Resolution No.: AC/

Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science, H.R.J. College of Commerce. (Bhavan's College) Autonomous

(Affiliated to University of Mumbai)

Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)

with effect from academic year 2023-24

PROGRAM OUTCOMES

PO	Description
PO	**A student completing Bachelor's Degree in Science will be able to:**
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
PO-4	Progress on Critical thinking, improve analytical power. Through Practical sessions grow on interpretation and documentation abilities.
PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Solve differential equations and understand its Applicability
PSO-2	Understand the properties of real number system.
PSO-3	Understand the limit and convergence of Sequences.
PSO-4	Understands about set theoretic concepts like relations, functions, equivalence relation and partition.
PSO-5	Understand geometrical interpretation of complex numbers
PSO-6	Understands concepts of infinite series, limits and continuity of R-R functions and use applications of differentiability in other branches of science.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
F.Y.B.Sc	I	BH. USMT.MAJ101	(Major)Calculus I	03
F.Y.B.Sc.	I	BH.USMT.MAJP101	Practicals based on (Major subject)	01
F.Y.B.Sc.	I	BH. USMT.MIN101	(Minor)Discrete Mathematics	03
F.Y.B.Sc.	I	BH.USMT.MINP101	Practical based on (Minor subject)	01
F.Y.B.Sc	I	BH.USMT.OE101	Financial mathematics I (OE)	04
F.Y.B.Sc	I	BH.USMT.VSEC101	Numerical methods	04
F.Y.B.Sc	I	BH.USMT.VEC101	Introduction to Geogebra software	02
F.Y.B.Sc	I	BH.USMT.IKS101	Vedic Maths	02
F.Y.B.Sc.	II	BH.USMT.MAJ201	(Major)Calculus II	03
F.Y.B.Sc.	II	BH. USMT.MAJP201	Practicals (based on USMT 201)	01
F.Y.B.Sc.	II	BH. USMT.MIN201	(Minor)Algebra I	03
F.Y.B.Sc.	II	BH. USMT.MINP201	Practicals (based on Minor 201)	01
F.Y.B.Sc	II	BH.USMT.OE101	Financial mathematics II (OE)	04
F.Y.B.Sc	II	BH.USMT.VSEC101	Algorithms for Programming	04
F.Y.B.Sc	II	BH.USMT.VEC101	Introduction to Pl/SQL	02

DETAILED SYLLABUS –

SEMESTER I & II

PREAMBLE

Mathematics has been fundamental to the development of Science and Technology in recent decades, the extent of application of Mathematics to real world problems has increased by leaps and bounds. Mental discipline is effectively built by mathematics and it encourages logical reasoning. It is hence imperative that the content of undergraduate syllabi of Mathematics should be such that it supports other branches of science such as Physics, Statistics and Computer Science. The present syllabus of F.Y.B.Sc. for academic year 2023-24 is revised to align to different U.G. branches, learn basic concepts of Mathematics and later get exposed to more rigorous methods gently and slowly. There are two courses for 'Calculus' spread over two Semesters. The two courses are applied and needed in every conceivable branch of science. The two courses on 'Discrete Mathematics and Algebra' spread over two semesters develops mathematical reasoning and logical thinking and has applications in science and technology.

Program: B Sc.				**Semester: I**	
Course: Calculus I				**Course Code: BH. USMT.MAJ101**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory + Practical)**	**Continuous Internal Assessment (CIA) (Marks - 40)**	**End Semester Examination (ESE) (Marks: 60)**
3	2	0	3+1	40	60

Any other information: Batch size for Practical as prescribed by the University of Mumbai.

Pre-requisites and eligibility: As prescribed by the University of Mumbai

COURSE OBJECTIVES:

1) To teach the concept of differential equation.
2) To give the concept of real number system.
3) To give the concept of limit, convergence and divergence of sequence.

COURSE OUTCOMES:

1. Get knowledge of Solving differential equations.
2. Understand the properties of real number system.
3. Understand the limit and convergence of Sequences.

Detailed syllabus: (per session)

FIRST SEMESTER: PAPER I: CALCULUS I (Major)

Unit No.	Description	Period
1	**Differential Equations** a) Solution of homogeneous and non-homogeneous differential equations of first order and first degree, notion of partial derivatives, exact differential equations, condition for exactness of non- exact differential equation M(x,y)dx+ N(x,y)dy=0 (without proof). Integrating factor, rules for finding Integrating factor for a non-exact differential equation M(x,y)dx+N(x,y)dy=0 (without proof). Integrating factor is	**15**

	I) $\frac{1}{M.x+N.y}$ if M(x,y)dx+ N(x,y)dy=0 is a homogeneous DE (and M.x+N.y ≠ 0) II) $\frac{1}{M.x-N.y}$ if M(x,y)dx+ N(x,y)dy=0 is of the form y.f(x.y)dx+x.g(x.y)dy=0 (and M.x-N.y≠ 0) III) $e^{\int f(x)dx}$ if $\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}$ = f(x) (free from 'y') N IV) $e^{\int g(y)dy}$ if $\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}$ = g(y) (free from 'x') M V) of the form $x^{\alpha}\, y^{\beta}$ if the DE can be put in the from a) $x^a y^b(mydx+nxdy) + x^c y^d(rydx+sxdy) =0$. b) Linear DE of first order and first degree, Bernoulli's DE. c) c) Applications to population growth, law of cooling, motion under gravity etc.	
2	**Real Number System** a) Statements of algebraic and order properties of R (Set of all real numbers), consequences of these properties, AM-GM inequality. b) Absolute value function, basic properties and examples. Intervals, neighborhood and deleted neighborhood of a point in R. c) Bounded sets, Supremum, Infimum of a set, l.u.b. axiom and its consequences. d) (d) Archimedean Property and its consequences, density theorem.	**15**
3	**Sequences and Subsequences** a) Definition of sequence, convergent sequence, divergent sequence, Uniqueness of limit of a convergent sequence. Examples using $\varepsilon - n_0$ definition. Bounded sequences. b) Algebra of convergent sequences, sandwich theorem, examples. c) Monotonic sequences in R, properties. d) Convergence of (a^n), $(a^{1/n})$ (where a > 0), $n^{1/n}$ etc.	**15**

Text books

1. Differential Equations with applications & historical notes by G. F.Simmons (2nd edition)

2. Methods of Real Analysis by R. R. Goldberg
3. Calculus & Analytic Geometry by Thomas & Finney (6^{th} edition)]

Reference Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. R. G. Bartle- D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
3. G. F. Simmons, Differential Equations with Applications and Historical Notes, McGrawHill, 1972.
4. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.

PRACTICALS Paper I Calculus I BH. USMT.MAJP101

There will be one practical per paper per week for each learner to be conducted in batches as per norms prescribed in each semester.

Practical No.	Description
1	Solving differential equations.
2	Solving exact and non-exact differential equations.
3	Algebraic and Order properties of Real numbers and inequalities.
4	Lub Axioms and Archimedean properties in R.
5	Convergence and divergence of sequences.
6	Monotone sequence and subsequences.
7	Based on Unit I, II III (MISCELLANEOUS).

Details of Conduct of Practical Examination (Evaluation Scheme): To be conducted as a guided exercise.

Programme: B.Sc.					Semester I
Course: Discrete Mathematics (Minor)					Course Code:BH. USMT.MIN101
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory + Practical)	Continuous Internal Assessment (CIA-I & II) (Marks - 40)	End Semester Examination (ESE) (Marks: 60)

3	2	--	3+1	40	60

Any other information: Batch size for Practical as prescribed by the University of Mumbai.

Pre-requisites and eligibility: As prescribed by the University of Mumbai

COURSE OBJECTIVES:

1. Learn Set theory & its functions.
2. Understand Integers & divisibility
3. Study complex numbers.

COURSE OUTCOMES:

1. Learner becomes very clear about set theoretic concepts like relations, functions, equivalence relation, partitions, polynomials.
2. Learner will understand geometrical interpretation of complex numbers.

Detailed Syllabus: (per session plan)

Unit No.	Description	Periods
1	**Set theory and functions** a) Power set of a set, Cartesian product of two sets. Cardinality of Finite and Infinite sets. Equivalence relations, partition of a sets, Equivalence classes. Examples on above b) Definition of functions, domain, codomain and range of a function, Injective, surjective and bijective functions. Composite of functions, Invertible function and inverse of a function. Binary operations and properties. Examples on above.	**15**
2	**Integers and Divisibility** a) First principle of finite induction and strong second principle of finite induction. Examples on above. Least element in a subset of N. 1 is least element in N, Well ordering principle. b) Divisibility in Z, Division algorithm. GCD and LCM Of two non- zero integers, basic properties of GCD, including GCD for any two integers a and b if exists is unique and can be expressed as ua+vb, Euclidean algorithm. c) Congruence relation: definition and elementary properties. Euler's φ function, Statements of Euler's theorem, Fermat's little theorem and Wilson's theorem, Applications.	15
3	Complex Numbers a) Introduction of complex number as an ordered pair of real numbers. Addition and multiplication of complex numbers, modulus and amplitude of a complex number, conjugate of a complex number. Geometrical representation of a complex number in Argand diagram and geometrical	15

	representation of addition, subtraction, multiplication and division of a complex number. Polar form. b) De-Moivre's Theorem. Roots of unity and solving equation of the form $w^{n}{}_{n}=z$.	
	Total	**45**

Reference Books:

1. Norman Biggs, Discrete Mathematics, Oxford University Press.

2. Richard Brualdi, Introductory Combinatorics, John Wiley and sons.

3.V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.4.
4.R.V.Churchill. Complex Variables and applications. (7^{th} Ed) (Tata McGraw Hill).

PRACTICALS Paper II Discrete Mathematics BH. USMT.MINP101

There will be one practical per paper per week for each learner to be conducted in batches as per norms prescribed in each semester.

1	Solving injective, surjective functions
2	Invertible functions
3	Division algorithm and properties of congruences
4	Fermat's theorem and congruence
5	Complex numbers and properties
6	De moivre's theorem Applications
7	Based on Unit I, II III (Miscellaneous)

Details of Conduct of Practical Examination: To be conducted as a guided exercise.

Program: B.Sc.				**Semester: II**	
Course: Calculus II (Major)				**Course Code: BH.USMT.MAJ201**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (Marks - 40)**	**End Semester Examination (ESE) (marks 60)**
3	2	-	3+1	40	60

Any other information: Batch size for Practical as prescribed by the University of Mumbai.

Pre-requisites & eligibility: As prescribed by the University of Mumbai

COURSE OBJECTIVES:

1. The objective of this course is to teach the learner basic concepts of Calculus.
2. To introduce Differentiability and its applications in various contexts.

COURSE OUTCOMES:

Learner becomes confident about concepts of infinite series, limits and continuity of R-R functions and use applications of differentiability in other branches of science.

Detailed syllabus

Unit No.	Description	Periods
1	**Infinite Series** (a) Infinite series in R, definition of convergence, divergence of infinite series in R, n^{th} term test, linearity ($\sum(\lambda a_n + \mu b_n) = \lambda\sum a_n + \mu\sum b_n$). Convergence of $\sum r^{n-1}$, Cauchy's condensation test, convergence of $\Sigma\ 1/n^p$. (b) Cauchy's criterion for convergence of infinite series in R, tests for convergence of infinite series in R viz comparison test, ratio test, root test, examples based on above tests. Alternating series in R, absolutely convergent series in R, their convergence. An absolutely convergent series is convergent but converse is not true. Leibnitz' test for convergence of alternating series in R, examples.	15
2	**Limits and Continuity** (a) $\varepsilon - \delta$ definition of limit of a function at a point in R (where function is defined on a set containing some deleted neighborhood of the point). Uniqueness of limit of a function at a point, examples. Left- and right-hand limits of a function at a point in R. limit of a function at a point in R exists if and only if both left- and right-hand limits exist and are equal at that point. Examples. (b) $\varepsilon - \delta$ definition of continuity of a function at a point in R (where function is defined on any subset of R), examples. Limits and continuity at a point in R in terms of convergent sequences. (c) Algebra of limits, algebra of continuous functions (i.e. sum, difference, product quotient, scalar product, composite function etc.). (d) (i) Intermediate value property (ii) continuous function on [a,b] is bounded and attains its bounds. (iii) continuous image of a closed and bounded interval is a closed and bounded interval. Examples based on above.	15

3	**Differentiability** (a) Definition of differentiability of a function at a point in R (where function is defined on a set containing some neighborhood of the point) and on domain of the function. Differentiability implies continuity but converse is not true. Examples on differentiability. Geometrical interpretation of differentiability. (b) Algebra of differentiable functions, chain rule. (c) Higher order derivatives, Leibnitz' rule, examples. (d) Absolute and relative maxima and minima, if f is a differentiable function and has relative maximum (or minimum) at point 'p' in R then f'(p)=0, converse is not true. Rolle's Mean Value Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem. Increasing and decreasing functions. For a differentiable function, if f'(x) >0 for all x in an open interval then f is increasing (similar result for decreasing functions). Examples based on all above.	**15**

Reference Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.2. R. G. Bartle- D. R. Sherbert,
2. Introduction to Real Analysis, John Wiley & Sons, 1994.
3. G. F. Simmons, Differential Equations with Applications and Historical Notes, McGrawHill, 1972.
4. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.5 Calculus by James Stewart (Eighth Edition) Cengage Learning

PRACTICALS: Calculus II BH.USMT.MAJP201

There will be one practical per paper per week for each learner to be conducted in batches as per norms prescribed in each semester.

1	**Infinite series**
2	**convergent of Infinite series**
3	**Algebra of limit and continuity**
4	**Algebra of differential functions**
5	**Rolle's Mean Value Theorem**
6	**Cauchy's Mean value Theorem**
7	**Based on Unit 1,2,3 (Miscellaneous)**

Details of Conduct of Practical Examination: To be conducted as a guided exercise.

Program: B. Sc.				Semester: II	
Course: ALGEBRA I (Minor)				Course Code:BH.USMT.MIN201	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory + Practical)**	**Continuous Internal Assessment (CIA-I & II) (Marks – 40)**	**End Semester Examination (ESE) (Marks: 60)**
3	2	-	3 + 1	40	60

Any other information: Batch size for Practical as prescribed by the University of Mumbai.

Pre-requisites & eligibility: As prescribed by The University of Mumbai.

COURSE OBJECTIVES:

1 The objective of this course is to teach the learner basic concepts of linear algebra.
2 To introduce basic properties and terms like linear dependence and linear independence, basis, dimension, applications to system of linear equations etc.

COURSE OUTCOMES:

1. Learner becomes very clear about above concepts and its utility.

2. Learners are motivated the nature-based problems to be solved using System of linear equations.

Detailed Syllabus: (per session plan)

Unit No.	Description	Periods
1	**Vector spaces over R** a) Definition of vector spaces over R. Examples like IR^n , R[x], space of mxn matrices over R, spaces of functions. b) Subspace: Definition, examples of subspaces of IR^2 and IR^3,such as lines, planes passing through origin, set of 2x2,3x3 upper triangular, lower triangular, diagonal, symmetric and skew symmetric matrices as	**15**

	subspaces of $M_2[R], M_3[R], P_n[x]$ over R,solutions of m homogeneous linear equations in n unknowns as a subspace of IR^n; space of continuous real functions on non-empty set X is subspace of F(X,R), properties of subspace such as necessary and sufficient condition for a non-empty subset of real vector space V to be a subspace of V, Linear span L(S) of a non- empty subset S of a real vector space V, Generator set of a subspace of V, linear span of a non-empty subset of V is a subspace of V, Linearly independent , linearly dependent sets in vector space, properties	
2	**Basis and Linear Transformation** a) Basis of a vector space.Dimensions of a real vector space. Maximal linearly independent subset of a vector space is a basis of a vector space. Minimal generating set of a vector space is a basis of a vector space. Any set of n+1 vectors in a vector space with n elements in its basis is linearly dependent. Any two bases of a finite real vector space have same number of elements. Any n linearly independent vectors in n dimensional vector space is basis of a vector space. If W_1 and W_2 are subspaces of a real vector space V then W_1+W_2 is a subspace of V. Generator set of a subspace of V. $\dim(W_1+W_2)=\dim W_1+\dim W_2-\dim(W_1\cap W_2)$. Extension of a linearly independent set to a basis of subspace. b) Linear transformation and its kernel. Matrix associated with a linear transformation. Properties such as kernel of a linear transformation is a subspace of domain space. For a linear transformation T, image (T) is a subspace of codomain space, Rank nullity theorem and examples.	**15**
3	**System of Linear Equations** System of homogeneous and non-homogeneous linear equations. To find solution of system of 'm' homogeneous linear equations in 'n' unknowns by elimination method and their geometrical interpretation for (m,n)=(1,2),(1,3),(2,2),(2,3),(3,3) System of linear equations in matrix form, elementary row operations, row echelon matrix, Gaussian elimination method.	**15**

References:

1. Ruel V. Churchill. . Complex variables and Applications
2. David Burton. Elementary Number Theory Tata McGraw-Hill (Walter Rudin Series)
3. Norman Biggs, Discrete Mathematics, Oxford University Press

4. Richard Brualdi, Introductory Combinatorics, John Wiley and sons
5. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
6. Discrete Mathematics and its Applications, Tata McGraw Hills.

PRACTICAL Algebra I: BH.USMT.MINP201

There will be one practical per paper per week for each learner to be conducted in batches as per norms prescribed in each semester.

1	Vector spaces
2	Subspace of a vector
3	Basis of vector spaces
4	Linear transformations and rank nullity theorem
5	Solving system of equations
6	Gauss elimination method
7	Based on Unit 1,2,3 (Miscellaneous)

Details of Conduct of Practical Examination: To be conducted as a guided exercise.

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr. No.	Evaluation type	Marks
1	Internal Class Test with Objective type questions and Short Notes (CIA-I)	20
2	One Assignment (CIA-II)	20
	TOTAL	40

Continuous Internal Assessment II will have assignments/New Problems, Projects.

B) External Examination- 60%- 60 Marks

Semester End Theory Examination: 60 marks (for offline Mode)

Duration: The examinations shall be of 2 hours duration.

Theory Question Paper Pattern:

a) There shall be FOUR questions. The questions Q1, Q2, Q3, Q4 shall be of 15 marks, each based on the units 1,2,3 respectively. Question Q4 shall be based on all the units.

b) All the questions shall be compulsory. The questions Q1, Q2, Q3, Q4 shall have internal choices within the questions. Including the choices, the marks for each question shall be 22-25.

c) The questions Q1, Q2, Q3, Q4 may be subdivided into sub-questions as a, b, c, d & e, etc and the allocation of marks depends on the weightage of the topic.

PRACTICALS EXAMINATION

For Sem I & Sem II each, Examination for Practicals is to be conducted for Major and Minorfor three hours duration and 100 marks per semester. Pattern will be as follows.

Particulars	Semester I & Semester II	
	Semester I	Semester II
MCQ (16 MCQ, 3 marks each)	48marks	48 marks
Descriptive type of questions (2 questions of 8 marks each)	32 marks	32 marks
Journal	10 marks	10 marks
Viva voce	10 marks	10 marks

Overall Examination & Marks Distribution Pattern

Semester I & II

Course	BH.USMT101 & 102			BH.USMT201 & 202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	80	120	200	80	120	200	400
Practical	-	100	100	-	100	100	200

Rubrics of evaluation for ESE

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
All units	05	05	05	10
1	05	05	05	10
2	05	05	05	10
3	05	05	05	10
Total per objective	20	20	20	60
% weightage	33.33	33.33	33.34	100

Rubrics of evaluation for CIA-2 assignment : <u>Presentation/debate</u>

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
CONTENT	10					
Content : Introduction	02					
Content : Development	03					
Content : Conclusion	03					
Content : Bibliography	02					
Effective communication skill	10					
Language, Style and Structure;	05					
Teaching aids;	05					
Total	20					

SEMESTER -I

Category: IKS (credit 2) **Course Code: BH.USMT.IKS.101**

Paper Title: Introduction to Indian Knowledge System

The study of Vedic Mathematics at the First Year Bachelor of Science (FYBSc) level introduces students to a unique and ancient system of mathematical techniques originating from ancient Indian scriptures known as the Vedas. Vedic Mathematics is a holistic approach that provides students with a set of simplified and efficient methods for performing mathematical calculations, solving problems, and improving computational speed.

The syllabus of Vedic Mathematics at the FYBSc level covers a wide range of topics that delve into the principles, applications, and techniques of this ancient mathematical system. Students will explore various concepts and strategies, enabling them to solve complex mathematical problems with ease and precision. The aim is to enhance students' mathematical abilities, promote mental ability, and foster a deeper understanding of the underlying mathematical principle**s.** By the end of the course, students will also gain insights into the cultural heritage and historical significance of this ancient mathematical system, making it a rewarding and enriching academic pursuit.

OUTCOMES:

1. Students will be introduced to the historical background and significance of Vedic Mathematics.
2. Students will study techniques such as Ekadhikena Purvena, Nikhilam Navatashcaramam Dashatah, Urdhva-Tiryakbhyam, and other Vedic formulae
3.Students will delve into the Vedic techniques for performing basic arithmetic operations such as addition, subtraction, multiplication, and division. They will learn how to apply these techniques to perform calculations mentally and with great efficiency
4. Students will be able to solve real-world problems and practical applications, such as calculating interest, time and distance problems, algebraic equations

Syllabus :

UNIT	Title of unit and Contents	
1	**Overview of IKS:** 1. Survey of IKS domains: a broad overview of disciplines included in IKS, and historical developments. 2. Sources of IKS knowledge, classification of IKS texts, a survey of available primary text, translated primary text and secondary resource materials. Differences between a sutra, bhashya, karika and vartika texts. Fourteen/ eighteen vidyasthanas, tantrayukti 3. Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to concepts of non-transltables (Ex. Dharma, punya, aatma, karma, yagnya, shakti, varna, jati, moksh, loka, daana, itihaasa, purana etc.) and importance of using the proper terminology. Terms such as praja, Janata, loktantra, prajatantra, ganatantra, swarajya, Suraiya, rashtra, desh	**15 L**
II	**Introduction to Vedic Mathematics**: 1.**Introduction to vedic Mathematics:** Historical background, significance, and applications of Vedic Mathematics. **2.Sutras (Aphorisms):** Study of the fundamental Sutras (aphorisms) of Vedic Mathematics, such as Ekadhikena Purvena, Nikhilam Navatashcaramam Dashatah, Urdhva-Tiryakbhyam, etc. **3.Basic Operations**: Vedic techniques for performing basic arithmetic operations, including addition, subtraction, multiplication, and division. **4.Digit Sum Method**: The concept of digit sums and its applications in Vedic Mathematics. **5.Special Multiplication Techniques**: Methods for multiplying numbers, such as "Vertically and Crosswise" technique, "All from 9 and the last from 10" technique, and "Nikhilam" multiplication technique.	**15 L**

	Square Roots and Cube Roots: Techniques for finding square roots and cube roots of numbers using Vedic Mathematics. **Divisibility Tests**: Divisibility tests for numbers based on Vedic principles. **7. Quadratic Equations**: Vedic methods for solving quadratic equations, including the Sutra "By One More than the One Before." **8. Fraction Calculations**: Techniques for working with fractions, including addition, subtraction, multiplication, and division. **9. Time and Distance Problems**: Vedic Mathematics approach to solving problems related to time, speed, and distance. **10. Algebraic Equations:** Methods for solving algebraic equations using Vedic Mathematics principles. **11. Special Number Series:** Techniques for handling special number series, such as Fibonacci series and other sequences.	

SEMESTER I (Value Education Course)

Category: VEC (credit 3+1) **Course Code: BH.USMT.VEC.101**

Course Title: Introduction to GeoGebra Software Course

Course Description: The course "Introduction to GeoGebra Software" is designed to provide students with a solid foundation in using GeoGebra, a dynamic mathematics software that combines geometry, algebra, calculus, and graphing capabilities. The course aims to develop students' skills in visualizing mathematical concepts, constructing geometric figures, and exploring mathematical relationships through interactive and dynamic representations. Students will learn how to effectively utilize GeoGebra to enhance their problem-solving abilities and mathematical reasoning.

Course Objectives:

Familiarize students with the basic features and tools of GeoGebra software.
Enable students to construct and manipulate geometric objects using GeoGebra's dynamic geometry capabilities.
Enhance students' understanding of algebraic concepts through interactive algebraic representations.
Develop students' skills in creating graphs and analyzing mathematical functions using GeoGebra's graphing capabilities.
Apply GeoGebra in solving mathematical problems and investigating mathematical relationships.
Promote critical thinking and mathematical communication skills through collaborative GeoGebra projects.

Course Outline:

UNIT	Title of unit and Contents	
1	**Introduction to GeoGebra** Overview of GeoGebra software and its features. Exploring the GeoGebra user interface and toolbars. Creating and saving GeoGebra files. Basic operations and navigation in GeoGebra. **Points, Lines, and Angles** Constructing points, lines, and angles using GeoGebra tools. Investigating properties of geometric figures. Exploring transformations and symmetry using GeoGebra. Constructing polygons and examining their properties.	**15 L**
II	**Algebraic Representations** Using GeoGebra to perform algebraic computations. Graphing functions and exploring their properties. Solving equations and inequalities using GeoGebra. Investigating mathematical patterns and sequences. **Coordinate Geometry** Understanding the Cartesian coordinate system in GeoGebra. Plotting points, lines, and curves in the coordinate plane.	**15 L**

	Investigating geometric transformations using coordinate geometry. Exploring conic sections and their properties.	
III	**Calculus with GeoGebra** Computing derivatives and integrals using GeoGebra. Analyzing the behavior of functions and their derivatives. Investigating limits and continuity using GeoGebra. Exploring optimization problems and curve sketching. **GeoGebra in Problem Solving** Applying GeoGebra to solve mathematical problems. Investigating mathematical relationships through dynamic constructions. Creating interactive applets and simulations using GeoGebra. Collaborative projects and presentations using GeoGebra.	**15 L**

Assessment:

Assignments: Regular exercises and problem-solving tasks using GeoGebra. (30%)
Projects: Collaborative projects involving the application of GeoGebra in mathematical investigations. (40%)
Final Examination: Comprehensive examination covering all topics taught during the course. (30%)
Recommended Resources:
GeoGebra Official Website: www.geogebra.org
GeoGebra Tutorials and Documentation available on the GeoGebra website.
Additional resources and tutorials provided by the instructor

SEMESTER I (VSEC)

Category: VSEC (credit 3+1) **Course Code: BH.USMT.VSEC.101**

Course Title: Numerical Methods:

Syllabus:

UNIT	Title of unit and Contents	
1	**Introduction to Numerical Methods**: Overview of numerical methods and their importance in solving mathematical problems that cannot be solved analytically. **Root Finding Methods:** Study of methods for finding the roots of equations, including the bisection method, Newton-Raphson method, and secant method. Understanding their convergence, accuracy, and limitation**s.**	**15 L**
II	**Interpolation and Approximation**: Techniques for approximating functions and data interpolation, including Newton's divided difference interpolation, Lagrange interpolation, and spline interpolation. **Numerical Differentiation and Integration**: Methods for approximating derivatives and integrals numerically, such as forward difference, backward difference, and central difference formulas. Introduction to numerical integration techniques like the trapezoidal rule and Simpson's rule.	**15 L**
III	**Linear Systems of Equations**: Solving systems of linear equations using numerical methods, including Gaussian elimination, LU decomposition, and Gauss-Seidel iteration method. Understanding matrix operations and their computational aspects. **Eigenvalues and Eigenvectors**: Introduction to eigenvalues and eigenvectors of matrices. Study of iterative methods like the power method and Jacobi method for computing eigenvalues.	**15 L**

List of Practicals:

1. Finding the roots of equations, including the bisection method, Newton-Raphson method.

2.Finding the roots of equations Secant method
3. Newton's divided difference interpolation
4. Langrange's interpolation , and spline interpolation.
5. Forward difference, backward difference, and central difference formulas
6. Numerical integration by trapezoidal rule and Simpson's rule.
7. Solving systems of linear equations using Gaussian elimination, LU decomposition, and Gauss-Seidel iteration method
8. Power method and Jacobi method for computing eigenvalues.

Category: OG (credit 3+1) **Course Code: BH.USMT.OG.101**

Financial Mathematics-I

ABSTRACT

Financial Mathematics is a specialized field that combines principles of mathematics, statistics, and finance to analyze and solve complex financial problems. Financial Mathematics plays a crucial role in various areas of the financial industry, including investment banking, insurance, asset management, risk analysis, and quantitative trading. By utilizing mathematical tools, formulas, and algorithms, The course in Financial Mathematics provides a solid foundation for understanding the mathematical principles and quantitative techniques that underpin financial decision-making. It offers a unique blend of mathematical rigor, financial theory, and practical application, making it an ideal choice for individuals seeking a career in finance or looking to enhance their analytical skills in the financial industry.

Course Outcomes (COs) **On completion of the course, the students will be able to**:	
CO1	To distinguish interest and compound interest,
CO2	To calculate EMI, Present , Future value of Money
CO3	To operate addition, substractions, multiplication of two matrices
CO4	To solve system of equations using algebra of Matrices
CO5	To identify different types of Matrices based on their characterstics
CO6	Identitify ,Compute and correlate all mathematical functions and its types based on the their graphs

Syllabus: Financial Mathematics-I SEM I

UNIT	Title of unit and Contents	
1	**Quantitative Concepts:** What is interest? Simple and Compound interest, Nominal and Effective rate of interest, Concept and Calculations of Equated Monthly Instalments EMI, Time, Present and Future Value of Money, Applications of Time Value of Money, Impact of time and discount rate on present and future values, Relationship between net present value and financial investment, Applications of time value of money	**15 L**
II	**The Matrix Algebra**:The role of linear algebra, Definitions, addition and subtraction of matrices, scalar multiplication, vector multiplication, multiplication of matrices, commutative, associative and distributive laws in matrix algebra,	**15 L**

	Identity and Null matrices, matrix expression of a system of linear equations, row operations, augmented matrix, Gaussian method of solving linear equations.	
III	**Basic Concepts in Calculus**:Exponents, Polynomials, Factoring, Completing the square, Functions , Graphs, Slopes and Intercepts, Graphs of Non-linear Functions, Exponential and logarithmic functions, properties of exponents and logarithms , solving natural exponential and logarithmic functions	**15 L**

Learning Resources: 1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series 2. Frank Ayres, Mathematics of Finance, Schaum's Outline Series

SEMESTER II

Category: VSEC (credit 3+1) **Course Code:BH.USMT.VSEC.201**

CourseTitle: Algorithms for Programming

FYBSc

Course Description: The course "Introduction to Algorithms" is designed to provide students with a solid foundation in understanding and analyzing algorithms. The course aims to introduce students to various algorithmic techniques and problem-solving strategies. Students will learn how to analyze algorithm efficiency, measure time and space complexity, and gain hands-on experience in implementing algorithms. The course will cover topics such as algorithmic thinking, data structures, searching, sorting, and basic graph algorithms.

Course Objectives:

CO:1 Introduce students to the fundamental concepts and importance of algorithms in computer science and mathematics.
CO:2 Develop students' algorithmic thinking and problem-solving skills.
CO:3 Familiarize students with common algorithmic techniques and their applications.
CO:4 Enable students to analyze the efficiency of algorithms using time and space complexity analysis.
CO:5 Provide practical experience in implementing algorithms and solving computational problems.
CO:6 Prepare students for advanced courses in algorithms and data structures.

Course Outline:

UNIT	Title of unit and Contents	
1	**Introduction to Algorithms:** Importance of algorithms in problem-solving and computer science. Algorithm representation and analysis: time complexity, space complexity, and big-O notation. Strategies for algorithm design: brute force, divide and conquer, greedy, and dynamic programming. Introduction to algorithm analysis and correctness.	**15 L**
II	**Data Structures:** Introduction to common data structures: arrays, linked lists, stacks, and queues. Understanding the operations and properties of data structures. Choosing appropriate data structures for different problem scenarios. Implementing and manipulating data structures in code.	**15 L**
III	**UNIT 3: Searching and Sorting Algorithms:** Linear search and binary search algorithms. Analysis of searching algorithms: time complexity and efficiency. Searching in sorted and unsorted arrays. Applications of searching algorithms in various contexts. Bubble sort, insertion sort, and selection sort algorithms. Analysis of sorting algorithms: time complexity and efficiency. Comparison-based sorting algorithms: merge sort and quicksort. Non-comparison-based sorting algorithms: counting sort and radix sort.	**15 L**

List of practicals:
1. Algorithm representation in problems solving
2. arrays, linked lists, stacks, and queues
3. Understanding the operations and properties of data structures
4. Linear search and binary search algorithms
5. Searching in sorted and unsorted arrays
6. Bubble sort, insertion sort, and selection sort algorithm.
7. Merge sort and quicksort.

Assessment:

Assignments: Regular problem-solving assignments and algorithm analysis tasks. (30%) Programming Exercises: Hands-on implementation of algorithms in a suitable programming language. (40%) Final Examination: Comprehensive examination covering all topics taught during the course. (30%)

Recommended Resources:

"Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Online resources, tutorials, and algorithm visualization tools. Programming languages and environments suitable for algorithm implementation (e.g., Python, C++)

SEMESTER- II (Open Elective)
Category: OE (credit 3+1) **Course**
Code:BH.USMT.OE.201
CourseTitle: Financial Mathematics-II

Syllabus

Course Outcomes (COs) **On completion of the course, the students will be able to**:	
CO1	Calculate limit of function and able to test whether function continuous or not, differentiable or not
CO2	Find derivative and its problems based on economics
CO3	Find nature of curve increasing and decreasing in domain ,Marginal concept
CO4	Find relationship among Marginal and Average concepts
CO5	Solve indefinite integral, integral with boundary conditions
CO6	To find integration using proper methods and solve problems in economic domain.

UNIT	Title of unit and Contents	
1	**The Derivatives and the Rule of Differentiations :**Limit, Continuity, The slope of curve linear functions, Derivative, Differentiability and Continuity, Rules of Differentiation, Higher order derivatives, Implicit Differentiation.	**15 L**
II	**Use of Derivatives in Mathematics and Economics:** Increasing and Decreasing functions, Concavity and Convexity, Relative extrema, Inflection points, Curve Sketching, Optimization of Functions, Marginal concepts, Optimizing economic functions, Free elasticity of demand and supply, Relationship among total, Marginal and Average concepts.	**15 L**
III	**Integral Calculus**: The Indefinite Integral, Integration, Rules of integration, Initial conditions and boundary conditions, Integration by substitution, Integration by parts, Economic applications	**15 L**

Learning Resources: 1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series 2. Frank Ayres, Mathematics of Finance, Schaum's Outline Series

List of Practicals :

Sem I Financial Mathematics -I

1. problems based on interest, compound interest,EMI
2, Problems based on value of money ,time value of Money
3.Problems based on relationship between net present value and financial investment, Applications of time value of money.
4. , Problems based on Addition , subtraction of matrices, scalar multiplication, vector multiplication,
5. Problems based on commutative, associative and distributive laws in matrix algebra, Identity and Null matrices, matrix.
6. . Problems based on matrix expression of a system of linear equations, row operations, augmented matrix, Gaussian method of solving linear equations.
7. Problems based on Exponents, Polynomials, Factoring, Completing the square, Functions , Graphs, Slopes and Intercepts
8. , Problems based on Exponential and logarithmic functions, properties of exponents and logarithms , solving natural exponential and logarithmic functions

List of Practicals:

Sem II Financial Mathematics -II

1. Limit, Continuity
2. Finding derivatives of functions
3. Applications of derivatives -I
4. Applications of Derivative-II
5. Curve sketchings
6. Finding Integration of functions
7. Integration by Parts
8. Applications of Integrations.

SEMESTER II

Category: VEC (Credit 2+2) **Course Code:BH.USMT.VEC.201**

Course Title: Introduction to PL/SQL

ABSTRACT

The course "Introduction to PL/SQL" is designed to provide students with a foundation in programming using PL/SQL (Procedural Language/Structured Query Language). PL/SQL is a procedural language extension to SQL that is widely used for developing database applications. The course aims to develop students' skills in writing PL/SQL code, designing and implementing database procedures, functions, and triggers, and managing data using SQL statements within PL/SQL programs.

Course Objectives:

1.Introduce students to the fundamentals of PL/SQL programming language.
2.Enable students to write PL/SQL code to create and manipulate database objects.
3.Develop students' skills in designing and implementing stored procedures, functions, and triggers.
4.Enhance students' ability to manage and manipulate data using SQL statements within PL/SQL.
Provide hands-on experience in writing PL/SQL programs and executing them on a database server.
Foster problem-solving and critical thinking skills in the context of database programming.

Course Outline:

UNIT	Title of unit and Contents	
1	**PL/SQL Language Basics** PL/SQL block structure and syntax. Declaring variables and data types in PL/SQL. Writing control structures (conditional statements and loops) in PL/SQL. Handling exceptions and error handling in PL/SQL.	**15 L**
II	**PL/SQL Procedures and Functions**	**15 L**

	Creating and executing PL/SQL procedures and functions. Passing parameters to procedures and functions. Returning values from functions. Overloading procedures and functions. **PL/SQL Cursors** Working with cursors in PL/SQL. Declaring, opening, fetching, and closing cursors. Using explicit and implicit cursors. Cursor attributes and cursor loops.	
III	**PL/SQL Triggers** Understanding triggers and their types. Creating and managing triggers in PL/SQL. Trigger timing and triggering events. Triggers for enforcing data integrity and implementing business rules. **Managing Data in PL/SQL** Inserting, updating, and deleting data using PL/SQL. Using DML (Data Manipulation Language) statements within PL/SQL. Retrieving data using queries within PL/SQL. Bulk processing techniques and performance considerations. Assessment: Assignments: Regular programming assignments and problem-solving tasks. (30%) Laboratory Exercises: Practical exercises to write and execute PL/SQL code. (40%) Final Examination: Comprehensive examination covering all topics taught during the course. (30%) Recommended Resources: "Oracle PL/SQL Programming" by Steven Feuerstein and Bill Pribyl. "Oracle Database PL/SQL Language Reference" (Oracle documentation). Online tutorials and resources provided by Oracle and other reputable sources.	**15 L**

Practicals in PL/SQL :

1.Introduction to PL/SQL: a. Setting up the PL/SQL development environment (Oracle SQL Developer, SQL*Plus, etc.). b. Writing and executing simple PL/SQL blocks to display messages or perform basic calculations. c. Declaring variables, assigning values, and printing output in PL/SQL. d. Practicing the use of basic control structures (IF-ELSE, loops) in PL/SQL.
2. Write a program in Pl/Sql a. Creating and executing PL/SQL procedures to perform specific tasks. b. Writing functions to return values and using them in expressions. c. Passing parameters to procedures and functions. d. Calling and testing procedures and functions with different input values.
3.Cursors and Database Operations: a. Declaring and using explicit cursors to fetch data from database tables. b. Implementing loops to iterate through cursor results and process data. c. Performing database operations (INSERT, UPDATE, DELETE) using PL/SQL. d. Retrieving and manipulating data using SELECT statements within PL/SQL.
4.Exception Handling: a. Handling exceptions in PL/SQL using the EXCEPTION block. b. Using predefined exceptions and user-defined exceptions. c. Catching and handling specific exceptions. d. Implementing error logging and error handling strategies in PL/SQL.
5.Triggers: a. Creating and executing DML triggers in PL/SQL. b. Implementing row-level and statement-level triggers. c. Understanding the triggering events and timing of triggers. d. Using triggers to enforce data integrity and implement business rules.
6.PL/SQL Packages: a. Creating and using packages in PL/SQL. b. Organizing related procedures, functions, and variables in packages. c. Understanding package specifications and bodies. d. Implementing package-level variables and cursors.
7. Advanced PL/SQL Concepts: a. Dynamic SQL: Constructing and executing SQL statements dynamically in PL/SQL. b. Bulk Processing: Using bulk operations for improved performance. c.

Cursors with Parameters: Creating and using cursors with parameters in PL/SQL. d. Exception Propagation: Handling and propagating exceptions in nested PL/SQL blocks.

Resolution No.: AC/

Bharatiya Vidya Bhavan's
M. M. College of Arts, N.M. Institute of Science,
H.R.J. College of Commerce. (Bhavan's College)
Autonomous
(Affiliated to University of Mumbai)

Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)
with effect from academic year 2023-24

Program: B.Sc.			Sem 1	
Course: Numerical Methods			Course code: BH.USMT.VSEC.101	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assesment	End sem exam
3	1	3+1	40	60

PROGRAM OUTCOMES

	Description
PO	A student completing Bachelor's Degree in Science will be able to:
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
PO-4	Progress on Critical thinking, improve analytical power. Through Practical sessions grow on interpretation and documentation abilities.
PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Able to develop techniques of solving numerical problems.
PSO-2	Able to solve of root finding methods such as bisection, NRM, RFM
PSO-3	Able to gain proficiency in using Numerical integration methods like trapezoidal, Simpson's rule
PSO-4	Able to solve system of linear equation using methods like Gaussian elimination, LU decomposition
PSO-5	Able to develop skill in numerical solving of differential equations.
PSO-6	Able to explore and apply numerical methods to solve real-world numerical problems

SEMESTER -I

SEMESTER I (VSEC)

Category: VSEC (credit 3+1) **Course Code: BH.USMT.VSEC.101**

Course Title: Numerical Methods:

Syllabus:

UNIT	Title of unit and Contents	
1	**Introduction to Numerical Methods**: Overview of numerical methods and their importance in solving mathematical problems that cannot be solved analytically. **Root Finding Methods:** Study of methods for finding the roots of equations, including the bisection method, Newton-Raphson method, and secant method. Understanding their convergence, accuracy, and limitation**s.**	**15 L**
II	**Interpolation and Approximation**: Techniques for approximating functions and data interpolation, including Newton's divided difference interpolation, Lagrange interpolation, and spline interpolation. **Numerical Differentiation and Integration**: Methods for approximating derivatives and integrals numerically, such as forward difference, backward difference, and central difference formulas. Introduction to numerical integration techniques like the trapezoidal rule and Simpson's rule.	**15 L**
III	**Linear Systems of Equations**: Solving systems of linear equations using numerical methods, including Gaussian elimination, LU decomposition, and Gauss-Seidel iteration method. Understanding matrix operations and their computational aspects. **Eigenvalues and Eigenvectors**: Introduction to eigenvalues and eigenvectors of matrices. Study of iterative methods like the power method and Jacobi method for computing eigenvalues.	**15 L**

List of Practicals:

1. Finding the roots of equations, including the bisection method, Newton-Raphson method.
2. Finding the roots of equations Secant method
3. Newton's divided difference interpolation
4. Langrange’s interpolation , and spline interpolation.
5. Forward difference, backward difference, and central difference formulas
6. Numerical integration by trapezoidal rule and Simpson's rule.
7. Solving systems of linear equations using Gaussian elimination, LU decomposition, and Gauss-Seidel iteration method
8. Power method and Jacobi method for computing eigenvalues.

Resolution No.: AC/

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Autonomous

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Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)

with effect from academic year 2023-24

Program: B.Sc.			Sem 1	
Course: Introduction to GeoGebra Software			Course code: BH.USMT.VEC.101	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assesment	End sem exam
2		2	40	60

PROGRAM OUTCOMES

	Description
PO	**A student completing Bachelor's Degree in Science will be able to:**
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
PO-4	Progress on Critical thinking, improve analytical power. Through Practical sessions grow on interpretation and documentation abilities.
PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Familiarize students with the basic features and tools of GeoGebra software
PSO-2	Enable students to construct and manipulate geometric objects using GeoGebra's dynamic geometry capabilities
PSO-3	Enhance students' understanding of algebraic concepts through interactive algebraic representations
PSO-4	Develop students' skills in creating graphs and analyzing mathematical functions using GeoGebra's graphing capabilities
PSO-5	Apply GeoGebra in solving mathematical problems and investigating mathematical relationships
PSO-6	Promote critical thinking and mathematical communication skills through collaborative GeoGebra projects

SEMESTER I (Value Education Course)

Category: VEC (credit) **Course Code: BH.USMT.VEC.101**

Course Title: Introduction to GeoGebra Software Course

Course Description: The course "Introduction to GeoGebra Software" is designed to provide students with a solid foundation in using GeoGebra, a dynamic mathematics software that combines geometry, algebra, calculus, and graphing capabilities. The course aims to develop students' skills in visualizing mathematical concepts, constructing geometric figures, and exploring mathematical relationships through interactive and dynamic representations. Students will learn how to effectively utilize GeoGebra to enhance their problem-solving abilities and mathematical reasoning.

Course Outline:

UNIT	Title of unit and Contents	
1	**Introduction to GeoGebra** Overview of GeoGebra software and its features. Exploring the GeoGebra user interface and toolbars. Creating and saving GeoGebra files. Basic operations and navigation in GeoGebra. **Points, Lines, and Angles** Constructing points, lines, and angles using GeoGebra tools. Investigating properties of geometric figures. Exploring transformations and symmetry using GeoGebra. Constructing polygons and examining their properties.	**15 L**
II	**Algebraic Representations** Using GeoGebra to perform algebraic computations. Graphing functions and exploring their properties. Solving equations and inequalities using GeoGebra. Investigating mathematical patterns and sequences. **Coordinate Geometry** Understanding the Cartesian coordinate system in GeoGebra. Plotting points, lines, and curves in the coordinate plane. Investigating geometric transformations using coordinate geometry. Exploring conic sections and their properties.	**15 L**
III	**Calculus with GeoGebra** Computing derivatives and integrals using GeoGebra. Analyzing the behavior of functions and their derivatives. Investigating limits and continuity using GeoGebra. Exploring optimization problems and curve sketching. **GeoGebra in Problem Solving** Applying GeoGebra to solve mathematical problems. Investigating mathematical relationships through dynamic constructions. Creating interactive applets and simulations using GeoGebra. Collaborative projects and presentations using GeoGebra.	**15 L**

Assessment:

Assignments: Regular exercises and problem-solving tasks using GeoGebra. (30%)
Projects: Collaborative projects involving the application of GeoGebra in mathematical investigations. (40%)
Final Examination: Comprehensive examination covering all topics taught during the course. (30%)
Recommended Resources:
GeoGebra Official Website: www.geogebra.org
GeoGebra Tutorials and Documentation available on the GeoGebra website.
Additional resources and tutorials provided by the instructor

Resolution No.: AC/

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Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)

with effect from academic year 2023-24

Program: B.Sc.			Sem 1	
Course: Indian Knowledge system			Course code: BH.USMT.IKS.101	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assesment	End sem exam
2	0	2	40	60

PROGRAM OUTCOMES

	Description
PO	A student completing Bachelor's Degree in Science will be able to:
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
PO-4	Progress on Critical thinking, improve analytical power. Through Practical sessions grow on interpretation and documentation abilities.
PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	To perform mathematical calculations fast ,.
PSO-2	Solve mathematical problems using vedic math, and improve computational speed in Maths.
PSO-3	Develop mathematical ability to perform the calculation speedily.
PSO-4	Gain insights into the cultural heritage of India.
PSO-5	Use ancient Indian techniques to study algebra.
PSO-6	Remember and apply Sanskrit based vedic formulae in math.

SEMESTER -I

Category: IKS (credit 2) **Course Code: BH.USMT.IKS.101**

Paper Title: Introduction to Indian Knowledge System

The study of Vedic Mathematics at the First Year Bachelor of Science (FYBSc) level introduces students to a unique and ancient system of mathematical techniques originating from ancient Indian scriptures known as the Vedic Mathematics is a holistic approach that provides students with a set of simplified and efficient methods for performing mathematical calculations, solving problems, and improving computational speed.

The syllabus of Vedic Mathematics at the FYBSc level covers a wide range of topics that delve into the principles, applications, and techniques of this ancient mathematical system. Students will explore various concepts and strategies, enabling them to solve complex mathematical problems with ease and precision. The aim is to enhance students' mathematical abilities, promote mental ability, and foster a deeper understanding of the underlying mathematical principle**s.** By the end of the course, students will also gain insights into the cultural heritage and historical significance of this ancient mathematical system, making it a rewarding and enriching academic pursuit.

OUTCOMES:

1. Students will be introduced to the historical background and significance of Vedic Mathematics.

2. Students will study techniques such as Ekadhikena Purvena, Nikhilam Navatashcaramam Dashatah, Urdhva-Tiryakbhyam, and other Vedic formulae

3.Students will delve into the Vedic techniques for performing basic arithmetic operations such as addition, subtraction, multiplication, and division. They will learn how to apply these techniques to perform calculations mentally and with great efficiency

4. Students will be able to solve real-world problems and practical applications, such as calculating interest, time and distance problems, algebraic equations

Syllabus :

UNIT	Title of unit and Contents	
1	**Overview of IKS:** 1. Survey of IKS domains: a broad overview of disciplines included in IKS, and historical developments. 2. Sources of IKS knowledge, classification of IKS texts, a survey of available primary text, translated primary text and secondary resource materials. Differences between a sutra, bhashya, karika and vartika texts. Fourteen/ eighteen vidyasthanas, tantrayukti 3. Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to concepts of non-transltables (Ex. Dharma, punya, aatma, karma, yagnya, shakti, varna, jati, moksh, loka, daana, itihaasa, purana etc.) and importance of using the proper terminology. Terms such as praja, Janata, loktantra, prajatantra, ganatantra, swarajya, Suraiya, rashtra, desh	**15 L**
II	**Introduction to Vedic Mathematics**: 1.**Introduction to vedic Mathematics:** Historical background, significance, and applications of Vedic Mathematics. **2.Sutras (Aphorisms):** Study of the fundamental Sutras (aphorisms) of Vedic Mathematics, such as Ekadhikena Purvena, Nikhilam Navatashcaramam Dashatah, Urdhva-Tiryakbhyam, etc. **3.Basic Operations**: Vedic techniques for performing basic arithmetic operations, including addition, subtraction, multiplication, and division. **4.Digit Sum Method**: The concept of digit sums and its applications in Vedic Mathematics.	**15 L**

	5.Special Multiplication Techniques: Methods for multiplying numbers, such as "Vertically and Crosswise" technique, "All from 9 and the last from 10" technique, and "Nikhilam" multiplication technique. **Square Roots and Cube Roots**: Techniques for finding square roots and cube roots of numbers using Vedic Mathematics. **Divisibility Tests**: Divisibility tests for numbers based on Vedic principles. **7. Quadratic Equations**: Vedic methods for solving quadratic equations, including the Sutra "By One More than the One Before." **8. Fraction Calculations**: Techniques for working with fractions, including addition, subtraction, multiplication, and division. **9. Time and Distance Problems**: Vedic Mathematics approach to solving problems related to time, speed, and distance. **10. Algebraic Equations:** Methods for solving algebraic equations using Vedic Mathematics principles. **11. Special Number Series:** Techniques for handling special number series, such as Fibonacci series and other sequences.	

Ref Books:

1.Vedic Mathematics by Swami Bharati Krishna Tirtha

2.The Magic of Vedic Mathematics: For All Ages by Dilip Kumar M.

3. Vedic Mathematics Made Easy by Dhaval Bathia

4. Vedic Mathematics Secrets by Kenneth Williams

5. Speed Mathematics Simplified (Dover Books on Mathematics) by Edward Stoddard

6. Vedic Mathematics for Schools (Book 1) by James T. Glover

7. Vedic Mathematics: The Ancient Art of Superfast Calculations. by Sumita Bose

8. Vedic Mathematics: A Fuzzy and Neutrosophic Analysis" by W. B. Vasantha Kandasamy, Florentin Smarandache, K. Kandasamy

9. The Cosmic Calculator: A Vedic Mathematics Course for Schools ,by Kenneth R. Williams

Video links:

1. https://youtube.be/Qzam3vEnD-8
2. https://youtu.be/7RoeiiBjGDg

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Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)

with effect from academic year 2023-24

Program: B.Sc.			Sem 1	
Course: Financial Mathematics I			Course code: BH.USMT.OE.101	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assessment	End sem exam
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PROGRAM OUTCOMES

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PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
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PSO-2	To calculate EMI, Present, Future value of Money
PSO-3	To operate addition, substractions, multiplication of two matrices
PSO-4	To solve system of equations using algebra of Matrices
PSO-5	To identify different types of Matrices based on their characteristics
PSO-6	Identify, Compute and correlate all mathematical functions and its types based on their graphs

Category: OE (credit 3+1) **Course Code: BH.USMT.OE.101**

Financial Mathematics-I

ABSTRACT

Financial Mathematics is a specialized field that combines principles of mathematics, statistics, and finance to analyse and solve complex financial problems. Financial Mathematics plays a crucial role in various areas of the financial industry, including investment banking, insurance, asset management, risk analysis, and quantitative trading. By utilizing mathematical tools, formulas, and algorithms,

The course in Financial Mathematics provides a solid foundation for understanding the mathematical principles and quantitative techniques that underpin financial decision-making. It offers a unique blend of mathematical rigor, financial theory, and practical application, making it an ideal choice for individuals seeking a career in finance or looking to enhance their analytical skills in the financial industry.

Syllabus: Financial Mathematics-I SEM I

UNIT	Title of unit and Contents	
1	**Quantitative Concepts:** What is interest? Simple and Compound interest, Nominal and Effective rate of interest, Concept and Calculations of Equated Monthly Instalments EMI, Time, Present and Future Value of Money, Applications of Time Value of Money, Impact of time and discount rate on present and future values, Relationship between net present value and financial investment, Applications of time value of money	**15 L**
II	**The Matrix Algebra**: The role of linear algebra, Definitions, addition and subtraction of matrices, scalar multiplication, vector multiplication, multiplication of matrices, commutative, associative and distributive laws in matrix algebra, Identity and Null matrices, matrix expression of a system of linear equations, row operations, augmented matrix, Gaussian method of solving linear equations.	**15 L**
III	**Basic Concepts in Calculus**: Exponents, Polynomials, Factoring, Completing the square, Functions, Graphs, Slopes and Intercepts, Graphs of Non-linear Functions, Exponential and logarithmic functions, properties of exponents and logarithms, solving natural exponential and logarithmic functions	**15 L**

Learning Resources: 1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series 2. Frank Ayres, Mathematics of Finance, Schaum's Outline Series

Resolution No.: AC/

Bharatiya Vidya Bhavan's
M. M. College of Arts, N.M. Institute of Science,
H.R.J. College of Commerce. (Bhavan's College)
Autonomous
(Affiliated to University of Mumbai)

Syllabus for: F.Y.B.Sc. Mathematics
Program: B.Sc.

Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)
with effect from academic year 2023-24

Program: B.Sc.			Sem 2	
Course: Algorithms for Programming			Course code: BH.USMT.VSEC.201	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assesment	End sem exam
3	1	3+1	40	60

PROGRAM OUTCOMES

	Description
PO	A student completing Bachelor's Degree in Science will be able to:
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
PO-4	Progress on Critical thinking, improve analytical power. Through Practical sessions grow on interpretation and documentation abilities.
PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Introduce students to the fundamental concepts and importance of algorithms in computer science and mathematics
PSO-2	Develop students' algorithmic thinking and problem-solving skills
PSO-3	Familiarize students with common algorithmic techniques and their applications
PSO-4	Enable students to analyse the efficiency of algorithms using time and space complexity analysis
PSO-5	Provide practical experience in implementing algorithms and solving computational problems
PSO-6	Prepare students for advanced courses in algorithms and data structures

SEMESTER II

Category: VSEC (credit 3+1) **Course Code:BH.USMT.VSEC.201**

CourseTitle: Algorithms for Programming

FYBSc

Course Description: The course "Introduction to Algorithms" is designed to provide students with a solid foundation in understanding and analyzing algorithms. The course aims to introduce students to various algorithmic techniques and problem-solving strategies. Students will learn how to analyze algorithm efficiency, measure time and space complexity, and gain hands-on experience in implementing algorithms. The course will cover topics such as algorithmic thinking, data structures, searching, sorting, and basic graph algorithms.

Course Outline:

UNIT	Title of unit and Contents	
1	**Introduction to Algorithms:** Importance of algorithms in problem-solving and computer science. Algorithm representation and analysis: time complexity, space complexity, and big-O notation. Strategies for algorithm design: brute force, divide and conquer, greedy, and dynamic programming. Introduction to algorithm analysis and correctness.	**15 L**
II	**Data Structures:** Introduction to common data structures: arrays, linked lists, stacks, and queues. Understanding the operations and properties of data structures. Choosing appropriate data structures for different problem scenarios. Implementing and manipulating data structures in code.	**15 L**
III	**UNIT 3: Searching and Sorting Algorithms:** Linear search and binary search algorithms. Analysis of searching algorithms: time complexity and efficiency. Searching in sorted and unsorted arrays. Applications of searching algorithms in various contexts. Bubble sort, insertion sort, and selection sort algorithms. Analysis of sorting algorithms: time complexity and efficiency. Comparison-based sorting algorithms: merge sort and quicksort. Non-comparison-based sorting algorithms: counting sort and radix sort.	**15 L**

List of practicals:

1. Algorithm representation in problems solving

2. arrays, linked lists, stacks, and queues

3. Understanding the operations and properties of data structures

4. Linear search and binary search algorithms

5. Searching in sorted and unsorted arrays

6. Bubble sort, insertion sort, and selection sort algorithm.

7. Merge sort and quicksort.

Assessment:

Assignments: Regular problem-solving assignments and algorithm analysis tasks. (30%)

Programming Exercises: Hands-on implementation of algorithms in a suitable programming language. (40%)

Final Examination: Comprehensive examination covering all topics taught during the course. (30%)

Recommended Resources:

"Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Online resources, tutorials, and algorithm visualization tools.

Programming languages and environments suitable for algorithm implementation (e.g., Python, C++)

List of Practicals:

1. Finding the roots of equations, including the bisection method, Newton-Raphson method.

2.Finding the roots of equations Secant method

3. Newton's divided difference interpolation

9. Langrange's interpolation , and spline interpolation.
10. Forward difference, backward difference, and central difference formulas
11. Numerical integration by trapezoidal rule and Simpson's rule.
12. Solving systems of linear equations using Gaussian elimination, LU decomposition, and Gauss-Seidel iteration method
13. Power method and Jacobi method for computing eigenvalues.

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Choice Based Credit System (CBCS)

with effect from academic year 2023-24

Program: B.Sc.			Sem 2	
Course: Introduction to PL/SQL			Course code: BH.USMT.VEC.201	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assesment	End sem exam
2		2	40	60

PROGRAM OUTCOMES

	Description
PO	**A student completing Bachelor's Degree in Science will be able to:**
PO-1	Develop sound concepts and principles of science.
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PO-3	Develop good observatories assistances and thus can make a good career in the field of Research and development.
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PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Introduce students to the fundamentals of PL/SQL programming language.
PSO-2	Enable students to write PL/SQL code to create and manipulate database objects.
PSO-3	Develop students' skills in designing and implementing stored procedures, functions, and triggers.
PSO-4	Enhance students' ability to manage and manipulate data using SQL statements within PL/SQL.
PSO-5	Provide hands-on experience in writing PL/SQL programs and executing them on a database server.
PSO-6	Foster problem-solving and critical thinking skills in the context of database programming.

SEMESTER II

Category: VEC (Credit 2) **Course Code:BH.USMT.VEC.201**

Course Title: Introduction to PL/SQL

ABSTRACT

The course "Introduction to PL/SQL" is designed to provide students with a foundation in programming using PL/SQL (Procedural Language/Structured Query Language). PL/SQL is a procedural language extension to SQL that is widely used for developing database applications. The course aims to develop students' skills in writing PL/SQL code, designing and implementing database procedures, functions, and triggers, and managing data using SQL statements within PL/SQL programs.

Course Outline:

UNIT	Title of unit and Contents	
1	**PL/SQL Language Basics** PL/SQL block structure and syntax. Declaring variables and data types in PL/SQL. Writing control structures (conditional statements and loops) in PL/SQL. Handling exceptions and error handling in PL/SQL.	**15 L**
II	**PL/SQL Procedures and Functions** Creating and executing PL/SQL procedures and functions. Passing parameters to procedures and functions. Returning values from functions. Overloading procedures and functions. **PL/SQL Cursors** Working with cursors in PL/SQL. Declaring, opening, fetching, and closing cursors. Using explicit and implicit cursors. Cursor attributes and cursor loops.	**15 L**
III	**PL/SQL Triggers** Understanding triggers and their types. Creating and managing triggers in PL/SQL. Trigger timing and triggering events. Triggers for enforcing data integrity and implementing business rules. **Managing Data in PL/SQL** Inserting, updating, and deleting data using PL/SQL. Using DML (Data Manipulation Language) statements within PL/SQL. Retrieving data using queries within PL/SQL. Bulk processing techniques and performance considerations. Assessment: Assignments: Regular programming assignments and problem-solving tasks. (30%) Laboratory Exercises: Practical exercises to write and execute PL/SQL code. (40%) Final Examination: Comprehensive examination covering all topics taught during the course. (30%) Recommended Resources: "Oracle PL/SQL Programming" by Steven Feuerstein and Bill Pribyl. "Oracle Database PL/SQL Language Reference" (Oracle documentation). Online tutorials and resources provided by Oracle and other reputable sources.	**15 L**

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Program Code: BH. BSc

Course Code: BH. USMT

Choice Based Credit System (CBCS)

with effect from academic year 2023-24

Program: B.Sc.			Sem 1	
Course: Financial Mathematics I			Course code: BH.USMT.OE.101	
Teaching scheme			Evaluation scheme	
Lecture (periods per week)	Practical (per week)	Credit (theory+practical)	Continuous Internal Assessment	End sem exam
3	1	3+1	40	60

PROGRAM OUTCOMES

	Description
PO	**A student completing Bachelor's Degree in Science will be able to:**
PO-1	Develop sound concepts and principles of science.
PO-2	Grow on skills of inquisitiveness and find answers for many questions
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PO-5	Through Self-study exercises Explore the developments on the national & International fronts.
PO-6	Practical sessions develop independent thinking, problem solving, work cohesively in teams

PROGRAM SPECIFIC OUTCOMES

PSO	Description
	A student completing Bachelor's Degree Science with the subject of Mathematics will be able to:
PSO-1	Calculate limit of function and able to test whether function continuous or not, differentiable or not
PSO-2	Find derivative and its problems based on economics
PSO-3	Find nature of curve increasing and decreasing in domain ,Marginal concept
PSO-4	Find relationship among Marginal and Average concepts
PSO-5	Solve indefinite integral, integral with boundary conditions
PSO-6	To find integration using proper methods and solve problems in economic domain.

SEMESTER- II (Open Elective)

Category: OE (credit 3+1) **Course Code:BH.USMT.OE.201**

CourseTitle: Financial Mathematics-II

UNIT	Title of unit and Contents	
1	**The Derivatives and the Rule of Differentiations :**Limit, Continuity, The slope of curve linear functions, Derivative, Differentiability and Continuity, Rules of Differentiation, Higher order derivatives, Implicit Differentiation.	**15 L**
II	**Use of Derivatives in Mathematics and Economics:** Increasing and Decreasing functions, Concavity and Convexity, Relative extrema, Inflection points, Curve Sketching, Optimization of Functions, Marginal concepts, Optimizing economic functions, Free elasticity of demand and supply, Relationship among total, Marginal and Average concepts.	**15 L**
III	**Integral Calculus**: The Indefinite Integral, Integration, Rules of integration, Initial conditions and boundary conditions, Integration by substitution, Integration by parts, Economic applications	**15 L**

Learning Resources: 1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series 2. Frank Ayres, Mathematics of Finance, Schaum's Outline Series

List of Practicals :

Sem I Financial Mathematics -I

1. problems based on interest, compound interest,EMI

2, Problems based on value of money ,time value of Money

3.Problems based on relationship between net present value and financial investment, Applications of time value of money.

4. , Problems based on Addition , subtraction of matrices, scalar multiplication, vector multiplication,

5. Problems based on commutative, associative and distributive laws in matrix algebra, Identity and Null matrices, matrix.

6. . Problems based on matrix expression of a system of linear equations, row operations, augmented matrix, Gaussian method of solving linear equations.

7. Problems based on Exponents, Polynomials, Factoring, Completing the square, Functions , Graphs, Slopes and Intercepts

8. , Problems based on Exponential and logarithmic functions, properties of exponents and logarithms , solving natural exponential and logarithmic functions

List of Practicals:

Sem II Financial Mathematics -II

1. Limit, Continuity
2. Finding derivatives of functions
3. Applications of derivatives -I
4. Applications of Derivative-II
5. Curve sketchings
6. Finding Integration of functions
7. Integration by Parts
8. Applications of Integrations.