

B.O.S. Date: 07/04/2025

Item No.: 02

Academic Council Date: 28/04/2025

Item No.: 05



Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Re-accredited A++ Grade by NAAC (Fourth Cycle-CGPA-3.52)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

As per National Education Policy - 2020

B. Sc. in Mathematics

(Faculty of Science)

Syllabus for S.Y. B. Sc. (Mathematics)

Semester III and IV

(With effect from the academic year 2025-26)





Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

As per National Education Policy - 2020

| Sr. No. | Heading | Particulars |
|---------|--------------------------------------|-------------------------|
| 1 | Title of program | Mathematics |
| 2 | Eligibility | F.Y.B.Sc. (Mathematics) |
| 3 | Duration of program | 3 Years |
| 4 | Intake Capacity | |
| 5 | Scheme of Examination | 30:20 |
| 6 | Standards of Passing | 40% |
| 7 | Semesters | Two |
| 8 | Program Academic Level | |
| 9 | Pattern | Semester (30:20) |
| 10 | Status | Revised |
| 11 | To be implemented from Academic Year | Academic Year 2025-26 |

Prof. (Dr.) S. I. Unhale
Head, Department of Mathematics
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Janardan Bhagat Shikshan Prasarak Sanstha's
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Arts, Commerce and Science College, New Panvel (Autonomous)

Preamble

1) Introduction

Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Many of the developments and decisions made in our community rely to an extent on the use of mathematics. Besides foundation skills and knowledge in mathematics for all citizen in the society, it is important to widen mathematical experience for those who are mathematically inclined.

2) Aims and Objectives

1. Giving students sufficient knowledge of fundamental principles, methods and a clear perception of boundless power of mathematical ideas and tools and know how to use them by analysing, modeling, solving and interpreting.
2. Reflecting on the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science
3. Enhancing students overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment
4. A student should get adequate exposure to global and local concerns by looking at many aspects of mathematical Sciences

3) Learning Outcomes

1. Students knowledge and skills will get enhanced and they will get confidence and interest in mathematics, so that they can master mathematics effectively and will be able to formulate and solve problems from mathematical perspective.
2. Students thinking ability and attitude will change towards learning mathematics and practicals will improve their logical and analytical thinking.

4) Credit Structure of the S.Y.B. Sc. (Mathematics) Semester III and IV
Semester III

Under New Education Policy (NEP) 2020

| Course | Course Type | Course code | Hrs/ week | Internal assessment | Semester- end examination | Total | Credits |
|---------------------------|-------------|-------------|-----------|---------------------|---------------------------|-------|---------|
| Calculus II | Major | USC3MT3 | 2 | 20 | 30 | 50 | 2 |
| Linear Algebra-I | Major | USC3MT4 | 2 | 20 | 30 | 50 | 2 |
| Mathematics Practical-III | Major | USC3MTP | 4 | -- | 100 | 100 | 2 |
| IKS in Mathematics | IKS | USC3MT5 | 2 | 20 | 30 | | 2 |

Semester IV

Under New Education Policy (NEP) 2020

| Course | Course Type | Course code | Hrs/ week | Internal assessment | Semester- end examination | Total | Credits |
|--------------------------|-------------|-------------|-----------|---------------------|---------------------------|-------|---------|
| Multivariable Calculus | Major | USC4MT6 | 2 | 20 | 30 | 50 | 2 |
| Linear Algebra-II | Major | USC4MT7 | 2 | 20 | 30 | 50 | 2 |
| Mathematics Practical-IV | Major | USC4MTP | 4 | -- | 100 | 100 | 2 |
| Real Analysis | Major | USC4MT8 | 2 | 20 | 30 | 50 | 2 |

Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course



Program Outcomes (POs)

| PO No. | POs Statement | Knowledge and Skill |
|--------|--|-----------------------------|
| | After completing the Bachelor of Science Program, students will be able to- | |
| PO-1 | The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest. | Disciplinary knowledge |
| PO-2 | An ability to develop and conduct experiments, analyze, and interpret data and use scientific judgment to draw conclusions. | Scientific reasoning |
| PO-3 | An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information. | Digital literacy |
| PO-4 | Innovative, professional, and entrepreneurial skills needed in various disciplines of science. | Life-long learning |
| PO-5 | An ability to achieve high order communication skills. | Communication skills |
| PO-6 | An ability to collect, analyze and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches. | Problem solving |
| PO-7 | A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real- world settings. | Reflective thinking |
| PO-8 | An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges. | Life-long learning |
| PO-9 | A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes. | Teamwork |
| PO-10 | An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | Leadership |
| PO-11 | An ability to understanding values, ethics, and morality in a multidisciplinary context. | Moral and ethical awareness |



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Syllabus for S.Y. B. Sc. (Mathematics) Semester III and IV
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Structure

Semester III

Paper I: Calculus-II

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|---|--------|------------------|
| USC3MT3 | Unit I | Infinite Series | 02 | 02 |
| | Unit II | Limit, Continuity and Differentiability | | |

Paper II: Linear Algebra-I

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|---|--------|------------------|
| USC3MT4 | Unit I | Vector spaces over \mathbb{R} | 02 | 02 |
| | Unit II | Linear Transformations, Matrices and Determinants | | |

Paper III: Indian Knowledge System in Mathematics

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|--|--------|------------------|
| UIKS3MT5 | Unit I | Contribution of Indian Mathematicians, High Speed Addition and Subtraction | 02 | 02 |
| | Unit II | Miracle Multiplication and Excellent Division | | |

Mathematics Practical-III

| Course Code | Part | Paper | Credit | Lecture per Week |
|-------------|------|---------|--------|------------------|
| USC3MTP | A | USC3MT3 | 02 | 04 |
| | B | USC3MT4 | | |



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Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2025-2026)

Course Structure

Semester IV

Paper I: Multivariable Calculus

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|----------------------------------|--------|------------------|
| USC4MT6 | Unit I | Functions of several variables | 02 | 02 |
| | Unit II | Differentiation and Applications | | |

Paper II: Linear Algebra-II

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|--|--------|------------------|
| USC4MT7 | Unit I | Inner Product Spaces | 02 | 02 |
| | Unit II | Eigenvalues, Eigenvectors and Diagonalizable | | |

Paper III: Real Analysis

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|-----------------------------------|--------|------------------|
| USC4MT8 | Unit I | Riemann Integration | 02 | 02 |
| | Unit II | Indefinite and Improper Integrals | | |

Mathematics Practical-IV

| Course Code | Part | Paper | Credit | Lecture per Week |
|-------------|------|---------|--------|------------------|
| USC4MTP | A | USC4MT6 | 02 | 04 |
| | B | USC4MT7 | | |



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Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code : USC3MT3

Course Title : Calculus II

Course Type: Major

No. of Credits: 2 + 1

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|---|
| | After completing the course, Student will be able to: |
| CO-1 | evaluate convergence of series |
| CO-2 | evaluate limit of a function |
| CO-3 | examine continuity of a function |
| CO-4 | identify the differentiable function. |

Syllabus for S.Y.B. Sc. (Mathematics) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : USC3MT3

Course Title : Calculus-II

Unit I : Infinite Series

(15 Lectures)

1. Infinite series in real numbers. The sequence of partial terms of an infinite series, convergence and divergence of series, sum, difference and multiple of convergent series are again convergent.
2. Cauchy criterion of convergence of series. Absolute convergence of a series, Geometric series.
3. Alternating series, Leibnitz Theorem, Conditional convergence, an absolutely convergent series is conditionally convergent, but the converse is not true.
4. Rearrangement of series (without proof), Cauchy condensation test (statement only), application to convergence of p-series $\sum \frac{1}{n^p}$ ($p > 1$), Divergence of Harmonic series $\sum \frac{1}{n}$.
5. Tests for absolute convergence. Comparison test, Ratio test, Root test.
6. Power series, Radius of convergence of power series, The exponential, sine and cosine series.
7. Fourier series, Computing Fourier Coefficients of simple functions such as x , x^2 , $|x|$, piecewise continuous functions on $[-\pi, \pi]$

Unit II: Limit, Continuity and Differentiability

(15 Lectures)

1. Definition of Limit of a function, evaluation of limit of simple functions using the $\epsilon - \delta$ definition, uniqueness of limit if it exists, algebra of limits, limits of composite function, sandwich theorem, left-hand-limit, Right hand limit.
2. Continuous functions: Continuity of a real valued function on a set-in term of limits, examples, Continuity of a real valued function at end points of domain, Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.
3. Differentiation of real valued function of one variable: Definition of differentiation at a point of an open interval, examples of differentiable and non-differentiable functions, differentiable functions are continuous but not conversely, chain rule.
5. Higher order derivatives, Leibnitz rule, Derivative of inverse functions, Implicit differentiation (only examples)

Reference Books:

1. Robert G. Bartle and Donald R. Sherbet: Introduction to Real Analysis, Springer Verlag.
2. R. R. Goldberg: Methods of Real Analysis, Oxford and IBH Publication Company, New Delhi.
3. T. Apostol: Calculus Vol I, Second Edition, John Wiley. John Wiley.
4. Thomas Finney, Calculus, ninth edition section 5.1, 5.2, 5.3, 5.4, 5.5, 5.6.
5. Ajit Kumar, S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
6. K. Stewart, Calculus, Booke/Cole Publishing Co, 1994.
7. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic multivariable calculus.



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Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B. Sc. (Mathematics) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code : USC3MT4

Course Title : Linear Algebra-I

Course Type: Major

No. of Credits: 2 + 1

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|---|
| | After completing the course, Student will be able to: |
| CO-1 | define vector spaces and subspaces |
| CO-2 | relate Matrices and linear transformations |
| CO-3 | find basis and dimension of a vector space over \mathbb{R} |
| CO-4 | evaluate the determinant |

Syllabus for S.Y.B. Sc. (Mathematics) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: USC3MT4

Course Title: Linear Algebra-I

Unit I : Vector Spaces over \mathbb{R}

(15 Lectures)

1. Definition of a Vector Spaces over \mathbb{R} and examples.
2. Subspaces - definition and examples.
3. The sum and intersection of subspaces, direct sum of vector spaces.
4. Linear combination of vectors, linear span of a subset of a vector space.
5. Linear dependence and independence of a set.
6. Basis of a vector space, basis as a maximal linearly independent set and a minimal set of generators. Dimension of a vector space.

Unit II: Linear Transformations, Matrices and Determinants

(15 Lectures)

1. Linear transformations: definition, properties and examples, Kernel and image of a linear transformation, Rank-Nullity theorem (with proof), Linear isomorphisms, inverse of a linear isomorphism, Matrix representation of a linear transformation.
2. The matrix units and elementary matrices.
3. Row space, column space of an $m \times n$ matrix, row rank and column rank of a matrix.
4. Equivalence of rank of an $m \times n$ matrix A and rank of the linear transformation $L_A: \mathbb{R}^n \rightarrow \mathbb{R}^m$ ($L_A(A) = AX$). The dimension of solution space of the system of linear equations $AX = 0$ equals $n - \text{rank}(A)$.
5. The solutions of non-homogeneous systems of linear equations represented by $AX = B$ and the general solution of the homogeneous system.
6. Existence and uniqueness of determinant function via permutations. Laplace expansion of a determinant, Vandermonde determinant.
7. Linear dependence and independence of vectors in \mathbb{R}^n using determinants, The existence and uniqueness of the system $AX = B$, where A is an $n \times n$ matrix with $\det(A) \neq 0$.
8. Cofactors and minors of a matrix, Adjoint of an $n \times n$ matrix A .
9. Cramer's rule and examples. Determinant as area and volume.

Reference Books:

1. Serge Lang: Introduction to Linear Algebra, Springer Verlag.
2. S. Kumaresan: Linear Algebra A geometric approach, Prentice Hall of India Private Limited.
3. M. Artin: Algebra, Prentice Hall of India Private Limited.
4. K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw-Hill, New Delhi.
5. Gilbert Strang: Linear Algebra and its applications, International Student Edition.
6. L. Smith: Linear Algebra, Springer Verlag.
7. A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Tata McGrawHill, New Delhi.
8. T. Banchoff and J. Wermer: Linear Algebra through Geometry, Springer Verlag Newyork, 198
9. Sheldon Axler : Linear Algebra done right, Springer Verlag, Newyork.
10. Klaus Janich : Linear Algebra.
11. Otto Bretcher: Linear Algebra with Applications, Pearson Education.
12. Gareth Williams: Linear Algebra with Applications, Narosa Publication.

Syllabus for S.Y.B. Sc. (Mathematics) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
Course Code: UIKS3MT5
Course Title: Indian Knowledge System in Mathematics

Unit I: Contribution of Indian Mathematicians, High Speed Addition and Subtraction
(15 Lectures)

1. Varahmihir, Aryabhata, Srinivasa Ramanujan, Neelkanth Somayya, Bharti Krishna Tirtha
2. Vedic Maths: History of Vedic Maths and its Features
3. Vedic Maths formulae: Sutras and Upsutras
4. Addition in Vedic Maths: Without carrying, Dot Method
5. Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah (All from 9 last from 10)
6. Fraction -Addition and Subtraction

Unit II: Miracle Multiplication and Excellent Division
(15 Lectures)

1. Multiplication in Vedic Maths: Base Method (any two numbers upto three digits)
2. Multiplication by Urdhva Tiryak Sutra
3. Miracle multiplication: Any three-digit number by series of 1's and 9's
4. Division by Urdhva Tiryak Sutra (Vinculum method)
5. Squares of any two-digit numbers: Base method
6. Square of numbers ending in 5: Ekadhikena Purvena Sutra
7. Easy square roots: Dwandwa Yoga (duplex) Sutra
8. Square root of 2: Baudhayana Shulbasutra
9. Cubing: Yavadunam Sutra

Reference Books

1. Vedic Mathematics Made Easy, Dahaval Bathia, Jaico Publishing, New Delhi 2011
2. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi.
3. The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi 2019.
4. Learn Vedic Speed Mathematics Systematically, Chaitnaya A. Patil 2018.



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Syllabus for S.Y.B. Sc. (Mathematics) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2025-2026)

Course Code: USC3MTP

Course Title: Mathematics Practical-III

Course Type: Major

No. of Credits: 2

Course Outcomes (Cos)

| CO No. | COs Statement |
|--------|--|
| | After completing the course, Student will be able to: |
| CO-1 | Find limit, continuity and Differentiability of a function |
| CO-2 | Explain properties of vector space, linear transformation and determinant |

Practical's for Calculus-II

1. Convergence of series
2. Comparison test, Ratio test, Root test
3. Limits of function and Sandwich theorem
4. Continuous and discontinuous functions.
5. Properties of continuous and differentiable functions
6. Higher order derivatives, Leibnitz theorem
7. Mean value theorems and its applications
8. Miscellaneous Theoretical Questions based on full paper

Practicals for Linear Algebra-I

1. Subspaces: Determine whether a given subset of a vector space is a subspace.
2. Linear dependence and independence of subsets of a vector space.
3. Rank-Nullity Theorem.
4. System of linear equations.
5. Determinant, calculating determinants of 2×2 matrices, $n \times n$ diagonal, upper triangular matrices using definition and laplace expansion.
6. Finding inverses of Finding inverses of $n \times n$ matrices using adjoint
7. Determinant, calculating determinants of 2×2 matrices, 3×3 matrices using adjoint.
8. Miscellaneous Theoretical Questions based on full paper



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Syllabus for S.Y.B. Sc. (Mathematics) Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code : USC4MT6

Course Title : Multivariable Calculus

Course Type: Major

No. of Credits: 2+ 1

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|---|
| | After completing the course, Student will be able to: |
| CO-1 | evaluate limit of a functions of several variables |
| CO-2 | examine continuity of a functions of several variables |
| CO-3 | identify the differentiable functions |
| CO-4 | apply multivariable calculus in optimization problems |

Syllabus for S.Y.B. Sc. (Mathematics) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : USC4MT6

Course Title: Multivariable Calculus

Unit I : Functions of several variables

(15 Lectures)

1. The Euclidean inner product on \mathbb{R}^n and Euclidean norm function on \mathbb{R}^n , distance between two points, open ball in \mathbb{R}^n , definition of an open subset of \mathbb{R}^n , neighborhood of a point in \mathbb{R}^n , sequences in \mathbb{R}^n , convergence of sequences-these concepts should be specially discussed for $n = 2$ and $n = 3$.
2. Functions from $\mathbb{R}^n \rightarrow \mathbb{R}$ (scalar fields) and from $\mathbb{R}^n \rightarrow \mathbb{R}^m$ (vector fields), limits, continuity of functions, basic results on limits and continuity of sum, difference, scalar multiples of vector fields, continuity and components of a vector fields.
3. Directional derivatives and partial derivatives of scalar fields.
4. Mean value theorem for derivatives of scalar fields.

Unit II: Differentiation and its applications

(15 Lectures)

1. Differentiability of a scalar field at a point of \mathbb{R}^n (in terms of linear transformation) and on an open subset of \mathbb{R}^n , the total derivative, uniqueness of total derivative of a differentiable function at a point, simple examples of finding total derivative of functions such as $f(x, y) = x^2 + y^2$, $f(x, y) = x + y + z$, differentiability at a point of a function f implies continuity and existence of directional derivatives of f at the point, the existence of continuous partial derivatives in a neighborhood of a point implies differentiability at the point.
2. Gradient of a scalar field, geometric properties of gradient, level sets and tangent planes.
3. Chain rule for scalar fields.
4. Second order partial derivatives, mixed partial derivatives, sufficient condition for equality of mixed partial derivative.
5. Second order Taylors formula for scalar fields.
6. Differentiability of vector fields, definition of differentiability of a vector field at a point, Jacobian matrix, differentiability of a vector field at a point implies continuity. The chain rule for derivative of vector fields (statements only).
7. Mean value inequality.
8. Second derivative test for extrema of functions of two variables.
9. Hessian matrix, Maxima, minima and saddle points of functions of two variables.
10. Method of Lagrange Multipliers.

Reference Books:

1. T. Apostol: Calculus, Vol. 2, John Wiley.
2. J. Stewart, Calculus, Brooke/ Cole Publishing Co.
3. G.B. Thoman and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley, 1998.
4. Sudhir R. Ghorpade and Balmohan V. Limaye, A Course in Multivariable Calculus and Analysis, Springer International Edition.
5. Howard Anton, Calculus- A new Horizon, Sixth Edition, John Wiley and Sons Inc, 1999.



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Syllabus for S.Y.B. Sc. (Mathematics) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2025-2026)

Course Code : USC4MT7

Course Title : Linear Algebra-II

Course Type: Major

No. of Credits: 2 + 1

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|--|
| | After completing the course, Student will be able to: |
| CO-1 | explain properties of inner product space. |
| CO-2 | determine orthogonality in inner product space. |
| CO-3 | find eigenvalues and eigenvectors. |
| CO-4 | identify diagonalizable matrix. |

Syllabus for S.Y.B. Sc. (Mathematics) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : USC4MT7

Course Title : Linear Algebra-II

Unit I: Inner Product Spaces (15 Lectures)

1. Dot product in \mathbb{R}^n , Definition of general inner product on a vector space over \mathbb{R} and examples
2. Norm of a vector in an inner product space. Cauchy-Schwarz inequality, Triangle inequality, Orthogonality of vectors, Pythagoras theorem and geometric applications in \mathbb{R}^2 , Projections on a line, The projection being the closest approximation, Orthogonal complements of a subspace, Orthogonal complements in \mathbb{R}^2 and \mathbb{R}^3 . Orthogonal sets and orthonormal sets in an inner product space, Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process, Simple examples in \mathbb{R}^3 , \mathbb{R}^4 .

Unit II: Eigenvalues, Eigenvectors and Diagonalizable (15 Lectures)

1. Eigenvalues and eigenvectors of a linear transformation $T : V \rightarrow V$, where V is a finite dimensional real vector space, Eigenvalues and eigenvectors of linear transformations examples.
2. The linear independence of eigenvectors corresponding to distinct eigenvalues of a linear transformation.
2. Eigenvalues and eigenvectors of $n \times n$ real matrices.
3. The characteristic polynomial of an $n \times n$ real matrix, characteristic roots.
4. Similar matrices, characteristic polynomials of similar matrices.
5. The characteristic polynomial of a linear transformation $T : V \rightarrow V$, where V is a finite dimensional real vector space.
6. Diagonalizability of an $n \times n$ real matrix and a linear transformation of a finite dimensional real vector space to itself. Definition: Geometric multiplicity and Algebraic multiplicity of eigenvalues of an $n \times n$ real matrix and of a linear transformation.
7. An $n \times n$ matrix A is diagonalisable if and only if \mathbb{R}^n has a basis of eigenvectors of A , if and only if the sum of dimension of Eigen spaces of A is n if and only if the algebraic and geometric multiplicities of eigenvalues of A coincide. Examples of non-diagonalizable matrices.
8. Orthogonal diagonalization and Quadratic Forms.
9. Orthogonal diagonalization of $n \times n$ real symmetric matrices.

Reference Books:

1. Serge Lang: Introduction to Linear Algebra, Springer Verlag.
2. S. Kumaresan: Linear Algebra A geometric approach, Prentice Hall of India Private Limited.
3. M. Artin: Algebra, Prentice Hall of India Private Limited.
4. K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw-Hill, New Delhi.
5. Gilbert Strang: Linear Algebra and its applications, International Student Edition.
6. L. Smith: Linear Algebra, Springer Verlag.
7. A. Ramachandra Rao and P. Bhima Sankaran: Linear Algebra, Tata McGrawHill, New Delhi.
8. T. Banchoff and J. Wermer: Linear Algebra through Geometry, Springer Verlag Newyork, 198
9. Sheldon Axler : Linear Algebra done right, Springer Verlag, Newyork.
10. Klaus Janich : Linear Algebra.
11. Otto Bretcher: Linear Algebra with Applications, Pearson Education.
12. Gareth Williams: Linear Algebra with Applications, Narosa Publication.



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Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B. Sc. (Mathematics) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2025-2026)

Course Code : USC4MT8

Course Title : Real Analysis

Course Type: Major

No. of Credits: 02+02

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|--|
| | After completing the course, Student will be able to: |
| CO-1 | <u>identify</u> Riemann integrability of functions |
| CO-2 | <u>define</u> Beta and Gamma functions |
| CO-3 | <u>examine</u> convergence of Improper and Indefinite Integrals |

Syllabus for S.Y.B. Sc. (Mathematics) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : USC4MT8

Course Title : Real Analysis

Unit I : Riemann Integration

(15 Lectures)

Approximation of area, Upper/Lower Riemann sums and properties, Upper/Lower integrals, Definition of Riemann integral on a closed and bounded interval, Criterion of Riemann integrability, if $a < c < b$, then $f \in R[a, b]$ if and only if $f \in R[a, c]$ and $f \in R[c, b]$ and $\int_a^b f = \int_a^c f + \int_c^b f$, Properties of Riemann integration

Unit II : Indefinite Integrals and Improper Integrals

(15 Lectures)

Continuity of $F(x) = \int_a^x f(t) dt$, where $f \in R[a, b]$, Fundamental theorem of calculus, Mean value theorem, Integration by parts, Leibnitz rule, Improper integrals type 1 and type 2, Absolute convergence of improper integrals, Comparison tests, Abels and Dirichlets tests (without proof). β and Γ functions and their properties, relationship between β and Γ functions (without proof).

Reference Books:

1. Robert G. Bartle and Donald R. Sherbet: Introduction to Real Analysis, Springer Verlag.
2. R. R. Goldberg: Methods of Real Analysis, Oxford and IBH Publication Company, New Delhi.
3. T. Apostol: Calculus Vol I, Second Edition, John Wiley. John Wiley.
4. Thomas Finney, Calculus, ninth edition section 5.1, 5.2, 5.3, 5.4, 5.5, 5.6.
5. Ajit Kumar, S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B. Sc. (Mathematics) Semester IV

Choice Based Credit System

Under New Education Policy (NEP) 2020

(To be implemented from the academic year 2025-2026)

Course Code: USC4MTP

Course Title: Mathematics Practical-IV

Course Type: Major

No. of Credits: 2

Course Outcomes (Cos)

| CO No. | COs Statement |
|--------|---|
| | After completing the course, Student will be able to: |
| CO-1 | Evaluate limit, continuity and differentiability of functions of several variables |
| CO-2 | Explain properties of inner product space, eigenvalues , eigenvectors and diagonalizable |

Practicals for Multivariable Calculus

- Sequences in \mathbb{R}^2 and \mathbb{R}^3 limits and continuity of scalar fields and vector fields, using definition and otherwise, iterated limits.
- Computing directional derivatives, partial derivatives and mean value theorem of scalar fields.
- Total derivative, gradient, level sets and tangent planes.
- Chain rule, higher order derivatives and mixed partial derivatives of scalar fields.
- Taylor's formula, differentiation of a vector field at a point, Hessian/Jacobian matrix, Mean Value Inequality.
- Finding maxima, minima and saddle points, second derivative test for extrema of functions of two variables and method of Lagrange multipliers.
- Miscellaneous Theoretical Questions based on full paper.

Practicals for Linear Algebra-II

- Inner Product Spaces, examples. Orthogonal complements in \mathbb{R}^2 and \mathbb{R}^3
- Gram-Schmidt method.
- Finding characteristic polynomial, eigenvalues of 2×2 and 3×3 matrices.
- Eigenvalues and eigenvectors of linear transformation.
- Diagonalization and orthogonal diagonalization.
- Orthogonal Diagonalization Forms
- Miscellaneous Theoretical Questions based on full paper

Scheme of Examination (Amended)

➤ For Major Courses (50 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

| Sr. No. | Particular | Marks |
|---------|--|----------|
| 01 | One periodical class test / online examination to be conducted in the given semester | 20 Marks |

Question Paper Pattern (Periodical Class Test)

Maximum Marks: 20

Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

| Question No. | Particular | Marks |
|--------------|--|----------|
| Q-1 | Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each) | 10 Marks |
| Q-2 | Answer in Brief (Attempt any Two of the Three) (5 Marks each) | 10 Marks |

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 2 hours duration.

Question Paper Pattern

| Theory question paper pattern |
|---|
| <ol style="list-style-type: none">1. There shall be three questions each of 10 marks.2. All questions shall be compulsory with internal options.3. Question may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit. |

- **Practical Examination (PE) for Major Courses 100 Marks**
Question Paper Pattern for Semester End Practical Examination

Section-I: Based on USC3MT1/USC4MT1

Section-II: Based on USC3MT2/USC4MT2

Maximum Marks: 80

Duration: 03 Hours

Section-I

Q.1 Objective Questions- Attempt any 8 out of 12 (08*03=24 M)

Q.2 Problems : Attempt any 2 out of 3 (08*02=16 M)

Section-II

Q.1 Objective Questions- Attempt any 8 out of 12 (08*03=24 M)

Q.2 Problems : Attempt any 2 out of 3 (08*02=16 M)

For each course 1) Journal-10 M (05 Marks for each Journal)

2) Viva- 10 M (05 Marks for each Course)

➤ **Passing Standard**

- **Major Courses:** The learners shall obtain minimum of 40% marks (i.e. 08 out of 20) in the Continuous Internal Assessment (CIA) and 40% marks in Semester End Examination (SEE) (i.e. 12 out of 30) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Continuous Internal Assessment (CIA) and Semester End Examination (SEE).
- **For Practical Examinations (PE):** The learners shall obtain minimum of 40% marks (i.e. 40 out of 100) in Practical Examination (PE), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.

Note: As per previous ordinance there will not be any internal examination for practical.

➤ **Eligibility Condition to appear for Additional Examination of any Semester**
(Applicable only for Regular Semester End Examinations)

A learner who remains absent in some or all the subjects on medical grounds or for representing the College or University in NSS, NCC, Sports, Cultural Activities or co-curricular/extracurricular/extension activities with prior permission of the Principal or Head of the institute reported to the examination section, by producing necessary documents and testimonials, will be allowed to appear for the Additional Semester End Examination (ASEE). This is not applicable for any A.T.K.T. / Supplementary Examinations.

➤ **Supplementary Examination (SE)**

The college will conduct supplementary examinations for semester II, IV, and VI after the declaration of their respective results.

B.O.S. Date: 07/04/2025

Item No.: 03

Academic Council Date: 28/04/2025

Item No.: 05



Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai



As per National Education Policy - 2020

S.Y.B. Sc. Mathematics

(Faculty of Science)

Syllabus for S.Y. B. Sc. Mathematics: Minor Course

Semester III and IV

(With effect from the academic year 2025-26)





Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

As per National Education Policy - 2020

| Sr. No. | Heading | Particulars |
|---------|--------------------------------------|---------------------------------------|
| 1 | Title of program | S.Y. B. Sc. Mathematics: Minor Course |
| 2 | Eligibility | F.Y.B.Sc. |
| 3 | Duration of program | 3 Years |
| 4 | Intake Capacity | |
| 5 | Scheme of Examination | 30:20 |
| 6 | Standards of Passing | 40% |
| 7 | Semesters | Two |
| 8 | Program Academic Level | |
| 9 | Pattern | Semester (30:20) |
| 10 | Status | Revised |
| 11 | To be implemented from Academic Year | Academic Year 2025-26 |

Prof. (Dr.) S. I. Unhale
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(Autonomous)





Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Preamble

1) Introduction

Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Many of the developments and decisions made in our community rely to an extent on the use of mathematics. Besides foundation skills and knowledge in mathematics for all citizen in the society, it is important to widen mathematical experience for those who are mathematically inclined.

2) Aims and Objectives

1. Giving students sufficient knowledge of fundamental principles, methods and a clear perception of boundless power of mathematical ideas and tools and know how to use them by analysing, modelling, solving and interpreting.
2. Reflecting on the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science
3. Enhancing students overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment

3) Learning Outcomes

1. Students knowledge and skills will get enhanced and they will get confidence and interest in mathematics, so that they can master mathematics effectively.
2. Students thinking ability and attitude will change towards learning mathematics and practicals will improve their logical and analytical thinking.

4) Credit Structure:

S.Y. B. Sc. Mathematics: Minor Course

Semester III

Under New Education Policy (NEP) 2020

| Course | Course Type | Course code | Hrs/ week | Internal assessment | Semester- end examination | Total | Credits |
|----------------------------|-------------|-------------|-----------|---------------------|---------------------------|-------|---------|
| Differential Equations- II | Minor | USC3DEM | 2 | 20 | 30 | 50 | 2 |
| Practical | | | 4 | -- | 50 | 50 | 2 |

Semester IV

Under New Education Policy (NEP) 2020

| Course | Course Type | Course code | Hrs/ week | Internal assessment | Semester- end examination | Total | Credits |
|--------------------|-------------|-------------|-----------|---------------------|---------------------------|-------|---------|
| Laplace Transforms | Minor | USC4LTM | 2 | 20 | 30 | 50 | 2 |
| Practical | | | 4 | --- | 50 | 50 | 2 |

Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Program Outcomes (POs)

| PO No. | POs Statement | Knowledge and Skill |
|--------|--|-----------------------------|
| | After completing the Bachelor of Science Program, students will be able to- | |
| PO-1 | The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest. | Disciplinary knowledge |
| PO-2 | An ability to develop and conduct experiments, analyze, and interpret data and use scientific judgment to draw conclusions. | Scientific reasoning |
| PO-3 | An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information. | Digital literacy |
| PO-4 | Innovative, professional, and entrepreneurial skills needed in various disciplines of science. | Life-long learning |
| PO-5 | An ability to achieve high order communication skills. | Communication skills |
| PO-6 | An ability to collect, analyze and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches. | Problem solving |
| PO-7 | A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real- world settings. | Reflective thinking |
| PO-8 | An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges. | Life-long learning |
| PO-9 | A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes. | Teamwork |
| PO-10 | An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | Leadership |
| PO-11 | An ability to understanding values, ethics, and morality in a multidisciplinary context. | Moral and ethical awareness |



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y. B. Sc. Mathematics: Minor Course
Semester III and IV
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Structure

Semester III

DIFFERENTIAL EQUATIONS

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|-------------------------------------|--------|------------------|
| USC3DEM | Unit I | Second order differential equations | 02+02 | 06 |
| | Unit II | Partial differential equations | | |

Semester IV

LAPLACE TRANSFORMS

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|----------------------------|--------|------------------|
| USC4LTM | Unit I | Laplace transforms | 02+02 | 06 |
| | Unit II | Inverse Laplace transforms | | |



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y. B. Sc. Mathematics: Minor Course Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code: USC3DEM

Course Title: DIFFERENTIAL EQUATIONS

Course Type: Minor Course

No. of Credits: 2+2

Course Outcomes (COs)

| CO No. | COs Statement |
|---------------|--|
| | After completing the course, students will be able to- |
| CO-1 | <i>Recall</i> the first order differential equation. |
| CO-2 | <i>Solve</i> second order linear differential equations by using variation of parameter, method of undetermined coefficients |
| CO-3 | <i>Classify</i> partial differential equations. |
| CO-4 | <i>Solve</i> linear and non-linear partial differential equations using various methods |

Syllabus for S.Y. B. Sc. Mathematics: Minor Course Semester III
Under New Education Policy (NEP) 2020

Course Code: USC3DEM
Course Title: DIFFERENTIAL EQUATIONS

Unit I: Second order differential equations (15 Lectures)

Review: Homogeneous and non-homogeneous first order and first-degree differentiable equations

(a) The homogeneous second order differential equation with constant coefficients, Auxiliary equation. The general solution corresponding to real and distinct roots, real and equal roots and complex roots of the auxiliary equation. Wronskian and linear independence of the solutions. The general solution of differential equation. Complementary functions and particular integrals. Method of reduction, special second order equation.

(b) Non-homogeneous second order differential equations: The method of undetermined coefficients. The method of variation of parameters.

Unit II: Partial differential equations (15 Lectures)

(a) Partial differential equation: Definition, Order of a partial differential equation, Degree of a partial differential equation, Linear and non-linear partial differential equation, Classification of first order partial differential equations, Origin of partial differential equations, Rule (I) Derivation of partial differential equations by the elimination of arbitrary constants, Rule (II) Derivation of partial differential equations by elimination of arbitrary functions ϕ from the equation $\phi(u, v) = 0$, where u and v are functions of x, y and z , Cauchy's problem for first order equations.

(b) Linear partial differential equations of order one: Lagrange's equations, Lagrange's method of solving $Pp + Qq = R$, linear partial differential equation with n independent variables and its solutions.

(c) Non-linear partial differential equations of order one: Complete integral (or complete solution), particular integral, singular integral (or singular solution) and general integral (or general solution), Charpit method

Reference Books:

1. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill, 2017.
2. E. A. Coddington, An introduction to ordinary differential equations, Dover Books, 1961.
3. M.K. Venkataraman, Engineering Mathematics volume 3, National Publishing Co.
4. D. A. Murray, Introductory Course in Differential Equations, Longmans, Green and Co., 1897.
5. A. R. Forsyth, A Treatise on Differential Equations, MacMillan and Co., 1956.
6. An Elementary Course in Partial Differential Equations – T. Amarnath.
7. Dr. M. D. Raisinghania - Advanced Differential Equations - 19th Edition

Practical for USC3DEM:

1. Solve second order differential equations using Auxiliary equation
2. Problems on Wronskian and linear independence of the solution
3. Problems on Complementary functions and Particular integrals
4. Problems on Method of reduction
5. Problems on Special second order equation.
6. Problems on methods of undetermined coefficients and the method of variation of Parameters.
7. Lagrange method.
8. Cauchy's problems for first order PDE.
9. Charpit method
10. Miscellaneous Theoretical Questions based on a full paper.



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y. B. Sc. Mathematics: Minor Course Semester IV
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code: USC4LTM

Course Title: Laplace Transform

Course Type: Minor Course

No. of Credits: 02+02

Course Outcomes (COs)

| CO No. | COs Statement |
|---------------|--|
| | After completing course, students will be able to- |
| CO-1 | <i>Understand</i> basic concepts of Laplace transforms. |
| CO-2 | <i>Apply</i> Laplace transforms to differential equations. |
| CO-3 | <i>Solve</i> problems of inverse Laplace transforms |
| CO-4 | <i>Evaluate</i> convolution theorem. |

Syllabus for S.Y. B. Sc. Mathematics: Minor Course Semester IV
Under New Education Policy (NEP) 2020

Course Code: USC4LTT

Course Title: Laplace Transform

Unit I: Laplace Transform (15 Lectures)

- (a) Introduction of Laplace transform and its properties.
- (b) Laplace transform of elementary functions, special functions, unit step function and Dirac delta function. Problems based on properties of Laplace Transform.
- (c) Laplace transform of derivatives and Integrals, Evaluation of integral using Laplace Transform, Initial Value Theorem, Final Value Theorem and problems, Laplace Transform of periodic function
- (d) Convolution Theorem.

Unit II: Inverse Laplace Transform (15 Lectures)

- (a) Introduction, Properties of inverse Laplace transform, Shifting Theorem, Partial fraction Methods, Problems (usual types).
- (b) Inverse Laplace Transform using Convolution theorem.
- (c) Applications of Laplace transform.

Reference Books:

1. Murray R Spiegel, Schaum's Outline of Laplace Transforms
2. M.K. Venkataraman, Engineering Mathematics volume 3, National Publishing Co.
3. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and their Applications, CRC Press Taylor & Francis
4. I. N. Sneddon, Use of Integral Transforms, Tata-McGraw Hill.
5. Brian Davies, Integral transforms and their Applications, Springer

Practical's for USC2MT2:

1. Laplace transform of elementary functions
2. Laplace transform of discontinuous functions and special functions.
3. Laplace transform of derivatives
4. Laplace transform of Integrals
5. Laplace transform of initial value theorem
6. Laplace transform Final value theorem.
7. Laplace transform: Convolution Theorem
8. Inverse Laplace transform of elementary functions
9. Inverse Laplace transform: Convolution theorem.
10. Application of Laplace transform.

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Choice Based Credit System (CBCS)

❖ **Revised Scheme of Examination**

1. For 4 Credits Courses (Minor Course (MN)) (100 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

| Sr. No. | Particular | Marks |
|---------|--|----------|
| 01 | One periodical class test / online examination to be conducted in the given semester | 20 Marks |

Question Paper Pattern
(Periodical Class Test)

Maximum Marks: 20

Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

| Question No. | Particular | Marks |
|--------------|---|----------|
| Q-1 | Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each) | 10 Marks |
| Q-2 | Answer in Brief (Attempt any Two of the Three) (5 Marks each) | 10 Marks |

B) Semester End Examination (SEE): 60 %**30 Marks**

- Duration: The examination shall be of 1 hour duration.

Question Paper Pattern

| Theory question paper pattern |
|---|
| 1. There shall be two/three questions each of 15/10 marks. |
| 2. All questions shall be compulsory with internal options. |
| 3. Question may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit. |

• Practical Examination (PE) for Minor Course**50 Marks**

The Practical Examination (PE) shall be of 50 marks for Minor Course

| | |
|----------------------------|----------|
| Journal & Viva Voce | 10 Marks |
| Practical Examination (PE) | 40 Marks |

• Passing Standard

- Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE). A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE) together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE).
- **For Practical Examinations (PE):** The learners shall obtain minimum of 40% marks (i.e. 20 out of 50) in Practical Examination (PE), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.

B.O.S. Date: 07/04/2025

Item No.: 03

Academic Council Date: 28/04/2025

Item No.: 05



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR
Arts, Commerce and Science College, New Panvel
(Autonomous)

Re-accredited A++ Grade by NAAC (Fourth Cycle-CGPA-3.52)
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

As per National Education Policy - 2020

Title of the Programme
B. Sc. in Mathematics
(Faculty of Science)



Syllabus for S.Y. B. Sc. (Mathematics)
Skill Enhancement Course (SEC)
Semester III

(With effect from the academic year 2025-26)

Changu Kana Thakur Arts, Commerce and Science College, New Panvel (Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



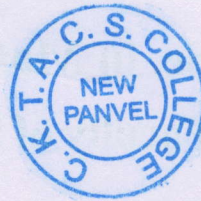
Arts, Commerce and Science College, New Panvel (Autonomous)

As per National Education Policy - 2020

| Sr. No. | Heading | Particulars |
|---------|--------------------------------------|-----------------------|
| 1 | Title of program | B.Sc. |
| 2 | Eligibility | F.Y.B.Sc. |
| 3 | Duration of program | 3 Years |
| 4 | Intake Capacity | |
| 5 | Scheme of Examination | 50 |
| 6 | Standards of Passing | 40% |
| 7 | Semesters | Two |
| 8 | Program Academic Level | |
| 9 | Pattern | Semester (50) |
| 10 | Status | Revised |
| 11 | To be implemented from Academic Year | Academic Year 2025-26 |



Prof. (Dr.) S. I. Unhale
Head, Department of Mathematics
Changu Kana Thakur
A.C.S. College, New Panvel
(Autonomous)



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A.C.S. College, New Panvel
(Autonomous)



Preamble

1) Introduction

Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Many of the developments and decisions made in our community rely to an extent on the use of mathematics. Besides foundation skills and knowledge in mathematics for all citizen in the society, it is important to widen mathematical experience for those who are mathematically inclined.

2) Aims and Objectives

1. Giving students sufficient knowledge of fundamental principles, methods, and a clear perception of boundless power of mathematical ideas and tools and know how to use them by analysing, modelling, solving, and interpreting.
2. Reflecting on the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
3. Enhancing students' overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent, and power of communication necessary for various kinds of employment
4. A student should get adequate exposure to global and local concerns by looking at many aspects of mathematical Sciences.

3) Learning Outcomes

1. Students knowledge and skills will get enhanced and they will get confidence and interest in mathematics, so that they can master mathematics effectively and will be able to formulate and solve problems from mathematical perspective.
2. Students thinking ability and attitude will change towards learning mathematics and practical's will improve their logical and analytical thinking.

4) Credit Structure of the S.Y.B. Sc. (Mathematics) Semester III
S.Y.B. Sc. (Mathematics)
Semester III
Under New Education Policy (NEP) 2020

| Course | Course Type | Course code | Hrs/ week | Continuous Internal Assessment (CIA) | Semester End Examination (SEE) | Total | Credits |
|------------------------------------|-------------|-------------|-----------|--------------------------------------|--------------------------------|-------|---------|
| Introduction to Python Programming | SEC | USEC3IPP | 04 | -- | 50 | 50 | 2 |

Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course



Program Outcomes (POs)

| PO No. | POs Statement | Knowledge and Skill |
|--------|--|-----------------------------|
| | After completing the Bachelor of Science Program, students will be able to- | |
| PO-1 | The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest. | Disciplinary knowledge |
| PO-2 | An ability to develop and conduct experiments, analyze, and interpret data and use scientific judgment to draw conclusions. | Scientific reasoning |
| PO-3 | An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information. | Digital literacy |
| PO-4 | Innovative, professional, and entrepreneurial skills needed in various disciplines of science. | Life-long learning |
| PO-5 | An ability to achieve high order communication skills. | Communication skills |
| PO-6 | An ability to collect, analyze and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches. | Problem solving |
| PO-7 | A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real- world settings. | Reflective thinking |
| PO-8 | An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges. | Life-long learning |
| PO-9 | A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes. | Teamwork |
| PO-10 | An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | Leadership |
| PO-11 | An ability to understanding values, ethics, and morality in a multidisciplinary context. | Moral and ethical awareness |



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B. Sc. (Mathematics) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Structure

Semester III

Introduction to Python Programming

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|-----------------------------------|--------|------------------|
| USEC3IPP | Unit I | Python Programming Fundamentals | 02 | 04 |
| | Unit II | File Handling and GUI Programming | | |



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B. Sc. (Mathematics) Semester III
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code : USEC3IPP

Course Title : Introduction to Python Programming

Course Type: Skill Enhancement Course (SEC)

No. of Credits: 2

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|--|
| | After completing the course, Student will be able to: |
| CO-1 | <u>apply</u> basic commands of python in computations. |
| CO-2 | <u>make a use of</u> basics operations, control structures, data types. |
| CO-3 | <u>solve</u> the problem using recursion and Tkinter module. |

Syllabus for S.Y.B. Sc. (Mathematics) Semester III

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: USEC3IPP

Course Title: Introduction to Python Programming

Unit I: Python Programming Fundamentals (15 Lectures)

1. Introduction to Computers and Programming: Introduction, Hardware and Software, How Computers Store Data, How a Program Works, Introduction to Python programming.
2. Input, Processing, and Output: Designing a Program, Input, Processing, and Output, Displaying Output with the print Statement, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, More about Data Output.
3. Simple Functions: Introduction to Functions, Defining and Calling a Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants.
4. Decision Structures and Boolean Logic: The *if Statement*, The *if -else Statement*, Comparing Strings, Nested Decision Structures and the *if-elif-else Statement*, Logical Operators, Boolean Variables.
5. Repetition Structures: Introduction to Repetition Structures, The while Loop: a Condition-Controlled Loop, The *for* Loop: a Count-Controlled Loop, Calculating a Running Total, Sentinels Input Validation Loops, Nested Loops.
6. Value-Returning Functions and Modules: Introduction to Value-Returning Functions, Generating Random Numbers, Writing Your Own Functions, The math Module, Storing Functions in Modules.

Unit II: File Handling and GUI Programming (15 Lectures)

1. Files and Exceptions: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions.
2. Working with Sequences: Strings and Lists: Sequences, Working with Strings, Lists. Classes and Object-Oriented Programming: Procedural and Object-Oriented Programming Classes, Working with Instances, Techniques for Designing Classes.
3. Inheritance: Introduction to Inheritance, Polymorphism.
4. Recursion: Introduction to Recursion, Problem Solving with Recursion, Examples of Recursive Algorithms.
5. GUI Programming: Graphical User Interfaces, Using the Tkinter Module, Display Text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with the Entry Widget, Using Labels as Output Fields, Radio Buttons and Check Buttons.

Reference Books:

1. Gaddis, Tony. Starting Out with Programming Logic and Design, 2/e. Pearson Education India, 2008.
2. Vander Plas, Jake. Python data science handbook: Essential tools for working with data. " O'Reilly Media, Inc.", 2016.
3. Rogel-Salazar, Jesus. Data science and analytics with Python. Chapman and Hall/CRC, 2018.
4. Madhavan, Samir. Mastering python for data science. Packt Publishing Ltd, 2015.

5. Dromey, R. Geoff. How to Solve it by Computer. Prentice-Hall, Inc., 1982.
6. Barry, Paul. Head first Python: A brain-friendly guide. " O'Reilly Media, Inc.", 2016.
7. Brown, Martin C. Python: The complete reference. McGraw-Hill Professional, 2001.
8. Jeeva Jose, P. Sojan Lal, "Introduction to Computing & Problem Solving with Python", Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810.
9. Thareja, Reema. Python Programming: Using Problem Solving Approach. Oxford university press, 2018.
10. R. Nageswara Rao, "Core Python Programming", Dreamtech Press; Second edition ISBN10:938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL.

List of Practicals

- 1) Introduction to Computers and Programming
- 2) Input, Processing, Output and Simple Functions
- 3) Understanding Data Types and Operations, Control Structures: Decision Making
- 4) Loops and Iteration, Functions and Modular Programming
- 5) Handling Input and Output Operations
- 6) Introduction to Lists, Dictionaries and Tuples
- 7) Repetition Structures: Loops
- 8) Handling Errors and Exceptions
- 9) Functions and Modules
- 10) Advanced Data Structures: Arrays and Matrices
- 11) Files and Exceptions
- 12) Error Handling with Try-Except Blocks
- 13) Reading, Writing CSV Files and Handling Large Datasets
- 14) Introduction to Recursion
- 15) Understanding GUI Programming

Scheme of Evaluation (Amended)

Faculty of Science (Under-graduate Programmes)

Choice Based Credit System (CBCS)

- Revised Scheme of Examination
- For 2 Credits Courses Skill Enhancement Course (SEC)

Practical Examination (PE) (50 Marks)

The Practical Examination (PE) shall be of 50 marks for Skill Enhancement Courses (SEC)

| | |
|----------------------------|----------|
| Journal/ & Viva Voce | 10 Marks |
| Practical Examination (PE) | 40 Marks |

- Passing Standard

For Practical Examinations (PE): The learners shall obtain minimum of 40% marks (i.e. 20 out of 50) in Practical Examination (PE), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.

Note: As per previous ordinance there will not be any internal examination for practical.

- Eligibility Condition to appear for Additional Examination of any Semester
(Applicable only for Regular Semester End Examinations)

A learner who remains absent in some or all the subjects on medical grounds or for representing the College or University in NSS, NCC, Sports, Cultural Activities or co-curricular/extracurricular/extension activities with prior permission of the Principal or Head of the institute reported to the examination section, by producing necessary documents and testimonials, will be allowed to appear for the Additional Semester End Examination (ASEE). This is not applicable for any A.T.K.T. / Supplementary Examinations.

- Supplementary Examination (SE)

The college will conduct supplementary examinations for semester II, IV, and VI after the declaration of their respective results.

B.O.S. Date: 07/04/2025

Item No.: 03

Academic Council Date: 28/04/2025

Item No.: 05



Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Re-accredited A++ Grade by NAAC (Fourth Cycle-CGPA-3.52)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

As per National Education Policy - 2020

B. Sc. in Mathematics

(Faculty of Science)

Syllabus for T.Y. B. Sc. (Minor Mathematics)

Semester V and VI

(With effect from the academic year 2025-26)





Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

As per National Education Policy - 2020

| Sr. No. | Heading | Particulars |
|---------|--------------------------------------|-----------------------|
| 1 | Title of program | B.Sc. |
| 2 | Eligibility | |
| 3 | Duration of program | 3 Years |
| 4 | Intake Capacity | |
| 5 | Scheme of Examination | 60:40 |
| 6 | Standards of Passing | 40% |
| 7 | Semesters | Two |
| 8 | Program Academic Level | |
| 9 | Pattern | Semester (60:40) |
| 10 | Status | Revised |
| 11 | To be implemented from Academic Year | Academic Year 2025-26 |

Prof. (Dr.) S. I. Unhale
Head, Department of Mathematics
Changu Kana Thakur
A.C.S. College, New Panvel
(Autonomous)



Prof. (Dr.) S.K. Patil
Principal
Changu Kana Thakur
A.C.S. College, New Panvel
(Autonomous)





Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for T.Y. B. Sc. (Minor Mathematics) Semester V and VI
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Structure
Semester V

Paper I: Numerical Methods

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|--|--------|------------------|
| USC5NMM | Unit I | Numerical Methods for Solving Algebraic, Transcendental Equations and Linear Systems | 02+02 | 02+04 |
| | Unit II | Interpolation, Numerical Differentiation, and Integration | | |

Semester VI

Paper II: Optimization Techniques

| Course Code | Unit | Topic | Credit | Lecture per Week |
|-------------|---------|--|--------|------------------|
| USC6OTM | Unit I | Linear Programming | 02+02 | 02+04 |
| | Unit II | Transportation and Assignment Problems | | |



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for T.Y.B. Sc. (Minor Mathematics) Semester V
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code: USC5NMM

Course Title: Numerical Methods

Course Type: Minor

No. of Credits: 2 + 2

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|--|
| | After completing the Bachelor of Science Program, students will be able to- |
| CO-1 | <i>Find</i> numerical solutions of system of linear equations and check the accuracy of the solutions. |
| CO-2 | <i>Solve</i> initial and boundary value problems in differential equations using numerical methods. |

Syllabus for T.Y.B. Sc. (Minor Mathematics) Semester V

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code: USC5NMM

Course Title: Numerical Methods

Unit-I: Numerical Methods for Solving Algebraic, Transcendental Equations and Linear Systems (15 Lecture)

Round-off error and computer arithmetic, Local and global truncation errors, Algorithms and convergence; Bisection method, False position method, Fixed point iteration method, Newton's method, and secant method for solving equations. Euler's method, Runge–Kutta methods. Partial and scaled partial pivoting, Gauss Elimination Method, Lower and upper triangular (LU) decomposition of a matrix and its applications, Gauss–Jacobi, Gauss–Seidel.

Unit-II: Interpolation, Numerical Differentiation, and Integration (15 Lecture)

Finite difference operators, Gregory–Newton forward and backward difference interpolations, Lagrange interpolations, Piecewise linear interpolation, First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rules, and error analysis

Reference Books:

1. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). *Numerical Methods for Scientific and Engineering Computation* (6th edition). New Age International Publishers.
2. Brian Bradie (2006), *A Friendly Introduction to Numerical Analysis*. Pearson.
3. C. F. Gerald & P. O. Wheatley (2008). *Applied Numerical Analysis* (7th edition), Pearson Education, India.
4. F. B. Hildebrand (2013). *Introduction to Numerical Analysis: (2nd edition)*. Dover Publications.
5. Robert J. Schilling & Sandra L. Harris (1999). *Applied Numerical Methods for Engineers Using MATLAB and C*. Thomson-Brooks/Cole.

List of practical for Numerical Methods using Scilab

1. Basic of Scilab Programming
2. Round-off Error and Truncation Errors and Root Finding Methods
3. LU Decomposition
4. Iterative Methods for Linear Systems: Gauss–Jacobi Method
5. Iterative Methods for Linear Systems: Gauss–Seidel Method
6. Lagrange and Newton Interpolations
7. Finite Difference Operators
8. Gregory-Newton Interpolation
9. Numerical Differentiation
10. Numerical Integration
11. Euler's Method
12. Runge–Kutta Methods



Janardan Bhagat Shikshan Prasarak Sanstha's
CHANGU KANA THAKUR



Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for T.Y.B. Sc. (Mathematics) Semester VI
Choice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2025-2026)

Course Code: USC6OTM

Course Title: Optimization Techniques

Course Type: Minor

No. of Credits: 2 + 2

Course Outcomes (Cos)

| CO No. | COs Statement |
|---------------|--|
| | After completing the Bachelor of Science Program, students will be able to- |
| CO-1 | <i>Solve</i> linear programming problems using Two-phase method, Big- <i>M</i> method, simplex method. |
| CO-2 | <i>Learn</i> techniques to solve transportation and assignment problems. |

Syllabus for T.Y.B. Sc. (Minor Mathematics) Semester VI

Choice Based Credit System

Under New Education Policy (NEP) 2020

Course Code : USC6LPM

Course Title : Optimization Techniques

Unit-I: Linear Programming (15 Lecture)

Formulation and examples, Canonical and Standard forms, Graphical solution, Convex and polyhedral sets, Extreme points, Basic solutions, Basic Feasible Solutions, Correspondence between basic feasible solutions and extreme points. Optimality criterion, improving a basic feasible solution, Unboundedness; Simplex algorithm and its tableau format; artificial variables, Two-phase method, Big-M method. Formulation of the dual problem, Duality theorems, Unbounded and infeasible solutions in the primal, solving the primal problem using duality theory.

Unit-II: Transportation and Assignment Problems (15 Lecture)

Formulation of transportation problems, Methods of finding initial basic feasible solutions: North-west corner rule, least cost method, Vogel approximation method, Algorithm for obtaining optimal solution; Formulation of assignment problems, Hungarian method.

Reference Books:

1. Mokhtar S. Bazaraa, John J. Jarvis & Hanif D. Sherali (2010). *Linear Programming and Network Flows* (4th edition). John Wiley & Sons.
2. G. Hadley (2002). *Linear Programming*. Narosa Publishing House.
3. Frederick S. Hillier & Gerald J. Lieberman (2015). *Introduction to Operations Research* (10th edition). McGraw-Hill Education.
4. Hamdy A. Taha (2017). *Operations Research: An Introduction* (10th edition). Pearson.
5. Paul R. Thie & Gerard E. Keough (2014). *An Introduction to Linear Programming and Game Theory* (3rd edition). Wiley India Pvt. Ltd.

List of Practical's for Optimization Techniques

1. Formulation of Linear Programming Problems.
2. Graphical Solution of Linear Programming Problems.
3. Canonical and Standard Forms - Converting LP problems into canonical and standard forms.
4. Convex and Polyhedral Sets - Visualizing and proving convexity of different sets.
5. Basic and Basic Feasible Solutions (BFS) - Computing BFS from system constraints.
6. Introduction to the Simplex Algorithm - Solving small LP problems using the simplex method.
7. Solving LP problems using Big-M Method, Two-Phase Method, and simplex method.
8. Formulating and Solving the Dual Problem.
9. Solving the Primal using Duality - Applying duality to simplify solution processes.
10. Formulation of Transportation Problems - Setting up and understanding transportation problems.
11. North-West Corner Rule - Finding an initial basic feasible solution.
12. Least Cost Method - Computing initial BFS using cost criteria.
13. Vogel's Approximation Method - Applying VAM for a better initial BFS.
14. Hungarian Method for Assignment Problems - Solving assignment problems optimally.

Scheme of Examination
Faculty of Science
(Undergraduate Programmes)

Choice Based Credit System (CBCS)

❖ **Revised Scheme of Examination**

1. For 04(02+02) Credits Courses (Minor Course (MN)) (100 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

| Sr. No. | Particular | Marks |
|---------|--|----------|
| 01 | One periodical class test / online examination to be conducted in the given semester | 20 Marks |

Question Paper Pattern
(Periodical Class Test)

Maximum Marks: 20

Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

| Question No. | Particular | Marks |
|--------------|---|----------|
| Q-1 | Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each) | 10 Marks |
| Q-2 | Answer in Brief (Attempt any Two of the Three) (5 Marks each) | 10 Marks |

B) Semester End Examination (SEE): 60 %**30 Marks**

- Duration: The examination shall be of 1 hour duration.

Question Paper Pattern

| Theory question paper pattern |
|---|
| 1. There shall be two/three questions each of 15/10 marks. |
| 2. All questions shall be compulsory with internal options. |
| 3. Question may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit. |

- **Practical Examination (PE) for Minor Course**

50 Marks

The Practical Examination (PE) shall be of 50 marks for Minor Course

| | |
|----------------------------|----------|
| Journal & Viva Voce | 10 Marks |
| Practical Examination (PE) | 40 Marks |

- **Passing Standard**

- Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE). A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE) together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE).
- **For Practical Examinations (PE):** The learners shall obtain minimum of 40% marks (i.e. 20 out of 50) in Practical Examination (PE), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.