AC –
Item No. –

As Per NEP 2020

University of Mumbai

Syllabus for Minor (Scheme III) Vertical 2	
Faculty of Science & Technology	
Board of Studies in Mathematics	
Third Year Programme in Minor (Specify Subject)	
Semester	V
Title of Paper	Numerical Methods OR Basics of Mathematics in Real Life – IV
Semester	VI
Title of Paper	---
Credits	---
From the Academic Year	2026-27

Sem. - V

Syllabus
B.Sc. (Mathematics)(Minor)
(Sem.- V)

Name of the Course: Numerical Method – I

Sr. No.	Heading	Particulars
1	**Description of the course :**	The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to solve. The increasing importance of numerical methods in applied sciences has led to a growing demand for courses dealing with the techniques of numerical analysis. This course aims to equip students with practical skills and mathematical tools for solving transcendental and polynomial equations, as well as systems of linear algebraic equations, using different numerical methods.
2	**Vertical :**	Minor
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives (CO):** This course provides a thorough examination of methods for solving transcendental and polynomial equations, as well as systems of linear algebraic equations. By the end of the course, students gain a strong understanding of various numerical methods and how to implement them through programming. **CO1:** To understand iteration methods based on first/second-degree equations and different approaches to solving systems of linear algebraic equations. **CO2:** To introduce various numerical methods for solving transcendental equations using iterative techniques. **CO3:** To solve the system AX=B using iterative methods. **CO4:** To gain hands-on experience by coding examples that incorporate the methods learned.	
8	**Course Outcomes**: **After completion of the course, students will be able to:** **OC1:** remember iteration methods based on first/second degree equation and direct/iterative methods to solve AX=B. **OC2:** apply iteration methods based on first/second degree equation to find solution of equation and direct / iterative methods to solve AX=B. **OC3:** evaluate/find inverse of a matrix by direct methods learnt and solution of non-linear equations **OC4:** analyse iteration methods based on first/second degree equation and direct/ iterative methods to solve AX=B **OC5:** analyse rate of convergence of methods learnt	

9	**Modules**:-	
	Module 1: Transcendental and Polynomial Equations	
	1) Concept of simple and multiple roots. Direct and Iterative methods, use of intermediate value theorem and finding initial approximation of a root. 2) Iteration methods based on first degree equation: Regula-Falsi method, Secant method, Newton-Raphson method, Geometrical interpretation of these methods, General Iteration Method. Methods for multiple roots. 3) Iteration methods based on second degree equation: Chebyshev method, Multipoint iteration method, Muller method. 4) System of non-linear equations by Newton- Raphson method. Methods for complex roots. 5) Rate of convergence of Secant method, Regula-Falsi method, Newton-Raphson method, General Iteration Method, Chebyshev method and Muller method.	
	Module 2: System of Linear Algebraic Equations	
	1) Matrix representation of linear system of equations AX=B, positive definite matrix, Tri-diagonal matrix. 2) Direct methods: Gauss elimination method, Forward and backward substitution methods, Triangularization methods-Doolittle`s and Crout`s method (LU decomposition), LU decomposition to Tri-diagonal system, Cholesky's method. 3) Iteration methods: Jacobi iteration method, Gauss-Seidel iterative method, SOR method and their respective error formats. 4) Finding inverse of a matrix by LU decomposition, Cholesky's method and Partition method and hence solve AX=B by matrix inversion method.	
10	**Text Books** • M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). *Numerical Methods for Scientific and Engineering Computation* (6th edition). New Age International Publishers. • Madhumangal Pal (2009). Numerical Analysis for Scientists and Engineers (2nd Edition). Narosa Publishing House.	
11	**Reference Books** • P. Sivaramakrishna Das and C. Vijayakumari (2014). Numerical Analysis. Pearson. • Brian Bradie (2006), *A Friendly Introduction to Numerical Analysis.* Pearson. • C. F. Gerald & P. O. Wheatley (2008). *Applied Numerical Analysis* (7th edition), Pearson Education, India	
	Scheme of the Examination	
	The performance of the learners shall be evaluated into two parts. • Internal Continuous Assessment of 20 marks for each paper. • Semester End Examination of 30 marks for each paper. • Separate head of passing is required for internal and semester end examination.	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**

13 **Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

Sr No	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/ group presentation on any one topic related to the syllabus.	05

Paper pattern of the Test (Offline Mode with One hour duration):

Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1).

Q2: Attempt any 2 from 3 Descriptive questions. (06 marks: 2 × 3)

14 **Format of Question Paper:**

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Note: Attempt any TWO questions out of THREE.			
Q.No.1	Module 1 and 2	Attempt any **THREE** out of **FOUR**. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.2	Module 1 and 2	Attempt any **THREE** out of **FOUR**. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (a) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any **THREE** out of **FOUR**. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

Syllabus
B.Sc. (Mathematics)(Minor)
(Sem.- V)

Name of the Course: Basics of Mathematics in Real Life – IV

Sr. No.	Heading	Particulars
1	**Description of the course :**	This course gives introduction to natural numbers, integers, rational numbers, real numbers and complex numbers in detail. Basic concepts like primes and congruences are introduced.
2	**Vertical :**	Minor
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives (CO):** This course gives introduction to basic concepts of mathematics, highlighting practical aspects with concrete examples. In this course, students from various science streams will recognize the importance of mathematics and learn. CO1: To develop the notions of limits and continuity CO2: To identify the properties of congruences CO3: To associate diagrams based on equalities and inequalities of complex numbers CO4: To recognize various properties of functions and their use in basic counting	
8	**Course Outcomes (OC):** At the end of the course, the students will be able to OC1: Understand and remember basic concepts of numbers, sets, functions, sequences, and counting principles. OC2: Apply mathematical techniques to solve routine and real-life problems. OC3: Analyze patterns, relationships, and structures in numbers, functions, and sequences. OC4: Justify/check mathematical results using logical reasoning and proof methods. OC5: Construct simple mathematical models, proofs, and examples for real-life situations.	
9	**Modules**:-	
	Module 1: Basics of integers, real numbers and complex numbers (15 Hours)	
	1. Natural numbers, Integers, Rational numbers and Irrational numbers 2. Introduction to induction in natural numbers via proofs of sums of first n natural numbers and sums of squares and cubes of the first n natural numbers. 3. Further applications of induction through problem solving. 4. Operations on integers and rational numbers like addition, multiplication and subtraction. Equivalence of two rational numbers. 5. Divisibility in integers and basic properties of divisibility 6. Definition of prime numbers and statement of fundamental theorem of arithmetic (without proof). 7. Greatest common divisor, least common multiple and relation to the product of numbers, Euclid's algorithm (without proof) 8. Infinitude of primes (with proof) and existence of irrational numbers (Square-root two is irrational with proof). 9. Congruences and their basic properties like solution of linear congruence 10. Real number line and properties of real numbers.	

	11. Order on real numbers and relation to the operation on real numbers. 12. Definition of a complex number and visualization in the plane. Plotting of complex numbers. 13. Operations on complex numbers like addition and multiplication and polar form of complex numbers. DeMoivre's theorem and its proof via induction. 14. Plotting of regions in the complex plane defined by equalities and inequalities. 15. Definition of a sequence and examples of sequences of natural numbers, integers and real numbers and analyzing the behaviour of sequences pictorially and introduction to the idea of convergence.
	Module 2: Introduction to basic counting and basics of functions (15 Hours)
	1. Permutations and combinations of distinct objects. 2. Examples based on permutations: digits, license plates etc. 3. Examples based on combinations: digits, bit strings etc. 4. Addition and multiplication principles for counting and illustrations 5. Permutations with repetitions (only formula) and examples 6. Combinations with repetitions (only formula) and examples 7. De Morgan's laws for sets and introduction to functions between sets 8. Injective and surjective functions 9. Bijective functions, examples and their properties 10. Inverse images of sets and their properties 11. Limit of a function at a point 12. Properties of limits: uniqueness (with proof) 13. Computations of limits in various examples 14. Definition and examples of continuous functions 15. Properties of continuous functions: sums, products and ratios
10	**Text Books:** 1) Burton, D. M/. Elementary Number Theory, McGraw Hill Education 2) Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.
11	**Reference Books:** 1) Niven, Ivan, Zuckerman H. S., Montgomery, H. L., An Introduction to the theory of numbers, Wiley, 1972. 2) Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.
	<u>Scheme of the Examination</u>
	The performance of the learners shall be evaluated in two parts. • Internal Continuous Assessment of 20 marks. • Semester End Examination of 30 marks. • A separate head of passing is required for internal and semester-end examinations.
12	**Internal Continuous Assessment: 40%** | **External, Semester End Examination 60% Individual Passing in Internal and External Examination**

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Q.No.2	Module 1 and 2	Attempt any **THREE** out of **FOUR**. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (b) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any **THREE** out of **FOUR**. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

Sign of the BOS Chairman
Name of the Chairman
BOS in Mathematics

Sign of the Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology