (3,4),(4,2),(4,1)}. Draw underlying graph of D2, Find indegrees and out degrees of all vertices in D2	
6	**Practical 6: Using networks from python do the following** 1. Draw any symmetric directed graph on given number of vertices 2. Draw any asymmetric directed graph on given number of vertices 3. Draw any complete symmetric directed graph on given number of vertices 4. Draw any complete asymmetric directed graph on given number of vertices	04
7	**Practical 7: Using networks from python do the following** 1. Create a simple graph G. Draw graph G with nodes and edges in colors of yourchoice 2. Create and draw complement of above G. Determine whether the complement is simple graph 3. Determine whether G is bipartite. 4. Find the number of components in the graph G 5. Determine whether G is connected. Determine whether the complement of G is connected	04
8	**Practical 8: Using networks from python do the following** 1. Draw K = Complete graph K_5, H= complement of N_5 . Determine whether K isisomorphic to H 2. Generate and draw any 2 graphs with names G1 and G2. Determine whether G1 isisomorphic to G2 3. Generate and draw any 2 graphs with names G1 and G2. Determine whether G1 isisomorphic to G2	04

	4. Generate and draw any 2 graphs with names G1 and G2. Determine whether G1 isisomorphic to G2	
9	**Practical 9: Using networks from python do the following** 1.Draw union of graphs G1 and G2 2. Draw intersection of graphs G1 and G2 3. Draw product of graphs G1 and G2	04
10	**Practical 10: Using networks from python do the following** 1. Draw any graph G 2. In the graph G add some vertices and add some edges 3. From the graph G delete some vertices and delete some edges 4. Determine whether G is connected graph 5. Find the vertex connectivity and edge connectivity of the graph G	04
11	**Practical 11: Using networks from python do the following** 1. Draw any connected graph G 2. Find all bridges, all cut vertices (articulation points) and cut set in G 3. Find the vertex connectivity and edge connectivity of G 4. Find the eccentricity of every vertex in G 5. Find center, radius and diameter of graph G	04
12	**Practical 12: Using networks from python do the following** 1.Draw any connected graph G. 2. Find all paths in G and all trails in G. 3. Draw paths of some given lengths from G. 4. Find all cycles in graph G. Is it Hamiltonian graph? 5.Determine whether G is Eulerian graph, whether it is Semi Eulerian graph.	
13	**Practical 13: Using networks from python do the following**	04

	1.Draw any connected graph G Determine whether G is a tree 2. Draw spanning tree T in G 3. Find the number of vertices in spanning tree of G 4.Find the number of edges in spanning tree of G. 5.Determine whether spanning tree T of G is a binary tree	
14	**Practical 14: Using network from python do the following** 1. Draw any graph T containing n number of vertices and n – 1 edges. 2. Determine whether T is a tree. 3. Determine whether T is a binary tree. 4. Determine whether T is a bipartite graph. 5.Find center, radius and diameter of graph T.	04
15	**Practical 15: Using networks from python do the following** 1.Draw balanced binary trees of heights 2, 4, and 5 etc. 2. Draw ternary trees of heights 1 and 3 etc. 3. Draw any n-ary tree of height h for given n and h . 4. Find the number of vertices and edges in given trees, Verify the relationbetween them. 5. Find centre, radius and diameter of above trees.	04

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NAAC Grade B++ (2.86 CGPA) ■ AISHE CODE : C-41829
Principal:
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Restructured Syllabus (CBCS Pattern as per NEP 2020)

To be implemented from Academic Year: 2024-25

Faculty	**Science**
Program	**BCA(Science)**
Class	**F.Y.BCA(Science)**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	CA-105 - TH	BSC	Discrete Mathematics and Statistics	Theory	02	02

Course Objectives:

1. Learn basic terminology formal logic, proofs, sets, relations, functions and perform the operations associated with same
2. Use formal logic proof and logical reasoning to solve problems
3. To understand significance of statistical measures
4. To study Correlation and Probability

Course Outcomes: On completion of the course, students will be able to–

1. Relate and apply techniques for constructing mathematical proofs and make use of appropriate set operations, propositional logic to solve problems
2. Use function or relation models to interpret associated relationships
3. Apply basic counting techniques and use principles of probability
4. Given a data, compute various statistical measures of central tendency

Unit	Title and content	No. of lectures in Clock Hours
1	**Set Theory and Logic:** **1.1 Sets–** Set Theory, Need for Sets, Representation of Sets, Set Operations, cardinality of set, **1.2 Types of Sets** – Bounded and Unbounded Sets, Countable and Uncountable Sets, Finite and Infinite Sets, Countable Infinite and Uncountable Infinite Sets, power set, **1.3 Propositional Logic-** logic**,** Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.	**06**
2	**Relations and Functions:** **2.1 Relations:** Properties, n-ary Relations and Applications, Representing Relations , Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Anti-Chains, Transitive Closure and Warshall's Algorithm **2.2 Functions-** Surjective, Injective and Bijective functions, Inverse Functions and Compositions of Functions.	**06**
3	**Counting and Probability** **3.1** The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, The Pigeonhole Principle. **3.2** Probability: Basic Concepts, Definition, Addition and Multiplication Theorems, Conditional probability and Bayes' Theorem	**06**

4	**Data Presentation and Aggregation:** **4.1 Data Types:** attribute, variable, discrete and continuous variable, **4.2 Data presentation:** frequency distribution, histogram, ogive, box-plot, bar plots **4.3 Measures of Central Tendency:** Arithmetic Mean (AM), Weighted Arithmetic Mean, Arithmetic Mean Computed from Grouped Data, Concept of Median, Mode, Geometric Mean (GM), Harmonic Mean (HM), Quartiles, Deciles, and Percentiles **4.4 Measures of Dispersion:** Standard Deviation, Root Mean Square, Variance, Absolute and Relative Dispersion	**06**
5	**Correlation Theory and Sampling:** **5.1 Correlation:** Bivariate data, scatter plots, Linear Correlation, Correlation of Attributes, Coefficient of correlation **5.2 Regression:** Concept, Linear Regression, Prediction **5.3 Elementary Sampling Theory** : Sampling Theory, Random Samples, Sampling With and Without Replacement, Stratified Sampling	**06**

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To be implemented from Academic Year: 2024-25

Faculty	**Science**
Program	**BCA**
Class	**FYBCA**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	CA-106 - PR	Practical	Practical course on CA-105 - TH	Practical	02	4

Course Objectives:

1. To learn to apply theoretical concepts of discrete mathematics and statistics to solve problems
2. To provide hands-on experience on R software

Course Outcomes : On completion of the course, student will be able to

1. Demonstrate understanding of fundamental mathematical concepts.
2. Apply mathematical and statistical concepts to solve problems.
3. Use R software to perform statistical operations and data visualization.

Practical No	Practical topic	No. of lectures in Clock Hours
Applied Mathematics: Practical based on following topics		
1.	Set Theory	04

2.	Logic	04
3.	Mathematical Induction	04
4.	Relations	04
5.	Lattice	04
6.	Functions	04
7.	Counting principal ,Permutation and Combination	04
8.	Probability	04
Statistics (To be performed using R software)		
9.	Download and Install R, understand IDE	04
10.	Using R execute the basic commands, array, list and frames	04
11.	Using R execute the basic commands , perform operations	04
12.	Using R execute the basic commands, draw different graphs	04
13	Using R Execute the statistical functions: mean, median, mode, quartiles, range.	04
14.	Using R import the data from Excel / .CSV file and calculate the standard deviation.	04
15.	Import the data from Excel / .CSV and perform the Statistical distribution: Normal Distribution.	04

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Faculty	**Science**
Program	**BCA**
	FYBCA

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	CA-155 - TH	Theory	Linear Algebra	Theory	02	2

Course Objectives:

1. To offer the learner the relevant Linear Algebra concepts through Computer Science applications.
2. To interpret existence and analyse the solution set of a system of linear equations.
3. To formulate, solve, apply, and interpret properties of linear systems.
4. To learn about the concept of linear independence of vectors and the dimension of a vector space.
5. To interpret basic concepts of linear transformations, dimension, matrix representation of a linear transformation.

Course Outcomes: On completion of the course, students will be able to–

1. Appreciate the relevance and applications of Linear Algebra in the field of Computer Science.
2. Instill a computational thinking while learning linear algebra.
3. Express clear understanding of the concept of a solution to a system of equations.

4. Find eigenvalues and corresponding eigenvectors for a square matrix. Represent linear transformations using matrices.

Unit	Title and content	No. of lectures in Clock Hours
1	**Systems of Linear Equations and Matrices** 1.1 Row echelon form of a matrix, reduced row echelon form of a matrix. 1.2 Definition of rank of a matrix using row echelon or row reduced echelon form. 1.3 System of linear equations- Introduction, matrix form of linear system, definition of row equivalent matrices. 1.4 Consistency of homogeneous and non-homogeneous system of linear equations using rank, condition for consistency Solution of System of Equations: Gauss elimination and Gauss-Jordan elimination method, examples.	06
2	**Vector Spaces - I** 2.1 Definition and examples 2.2 Basis of vector space 2.3 Subspaces 2.4 Linear Dependence and Independence (Statement and examples only)	06
3	Vector Spaces - II 3.1 Dimension of a vector space 3.2 Row Space, Column Space, and Null Space of a matrix 3.3 Definition: Rank and Nullity	06
4	**Eigen values and Eigen vectors** 4.1 Eigen values 4.2 Eigen vectors 4.3 Diagonalization	06
5	**Linear Transformations** 5.1 Definition and Examples, Properties, Equality 5.2 Kernel and range of a linear Transformation 5.3 Rank-Nullity theorem (Statement only) 5.4 Matrix representation of Linear Transformation	06

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Faculty	**Science**
Program	**BCA**
Class	**FYBCA**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. ofclock hours per week
II	CA-156 - PR	Practical	Practical course on CA-155 - TH	Practical	02	4

Course Objectives:

1. To learn to apply theoretical concepts of discrete mathematics and statistics to solve problems.
2. To provide hands-on experience on R software.

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Course Outcomes: On completion of the course, student will be able to

1. Demonstrate understanding of fundamental mathematical concepts.
2. Apply mathematical and statistical concepts to solve problems.
3. Use R software to perform statistical operations and data visualization.

Practical No	Practical topic	No. of lectures in Clock Hours
Applied Mathematics: Practical based on following topics		

1.	Row echelon or Row reduced echelon form	04
2.	system of linear equations using rank, condition for consistency(homogeneous and non-homogeneous)	04
3.	Gauss elimination and Gauss-Jordan elimination method	04
4.	Vector Space and Subspace	04
5.	Linear Dependence and Independence	04
6.	Row Space, Column Space, and Null Space of a matrix and Rank and Nullity	04
7.	Eigen value ,eigenvectors and diagonalizable	04
8.	Linear Transformation	04
Statistics (To be performed using R software)		
9.	Download and Install Scialb software	04
10.	Using Scialb software execute the basic commands, Basic math operations: Arithmetic, Trigonometric, Rational and logical.	04
11.	Using Scialb software execute the basic commands. Vector operations and Matrix operations and Row echelon or Row reduced echelon form	04
12.	Using Scialb software to solve system of linear equations	04
13	Using Scialb software create vector and perfume the operations	04
14.	Using Scialb software Execute the Row Space, Column Space, and Null Space of a matrix and Rank and Nullity	04
15.	Using Scialb software Execute the : Rank ,Eigenvalue ,Eigen vector and diagonalizable	04

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To be implemented from Academic Year: 2024-25

Faculty	**Commerce**
Program	**BBA**
Class	**F.Y. BBA**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
I	BBA101OE	OE	Business Mathematics	Theory	02	03

Course Objectives:

1. To provide solid Mathematical Foundation for B.B.A. Students in Business and Finance.
2. To develop appropriate understanding as how to use mathematic like computation interest, profit etc.
3. To enhance problem – solving Skills and ability for Academic and Professional Success
4. To cultivate right understanding regaining numerical aptitude
5. To develop logical approach towards analytical approach data

Course Outcomes:

1. Understand to apply the concept of interest and methods of calculation of interest
2. Apply the Mathematical competence for various interest related transactions and other activities.
3. Analyze the problem – solving Skills and ability.
4. Evaluate the simple and compound interest for various financial instruments.
5. Create their own models related to Finance and can solve them.
6. Apply the concept of matrices and determinants to solve the business problems

Unit	Title and Contents	No. of lectures in Clock Hours
1.	**Numerical Methods for Business Managers** 1.1 Ratio and proportion 1.2 Average 1.3 Percentages 1.4 Profit and loss	**08**
2.	**Mathematics of Finance** 2.1 Simple and compound interest 2.2 Commission 2.3 brokerage and premium 2.4 Banking , taxation and Calendar 2.5 Stock and Share	**10**
3.	**Matrices and Determinants** 3.1 Determinants [definitions and examples] 3.2 Matrices and its types 3.3 Algebra of matrices 3.4 Solution of system of linear equations (having uniquesolution and involving not more than three variables) using matrix inversion Method 3.5 Business Application	**12**

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Faculty	**Commerce**
Program	**BBA (CA)**
Class	**F.Y. BBA (CA)**

Semester	Course Code	Type of Course	Course Title	Theory/ Practical	Credits	No. of clock hours per week
II	OE-151-MTS-TH	OE	Business Mathematics	Theory	02	03

Course Objectives:

1. To understand the role and importance of Mathematics in various business situations and while developing software.
2. To develop skills related with basic mathematical technique.
3. Be able to communicate mathematical/logical ideas in writing.
4. Be familiar with several subfields of mathematics (e.g., numerical analysis, Business situations, operations research).
5. To increase price determination ability for financial analysis

Course Outcomes:

1. Explore theoretical approach in practical situations
2. To have better problem-solving skills.
3. To use effectively all the concepts in business.
4. It will help students to develop the logic and quantitative thinking.

Unit	Title and Contents	No. of lectures in Clock Hours
1.	**Ratio, Proportion and Percentage** **1.1 Ratio and Proportion:–** Definition, Continued Ratio,Inverse Ration, Proportion, Continued Proportion, Direct Proportion, Inverse Proportion, Variation, Inverse Variation, Joint Variation, Percentage, computation of Percentage. **1.2 Profit and Loss: -** Terms and Formulae, Trade Discount, Cash discount, Problems involving cost price, sellingprice, Trade discount and cash discount. **1.3 Commission and brokerage:** Introduction to Commission and brokerage, Problems on commission and brokerage	**15**
2.	**Interest and Annuity** **2.1 Interest:** Simple interest, Compound interest, equated monthly Installments (EMI) by interest of reducing balance and flat interest methods and problems. **2.2 Annuity**: Ordinary annuity, sinker fund, annuity due,present value and future value of annuity. **2.3 Shares and Mutual Funds: -** Concepts of Shares, face value, market value, dividend, brokerage, equity shares, preferentialshares, bonus shares, examples and problems, Concept of Mutual Funds Change in Net Asset Value (NAV), Systematic Investment Plan (SIP), Examples and Problems	**15**