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SIES College of Arts, Science and Commerce

(Autonomous)

(Affiliated to University of Mumbai)

Programme: B.Sc.

Subject: Mathematics- Major

Class: S.Y. B.Sc. Semester III & IV(CBCS)

Syllabus Revised in June 2024 under NEP

Major Paper1, Major Paper 2,

Choice Based Credit System (CBCS)

with effect from the academic year 2024-25

CONTENTS

1. 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. It is imperative that the content of the undergraduate syllabi of Mathematics should support other branches of science such as Physics, Chemistry, Statistics, Computer Science, Data Science. This syllabus of S.Y.B.Sc. Mathematics has been designed to provide learners sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas.

2. Learning Objectives

- ➢ To develop critical thinking, reasoning and logical skills of the learners
- ➢ To improve learners' analytical and problem solving skills
- ➢ To take the learners from simple to difficult and from concrete to abstract
- ➢ To equip learners with a deeper understanding of abstract theory and concepts
- ➢ To improve learners' capacity to communicate mathematical/logical ideas in writing.

3. Programme Outcomes

SIES has integrated the Learning Outcome Based Curriculum Framework in the syllabi of all the programmes since the academic year 2021-22. Upon completing the B.Sc. Mathematics Programme, the students are expected to develop the following abilities and skills:

I. **Solving Complex Problems:**

Applying the knowledge of various courses learned under a program with an ability to break down complex problems into simple components, by designing processes required for problem solving.

II. **Critical Thinking and reasoning ability:**

Exhibits ability to understand abstract concepts, analyze, and apply them in problem solving. Ability to formulate and develop logical arguments, developing the ability to think with different perspectives and ideas. (Skills necessary for progression to higher education and research.)

III. **Research Aptitude:**

Acquiring the ability to explore and gain knowledge in independent ways through reading assignments, problem solving assignments, projects, seminars, presentations.

IV. **Information and Digital literacy**:

Equip to select, apply appropriate tools and techniques, resources through electronic media for the purpose of visualizing mathematical objects, geometrical interpretations, coding, and analyzing data.

V. **Sound Disciplinary knowledge:**

Demonstrate comprehensive knowledge and understanding of the fundamental concepts and theories of mathematics; apply them to interdisciplinary areas of study.

VI. **Communicating Mathematical Ideas:**

Organize and deliver mathematical ideas through effective written, verbal, graphical/virtual communications.

4. Course structure with minimum credits and Lectures/ Week

SYBSc student who has chosen Mathematics as a Major subject will study the following courses in Semester III and Semester IV.

SEMESTER III Major courses				
INTEGRAL CALCULUS				
Course Code	UNIT	TOPICS	Credits	L/Week
SIUMTMJ211	I	Sequences and Infinite Series of real numbers	3	3
	II	Riemann Integration		
	III	Indefinite and improper integrals		
LINEAR ALGEBRA I				
Course Code	UNIT	TOPICS	Credits	L/Week
SIUMTMJ212	I	System of linear Equations and Matrices	3	3
	II	Vector Spaces over IR		
	III	Determinants, Linear Equations (Revisited)		
PRACTICALS				
Course Code		TOPICS	Credits	L/Week
SIUMTMJP211		Practicals in Integral Calculus	1	2
SIUMTMJP212		Practicals in Linear Algebra I	1	2
SEMESTER IV Major Courses				
MULTIVARIABLE DIFFERENTIAL CALCULUS				
Course Code	UNIT	TOPICS	Credits	L/Week
SIUMTMJ221	I	Functions of several variables	3	3
	II	Differentiation of Scalar Fields		
	III	Applications of Differentiation of Scalar Fields and Differentiation of Vector Fields		
LINEAR ALGEBRA II				
Course Code	UNIT	TOPICS	Credits	L/Week
SIUMTMJ222	I	Linear transformation, Isomorphism, Matrix associated with L.T.	3	3
	II	Inner product spaces		
	III	Eigenvalues, Eigen vectors, diagonalizable matrix		
PRACTICALS				
		TOPICS	Credits	L/Week
SIUMTMJP221		Practicals in Multivariable Differential Calculus	1	2
SIUMTMJP222		Practicals in Linear Algebra II	1	2

5. Consolidated Syllabus for semester III & IV with Course Outcomes

SEMESTER III

Course Code: SIUMTMJ211 **Major Theory paper1**

Course Name: INTEGRAL CALCULUS **3 Credits**

Expected Course Outcomes:

On completion of this course, students are expected to

1. State the definitions and prove results based on sequences of real numbers, State the definitions and prove results based on concepts summation and convergence of a series, the lower and upper Riemann integrals, the beta, gamma functions, indefinite and improper integrals.
2. Apply various definitions and results learnt to solve problems on convergence and divergence of a sequence, convergence of infinite series, improper integrals, upper and lower sums and checking integrability, problems in physics
3. Test the validity of mathematical statements and converses based upon the gained knowledge, choose appropriate methods to discuss integrability of a function, convergence of an integral and that of a sequence and series.

SIUMTMJ211: INTEGRAL CALCULUS

Unit I: Sequences and Infinite Series of real numbers (15 Lectures)

1.1 Definition of a sequence and examples, Definition of convergent and divergent sequences. Limit of sequence, uniqueness of limit, if it exists. Simple examples such as seq(1/n) , where convergence is checked using definition.Sandwich theorem, Algebra of convergent sequences , Examples.

1.2 Monotonic and Bounded sequences: Definition of bounded sequence. Every convergent sequence is bounded .Monotone sequences and Monotone convergence theorem. Examples.

Cauchy sequence and Cauchy criteria for convergence of sequences,Subsequences, results on subsequences.

(Limits of some special sequences like $(1 + \frac{1}{n})^n$,$\sqrt[n]{n}$ TO BE DISCUSSED ONLY IN PRACTICALS)

1.3 Definition of Series as a Sequence of partial sums, Summation of a series, simple examples like Geometric series. Convergent and divergent series, Necessary condition for convergence of series, Converse not true. Algebra of convergent series. Cauchy criterion for convergence of a series.

1.4 Alternating series, Leibnitz Test, Examples. Absolutely convergent series. Absolute convergence implies convergence but not conversely. Conditional convergence. Convergence of a p- series- $\sum_{n=0}^{\infty} \frac{1}{n^p}$; divergence of the Harmonic series $\sum_{n=0}^{\infty} \frac{1}{n}$

(Tests for convergence of an infinite series: Comparison test, limit form of comparison test, Ratio test, Limit form of ratio test, Root test, Limit form of root test to be covered in practicals. Abel's Test and Dirichlet's test as assignments.)

Unit II: Riemann Integration (15 Lectures)

2.1 Idea of approximating the area of the region under a curve by drawing polygons inside and outside the region. Partitions of an interval. Refinement of a partition. Upper and Lower sums for a bounded real valued function on a closed and bounded interval. Riemann integrability and the Riemann integral.

2.2 Criterion for Riemann integrability. Characterization of the Riemann integral as the limit of a sum. Examples.

2.3 Algebra of integrable functions: Sum, scalar multiplication, product of integrable functions are integrable. Properties of integrable functions: Integral of a non negative function is nonnegative, $\left|\int_a^b f\right| \leq \int_a^b |f|$; Examples based on domain additivity, Examples and counterexamples.

2.4 Riemann integrability of a continuous function, and examples of a bounded function whose set of discontinuities has only finitely many points. Riemann integrability of monotone functions.

Unit III: Indefinite and improper integrals (15 lectures)

3.1 Definition of Indefinite Riemann Integral function and its continuity.

3.2 Mean Value Theorem of Integral Calculus, 1^{st} and 2^{nd} Fundamental theorems of Integral Calculus, Integration by parts, Change of Variable formula for integration.

3.3 Improper integrals of types I & II, Absolute convergence, convergence of some special integrals, comparison test.

3.4 Definition and properties of beta and gamma functions. Relationship between Beta and gamma functions (statement and examples).

Topics for assignment and self-study:

i) Applications of definite Integrals: Area between curves, finding volumes of solids of revolution Lengths of plane curves, Areas of surfaces of revolution, finding average value of a function, finding mass and center of mass, any other application.
ii) Abel's and Dirichlet's Test of convergence of an infinite series, Applications of Infinite series.

Reference Books:

1) Apostol T. , Calculus Vol.2, any edition, John Wiley and Sons Inc.
2) Bartle and Sherbet, Introduction to real analysis, fourth edition or earlier, John Wiley and Sons Inc.
3) Ajit Kumar, Kumaresan S., A Basic Course in Real Analysis, first edition, CRC Press.
4) K. Stewart, Calculus, Booke /Cole Publishing Co.
5) Howard Anton, Calculus-A new Horizon, Sixth Edition, John Wiley and Sons Inc.
6) J .E. Marsden, A. J. Tromba and A. Weinstein, Basic multivariable calculus, 3rd edition, W.H. Freeman and Co Ltd.

Course Code: SIUMTMJ212 **Major Theory paper 2**
Course Name: Linear Algebra I **3 credits**

Expected Course Outcomes:

On completion of this course, students are expected to

1. State the definitions and prove the results of Systems of homogeneous and non-homogeneous linear equations, row echelon form of matrices, elementary matrices, Vector space over R, its basis, determinant.
2. Solve problems in system of linear equations using Gaussian elimination, Cramer's rule, *LU* Decomposition, finding inverse of matrix using row operations or by adjoint of the matrix, finding rank of a matrix, checking Linear independence of subsets of a vector space, checking subspace of vector space.

SIUMTMJ212: LINEAR ALGEBRA I

Note: Revision of relevant concepts is necessary.

Unit I. System of Equations, Matrices (15 Lectures)

1. Systems of homogeneous and non-homogeneous linear equations, Simple examples of finding solutions of such systems. Geometric and algebraic understanding of the solutions. Matrices (with real entries), Matrix representation of systems of homogeneous and non-homogeneous linear equations. Algebra of solutions of systems of homogeneous linear equations. A system of homogeneous linear equations with a number of unknowns more than the number of equations has infinitely many solutions.
2. Elementary row and column operations. Row equivalent matrices. Row reduction (of a matrix to its row echelon form). Gaussian elimination. Applications to solving systems of linear equations. Examples.
3. Elementary matrices. Relation of elementary row operations with elementary matrices. Invertibility of elementary matrices. Consequences such as (i) a square matrix is invertible if and only if its row echelon form is invertible. (ii) invertible matrices are products of elementary matrices. Examples of the computation of the inverse of a matrix using Gauss elimination method.

Unit II. Vector space over R (15 Lectures)

1. Definition of a vector space over R. Subspaces; criterion for a nonempty subset to be a subspace of a vector space. Examples of vector spaces, including the Euclidean space R^n, lines, planes and hyperplanes in R^n passing through the origin, space of systems of homogeneous linear equations, space of polynomials, space of various types of matrices, space of real valued functions on a set.
2. Intersections and sums of subspaces. Direct sums of vector spaces.
3. Linear combination of vectors. Linear span of a subset of a vector space. Definition of a finitely generated vector space. Linear dependence and independence of subsets of a vector space.
4. Basis of a vector space. Basic results that any two bases of a finitely generated vector space have the same number of elements. Dimension of a vector space. Examples. Bases of a vector space as a maximal linearly independent sets and as minimal generating sets.

Unit III. Determinants, Linear Equations (Revisited) (15 Lectures)

1. Inductive definition of the determinant of a $n \times n$ matrix (e. g. in terms of expansion along the first row). Example of a lower triangular matrix. Laplace expansions along an arbitrary row or column.
2. Basic properties of determinants (Statements only);
   (i) $\det A = \det A^T$. (ii) Multilinearity and alternating property for columns and rows.
   (iii) A square matrix A is invertible if and only if $\det A \neq 0$.
   (iv) Minors and cofactors. Formula for A^{-1} when $\det A \neq 0$. (v) $\det(AB) = \det A \det B$.
3. Row space and the column space of a matrix as examples of vector space. Notion of row rank and the column rank. Equivalence of the row rank and the column rank. Invariance of rank upon elementary row or column operations. Examples of computing the rank using row reduction.
4. Relation between the solutions of a system of non-homogeneous linear equations and the associated system of homogeneous linear equations. Necessary and sufficient condition for a system of non-homogeneous linear equations to have a solution (viz., the rank of the coefficient matrix equals the rank of the augmented matrix [A|B]). Equivalence of statements (in which A denotes an $n \times n$ matrix) such as the following:
   (i) The system $Ax = b$ of non-homogeneous linear equations has a unique solution.
   (ii) The system $Ax = 0$ of homogeneous linear equations has no nontrivial solution.
   (iii) A is invertible. (iv) $\det A \neq 0$. (v) $\text{rank}(A) = n$.
5. Cramer's Rule. *LU and PLU* Decomposition. If a square matrix A is a matrix that can be reduced to row echelon form U by Gauss elimination without row interchanges, then A can be factored as $A = LU$ where L is a lower triangular matrix.

Reference books

1) Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition.
2) Serge Lang, Introduction to Linear Algebra, Springer.
3) S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning.
4) K. Hoffman and R. Kunze : Linear Algebra, Tata McGraw-Hill, New Delhi.

Expected Course Outcomes in Practicals based on SIUMTMJ211 and SIUMTMJ212

Upon completion of this course, students are expected to

1. Apply various definitions, results and methods learnt in theory courses to solve problems.
2. Explore mathematical softwares/mobile apps like Matlab/ Scilab/ Geogebra/ SAGE/ Desmos to solve problems and visualize graphs. (free and open versions)
3. Test validity of mathematical statements using results and constructing appropriate examples

Course Code: SIUMTMJP211

Course Name: Practicals in Integral Calculus 1 credit

1. Testing if a sequence is convergent / divergent using definition and using tests of convergence. Application of necessary condition, results of definition.
2. Finding sum of a series, Problems based on Tests for convergence of series.
3. Calculation of upper sum, lower sum and Riemann integral, properties of Riemann integral.
4. Applications of integration to find average value, area, volume, surface area, length of a curve, applications in physics. (two applications to be given as assignment topic)
5. Problems on fundamental theorem of calculus, mean value theorems, integration by parts.
6. Convergence of improper integrals, tests for convergence. Properties of Beta, Gamma Functions.

Course Code: SIUMTMJP211

Course Name: Practicals in Linear Algebra I 1 credit

1. Systems of homogeneous and non-homogeneous linear equations.
2. Elementary row/column operations and Elementary matrices.
3. Vector spaces, Subspaces.
4. Linear Dependence/independence, Basis, Dimension.
5. Determinant and Rank of a matrix.
6. Solution to a system of linear equations, LU decomposition

SEMESTER IV

Course Code: SIUMTMJ221 **Major paper1**

Course Name: Multivariable Differential Calculus **3 credits**

Expected Course Outcomes:

On completion of this course, the students are expected to

1. State the definitions and prove results based on concepts continuity, partial and directional derivatives, the gradient vector, total derivative of scalar and vector fields.
2. Apply various definitions learnt to identify and plot quadric surfaces and level curves, compute gradient, partial and directional derivatives, Jacobian and total derivatives, extreme values.
3. Test the validity of mathematical statements and converses based upon the gained knowledge, to discuss differentiability of a function,existence of derivatives.

SIUMTMJ221: Multivariable Differential Calculus

Unit I: Functions of several variables (15 Lectures)

1.1 The Euclidean inner product on R^n and Euclidean norm function on R^n, distance between two points. Review of vectors with special emphasis on R^2 and R^3. Real valued function of several variable ($R^n \rightarrow R$ scalar fields), examples. Graph of a scalar field. Quadric Surfaces. Level sets (Level curves and surfaces, with examples in R^2 and R^3). Cylinders in space. Vector valued functions of several variables (from $R^n \rightarrow R^m$, vector fields), Component functions, examples.

1.2 Sequences, Limits and Continuity:

Sequence in R^n(with emphasis on R^2 and R^3 and their limits). Neighborhoods in R^n. Limits and continuity of scalar fields. Composition of continuous functions. Algebra of limits and continuous functions. Iterated limits.

1.3 Limits and continuity of vector fields. Algebra of limits and continuity vector fields. (without proof). Necessary and sufficient condition for a vector field to be continuous at a point.

Unit II: Differentiation (15 Lectures)

2.1 Directional derivatives and partial derivatives of scalar fields: definition and examples, with emphasis on R^2 and R^3. Differentiability of scalar fields (in terms of linear transformation). The concept of (total) derivative. Uniqueness of total derivative of a differentiable function at a point. Examples of functions of two or three variables.

2.2 Increment Theorem. Basic properties include (i) continuity at a point of differentiability, (ii) existence of partial derivatives at a point of differentiability, and (iii) differentiability when the partial derivatives exist and are continuous.

2.3 Gradient vector. Relation between total derivative and gradient of a function.Geometric properties of gradient. The maximum and minimum rate of change of scalar fields. Average value of a scalar function, Mean value theorem for derivatives of scalar fields.

2.4 Chain rule for scalar valued functions. Linearization and Tangent planes.

Unit III: Applications (15 lectures)

3.1 Higher order partial derivatives. Mixed Partial derivatives Theorem (n=2), Euler's Theorem.

3.2 Second order Taylor's Theorem for twice continuously differentiable scalar fields. Examples.

3.3 Critical Points, Maxima, minima and saddle points.Hessian matrix, Second derivative test for extrema of functions of two variables. Constrained extrema, Method of Lagrange Multipliers.

3.4 Differentiability of vector fields, Jacobian matrix, relation between differentiability and Jacobian, differentiability of a vector field at a point implies continuity. The chain rule for derivative of a vector field (statements only)

Topics for assignment and self-study:

1. Using Geogebra or Desmos or any other suitable mathematical software to plot quadric surfaces.
2. Demonstrating any mathematical software through an application.
3. Applications of solid geometry in other fields of study

Reference Books:

1. T. Apostol: Calculus, Vol.2, John Wiley.
2. J. Stewart, Calculus, Brooke/Cole Publishing Co.
3. G.B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.
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.
6. Openstax Learning Resources: Calculus volume I, II and III, https://openstax.org/details/books/calculus-volume-3

Course Code: SIUMTMJ222 **Major paper 2**

Course Name: LINEAR ALGEBRA II **3 credits**

Expected Course Outcomes:

On completion of this course, students are expected to

1. State the definitions and prove the results in kernel and image of linear transformations, matrix associated with linear transformation, Inner Products and Orthogonality, Eigenvalues, Eigenvectors and Diagonalization.
2. Solve problems of finding kernel and image of linear transformation, finding matrix associated with linear transformation, finding orthonormal set using Gram-Schmidt orthogonalization, finding eigenvalues, eigenvectors and Diagonalizing a matrix.

SIUMTMJ222: LINEAR ALGEBRA II

UNIT I. Linear Transformations

1. Definition of a linear transformation of vector spaces; elementary properties. Examples. Sums and scalar multiples of linear transformations. Composites of linear transformations. A Linear transformation of $V \to W$, where V, W are vector spaces over R with V a finite-dimensional vector space, is completely determined by its action on an ordered basis of V.
2. Null-space (kernel) and the image (range) of a linear transformation. Nullity and rank of a linear transformation. Rank-Nullity Theorem (Fundamental Theorem of Homomorphism).
3. Matrix associated with linear transformation of $V \to W$ where V and W are finite dimensional vector spaces over R. Matrix of the composite of two linear transformations. Invertible linear transformations (isomorphisms), Linear operator, Effect of change of bases on matrices of linear operator.
4. Equivalence of the rank of a matrix and the rank of the associated linear transformation. Similar matrices.

UNIT II. Inner Products and Orthogonality

1. Inner product spaces (over R). Examples, including the Euclidean space R^n and the space of real valued continuous functions on a closed and bounded interval. Norm associated with an inner product. Cauchy-Schwarz inequality. Triangle inequality.
2. Angle between two vectors. Orthogonality of vectors. Pythagoras theorem and some geometric

applications in R^2. Orthogonal sets, Orthonormal sets. Gram-Schmidt orthogonalization process. Orthogonal basis and orthonormal basis for a finite-dimensional inner product space.

3. Orthogonal complement of any set of vectors in an inner product space. Orthogonal complement of a set is a vector subspace of the inner product space. Orthogonal decomposition of an inner product space with respect to its subspace. Orthogonal projection of a vector onto a line (one dimensional subspace). Orthogonal projection of an inner product space onto its subspace.

UNIT III. Eigenvalues, Eigenvectors and Diagonalization

1. Eigenvalues and eigenvectors of a linear transformation of a vector space into itself and of square matrices. The eigenvectors corresponding to distinct eigenvalues of a linear transformation are linearly independent. Eigenspaces. Algebraic and geometric multiplicity of an eigenvalue.
2. Characteristic polynomial. Properties of characteristic polynomials (only statements). Examples. Cayley-Hamilton Theorem. Applications.
3. Invariance of the characteristic polynomial and eigenvalues of similar matrices.
4. Diagonalizable matrix. A real square matrix A is diagonalizable if and only if there is a basis of R^n consisting of eigenvectors of A. (Statement only - $A_{n\times n}$ is diagonalizable if and only if sum of algebraic multiplicities is equal to sum of geometric multiplicities of all the eigenvalues of $A = n$). Procedure for diagonalizing a matrix.
5. Spectral Theorem for Real Symmetric Matrices (Statement only). Examples of orthogonal diagonalization of real symmetric matrices. Applications to quadratic forms and classification of conic sections.

Reference books

1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition.
2. Serge Lang, Introduction to Linear Algebra, Springer.
3. S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning.
4. K. Hoffman and R. Kunze : Linear Algebra, Tata McGraw-Hill, New Delhi.

Expected Course Outcomes in Practicals based on SIUMTMJ221 and SIUMTMJ222

Upon completion of this practical course, students are expected to

1. Apply various definitions, results and methods learnt in three theory courses to plot graphs and solve problems.
2. Explore mathematical softwares like Matlab/ Scilab/ Geogebra/ SAGE/ Desmos to solve problems and visualize solids.
3. Test validity of mathematical statements using results and constructing appropriate examples.

Course Code: SIUMTMJP221

Course Name: Practicals in Multivariable Differential Calculus **1 credit**

1. Limits and continuity of scalar fields and vector fields, using definition and otherwise, iterated limits.
2. Quadric surfaces, gradient, level sets and tangent planes.
3. Computing directional derivatives, partial derivatives and mean value theorem of scalar fields.
4. Computing Total Derivative. Checking differentiability of a scalar field, Chain rule, higher order derivatives and mixed partial derivatives of scalar fields.
5. Taylor's formula, Finding maxima, minima and saddle points, second derivative test for extrema of functions of two variables and method of Lagrange multipliers.
6. Differentiation of a vector field at a point, finding Hessian/ Jacobian matrix.

Course Code: SIUMTMJP222

Course Name: Practicals in Linear Algebra II **1 credit**

1. Linear transformation, Kernel, Rank-Nullity Theorem.
2. Linear Isomorphism, Matrix associated with Linear transformations.
3. Inner product and properties, Projection, Orthogonal complements.
4. Orthogonal, orthonormal sets, Gram-Schmidt orthogonalisation
5. Eigenvalues, Eigenvectors, Characteristic polynomial. Applications of Cayley Hamilton Theorem.
6. Diagonalisation of matrix, orthogonal diagonalisation of symmetric matrix and application to quadratic form.

6. Teaching Pattern for semester III & IV

A) Theory Courses

Three lectures of one hour each, per week per Theory course in each semester.

B) Practical Course based on Theory courses

One practical per week per batch based on each course.

Minimum 6 practicals to be conducted in each course in each semester.

Conduct of Practicals

The Practicals shall be conducted in batches formed as per the University circular. The Practical session shall consist of discussion between the teacher and the students in which students should participate actively. The students should maintain a journal for practicals which should be submitted for checking regularly and at the end of the semester.

7. Scheme of Evaluation for Semesters III & IV

A) Theory Courses

In each semester, the performance of the learners shall be evaluated in two ways:

1) Continuous Internal Assessment of 25 marks in each Theory course in each semester.

Sr No	Evaluation type	Marks
1	One class test	10
2	Teachers may use various methods to encourage experiential learning and problem-solving skills of the student. Written assignment/ project assignment/ oral or ppt or poster presentation/ reading assignment with viva voce, seminar etc.	15
Total		25

2) Semester End Examinations of 50 marks in eachTheory course at the end of each semester.

Marks: 50 Duration – 2 hours.

Question Paper Pattern

One question on each unit (Questions 1, 2, 3).

Question 4 will be based on the entire syllabus.

B) Practical Course based on Theory Courses

Practical exam of 25 marks, 1 hour, for each course of the practical at the end of each semester. Students will be required to submit a certified journal at the time of examination.

Semester End Practical Examination	20 Marks
Journal and Viva	5 marks
Total	**25 marks**

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