RAIGANJ UNIVERSITY
DEPARTMENT OF MATHEMATICS

SYLLABUS FOR MATHEMATICS
B. Sc. (3/4 years)

(as per N.E.P-2020)
w.e.f. the academic session 2023 - 2024.

RAIGANJ UNIVERSITY
Raiganj, Uttar Dinajpur
West Bengal, India.

Contents

SEMESTER 1

Course Title: Algebra

Course Code: MTMMAJ-I

Course Type: Major

Total Marks: 60 (End Semester Exam:45+Tutorial Test:15)

Total Credit:04 (Theory:03+Tutorial:01)

Total no. of Lectures: 65 (Theory: 50+Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Algebra.**
2. **To help the students understand the applications of Algebra**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Algebra in Engineering.**
2. **The students will be able to apply the concepts of Algebra in Finance and economics.**
3. **The students will be able to apply the concepts of Algebra in physics and computer science.**

Teaching Learning Approach:

1. **Lecture based learning.**
2. **Technology based learning.**
3. **Group learning.**
4. **Tutorial classes.**

Unit	Topic	No. of Lectures
1.1.1-I	Integers	15
1.1.1-II	Congruences	15
1.1.2.-I	Complex Numbers	10
1.1.2.-II	Theory of Equations	15
1.1.2.-III	Inequalities	10

Suggested Readings:

1. **Advanced Higher Algebra: Das, A.N. (Books and Allied)**

2. **Advanced Higher Algebra: Chakravorty, J.G. and Ghosh, P. R(U.N. Dhur and Sons)**

3. **Algebra: R.M. Khan(New Central Book Agency)**

4. **Higher Algebra-Classical: S. K. Mapa (Sarat Book House)**

Suggested Continuous Evaluation Methods:	Marks
Project/Assignment/Internal Class Test	15

Course content:

1.1 Algebra (Major): Code: MTMMAJ-1 Marks 45(S.E)+15(I.E) [Credit 4]

1.1.1 Number Theory

Unit 1.1.1-I: Integers : Well-ordering property of positive integers, First and Second principles of mathematical induction, equivalence of these two principles (statement only). The Euclid's division theorem(or algorithm). The greatest common divisor (g.c.d.) of two integers a and b. Existence and uniqueness of $g.c.d(a, b)$. Relatively prime integers. Linear Diophantine equation and its solvability. Prime integers. Euclid's first theorem: If some prime p divides ab, then p divides either a or b. Euclid's second theorem: There are infinitely many prime integers. Unique factorization theorem. The greatest integer function.

Unit 1.1.1-II: Congruences: Definition and properties. Euler's phi function. Multiplicative property of Euler's phi function. Fermat's theorem, Euler's theorem, Wilson's theorem. Solutions of Linear Congruence equations. Statement of Chinese Remainder theorem and simple problems. Primitive Roots. Divisibility tests. Checkdigits in ISBN, UPC and Credit cards.

1.1.2 Classical Algebra

Unit 1.1.2-I: Complex Numbers : De-Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of $a^z (a \neq 0)$. Gregory's series. Inverse circular and Hyperbolic functions.

Unit 1.1.2-II: Theory of Equations (polynomials with real coefficients) : Fundamental theorem of Algebra (statement only). Nature of roots of an equation (surds or complex roots occur in pairs). Statements of Rolle's theorem, Descarte's rule of signs, Sturm's theorem and their applications. Multiple roots. Relation between roots and coefficients. Symmetric functions of the roots. Transformation of equations. Reciprocal equations. Cardan's method of solving a cubic equation. Ferrari's method of solving a biquadratic equation. Binomial equations. Special roots.

Unit 1.1.2-III: Inequalities: $A.M. \geq G.M. \geq H.M.$ and their generalizations. The theorem of weighted means and m-th power theorem (statements and applications only). Cauchy's inequality (statement only) and its direct applications.

Course Title: Analytical Geometry of Two and Three Dimensions and Vector Algebra
Course Code: MTMMIN-1
Course Type: Minor

Total Marks: 60 (End Semester Exam: 45+Tutorial Test:15)

Total Credit: 04 (Theory: 03 + Tutorial: 01)
Total no. of Lectures: 65(Theory:50+Tutorial:15)

Course Objective:

1. **To help the students understand the concepts of Geometry.**
2. **To help the students understand the concepts of Vector algebra**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Geometry in computer graphics and animation.**
2. **The students will be able to apply the concepts of Geometry in architecture and construction.**
3. **The students will be able to apply the concepts of Vector Algebra in fluid dynamics.**

Teaching Learning Approach:

1. **Lecture based learning.**
2. **Technology based learning.**
3. **Group learning.**
4. **Tutorial classes.**

Unit	Topic	No. of Lectures
1.2.1-I	Transformations of Rectangular axes	5
1.2.1-II	Pair of Straight Lines	10
1.2.1-III	General equation of Second degree (in x and y)	5
1.2.1-IV	Tangents	5
1.2.1-V	Polar Equations	5
1.2.2-I	Plane and Straight line	5
1.2.2.-II	Central and Non-Central Conicoids	10
1.2.2.-III	General equation of second degree (in x, y and z)	5
1.1.3.	Vector Algebra	15

Suggested Readings:

1. **Advanced Analytical Geometry: Chakravorty, J.G. and Ghosh, P.R .(U. N. Dhur and Sons)**
2. **Analytical Geometry and Vector Algebra: N. Datta and R. N. Jana (Shreedhar Prakashani)**
3. **Analytical Geometry of two and three Dimensions: Das, A. N (New Central Book Agency)**
4. **Analytical Geometry of two and three Dimensions and Vector Analysis: R. M. Khan (New Central Book Agency)**
5. **Vector Analysis: Chakravorty, J. G. and Ghosh, P. R. (U. N. Dhur and Sons)**
6. **Vector Analysis. Introduction to Tensor Analysis: Das, A.N (U. N. Dhur and Sons)**
7. **Vector Analysis and An Introduction to Tensor Analysis: M. R. Spiegel (Mc Graw Hill)**
8. **Vector Analysis: R. K. Ghosh and K. C. Maity (New Central Book Agency)**

Suggested Continuous Evaluation Methods:	Marks
Project/Assignment/Internal Class Test	15

Course content:

1.2 Analytical Geometry of Two and Three Dimensions and Vector Algebra (Minor) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMIN-1 Marks 45(S.E)+15(I.E) [Credit 4]

1.2.1 Analytical Geometry of Two Dimensions

Unit 1.2.1-I: Transformations of Rectangular axes: translation, rotation and their combinations.

Unit 1.2.1-II: Pair of straight lines: condition that the general equation of second degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of pair of straight lines joining the origin to the points in which a line meets a conic.

Unit 1.2.1-III: General Equation of Second Degree (in x and y): Finding the nature of a conic using discriminant. Reduction to canonical forms and classification of conics.

Unit 1.2.1-IV: Tangents: Pair of tangents from an external point to different conics. Chord of contact of tangents.

Unit 1.2.1-V: Polar Equations: Polar equation of straight line and circle. Polar equation of a conic referred to a focus as pole.

1.2.2 Analytical Geometry of Three Dimensions

Unit 1.2.2-I: Plane and Straight line: Brief overview of plane and straight line.

Unit 1.2.2-II: Central and Non-central Conicoids: Sphere and its tangent plane. Cone and Cylinder. Ellipsoid, Hyperboloid and Paraboloid.

Unit 1.2.2-III: General Equation of Second Degree (in x, y and z): Reduction to canonical forms and classification of quadrics.

1.2.3 Vector Algebra

Unit 1.2.3: Collinear and coplanar vectors. Scalar and vector products of three vectors. Simple applications to problems of Geometry. Vector equations of plane and straight line. Volume of a tetrahedron. Applications to problems of Mechanics (Work done and Moment).

Course Title: Foundation Course in Mathematics-I

Course Code: MTMSEC-1

Course Type: Skill Enhancement Course

Total Marks: 45 (End Semester Exam: 30 + Tutorial Test: 15)

Total Credit: 03 (Theory: 02+Tutorial: 01)
Total no. of Lectures: 50 (Theory: 35+Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of mathematical logic.**
2. **To help the students understand the concepts of set theory and functions.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of mathematical logic in computer science and programming.**
2. **The students will be able to apply the concepts of mathematical logic in educational planning.**
3. **The students will be able to apply the concepts of set theory in economics and statistics.**

Teaching Learning Approach:

1. **Lecture based learning.**
2. **Technology based learning.**
3. **Group learning.**
4. **Tutorial classes.**

Unit	Topic	No. of Lectures
1.3-I	Statement and Logic	20
1.3-II	Set and relation	15
1.3-III	Function/mapping	15

Suggested Readings:

1. **Foundation course in Mathematics: A. Kumar, S. Kumaresan and Sharma (Alpha science International Ltd.)**
2. **Discrete Mathematics (with Graph Theory): E. G. Goodaire and M. M. Permenter (Prentice Hall of India)**
3. **Discrete Mathematics: J. K. Sharma (Macmillan)**
4. **Selected Topics on Discrete Mathematics: S. Kar (U.N.Dhur and Sons)**
5. **Discrete Mathematical Structures with Applications to Combinatorics: V Ramaswamy (Universities Press)**

Suggested Continuous Evaluation Methods:	Marks
Project/Assignment/Internal Class Test	15

Course content:

1.3 Foundation Course in Mathematics-I (Skill Enhancement Course): Code: MTMSEC-1 Marks 30(S.E)+15(I.E) [Credit 3]

Unit 1.3-I: Statement and Logic : Different type of statements (simple, compound, if and only if, etc.) and negation of a statement. Quantifier. Implication, converse and contrapositive of an implication. Truth table. Different type of "Proofs" in Mathematics (direct proof, proof using contrapositive statement, proof by the method of contradiction, proof by induction principle, etc.)

Unit 1.3-II: Set and relation: Definition and different forms of expressing a set (roster form, set-builder form, etc.), Operations on sets ($\cup$, $\cap$, Δ, etc.), "Normal" and "Abnormal" sets and Russel's Paradox. Complement of a set and De Morgan's law. Family of sets, power set and Cartesian product of sets. Cardinal number, Ordinal number and Cardinality of some well-known sets. Different types of relations. Equivalent class and partition of a set.

Unit 1.3-III: Function/mapping: Definition and examples of single-valued and multiple-valued functions. Basic terminologies [domain, codomain, range, image, pre-image, constant function, zero function, etc.]. Surjective (onto), Injective (one-one), Bijective functions and related theorems. Inclusion function (embedding). Image and inverse image of a subset under a function. Graph of a function and graph of inverse of a function.

Course Title: Discrete Mathematics and Boolean Algebra

Course Code: MTMMDC-1

Course Type: Multi-Disciplinary Course

Total Marks: 45 (End Semester Exam: 30+Tutorial Test: 15)

Total Credit: 03 (Theory: 02+ Tutorial: 01)
Total no. of Lectures: 50 (Theory: 35+Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Discrete Mathematics.**
2. **To help the students understand the applications of Boolean Algebra.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Discrete Mathematics in artificial intelligence.**
2. **The students will be able to apply the concepts of Discrete Mathematics in cryptography.**
3. **The students will be able to apply the concepts of Boolean Algebra in computer science.**
4. **The students will be able to apply the concepts of Boolean Algebra in electronic security system.**

Teaching Learning Approach:

1. **Lecture based learning.**
2. **Technology based learning.**
3. **Group learning.**
4. **Tutorial classes.**

Unit	Topic	No. of Lectures
1.4-I	Combinatorics	15
1.4-II	Posets and Lattices	15
1.4-III	Boolean Algebra.	20

Suggested Readings:

1. **Discrete Mathematics (with Graph Theory): E. G. Goodaire and M. M. Permenter (Prentice Hall of India)**
2. **Discrete Mathematics: J. K. Sharma (Macmillan)**
3. **Selected Topics on Discrete Mathematics: S. Kar (U.N.Dhur and Sons)**
4. **Algebra: R.M. Khan (New Central Book Agency)**

Suggested Continuous Evaluation Methods:	Marks
Project/Assignment/Internal Class Test	15

Course content:

1.4 Discrete Mathematics and Boolean Algebra (Multi-Disciplinary Course) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMDC-1 Marks 30(S.E)+15(I.E) [Credit 3]

Unit 1.4-I: Combinatorics: Principle of inclusion and exclusion. Pigeon-hole principle. Finite combinatorics. Generating functions. Partitions. Recurrence relations. Linear difference equations with constant coefficients.

Unit 1.4-II: Posets and Lattices: Partial and linear orderings. Chains and antichains. Lattices. Distributive lattices. Complementation.

Unit 1.4-III: Boolean Algebra: Definition (using Huntington postulates) and examples (including algebra of sets and Switching Algebra). Principle of duality and other important properties. Boolean functions and truth table. Disjunctive and Conjunctive Normal Forms (DNF and CNF). Conversion from DNF to CNF (and vice-versa). Applications of Boolean Algebra in designing of simple switching circuits.

SEMESTER 2

Course Title: Analytical Geometry

Course Code: **MTMMAJ-2**

Course Type: Major

Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)

Total Credit: 04 (Theory: 03+Tutorial: 01)

Total no. of Lectures: 65 (Lectures: 50 + Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Geometry**.
2. **To help the students understand the applications of Geometry**.

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Geometry in Engineering.**
2. **The students will be able to apply the concepts of Geometry in architecture, astronomy and sculptures etc.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
2.1.1-I	Transformations of Rectangular axes	5
2.1.1-II	Pair of straight lines	5
2.1.1-III	General equation of second degree in two variables	5
2.1.1-IV	Tangents	5
2.1.1-V	Pole and polar	5
2.1.1-VI	Polar equations	5
2.1.2-I	Plane and Straight line	10
2.1.2-II	Sphere	5
2.1.2-III	Central and Non-Central Conicoids	5
2.1.2-IV	Tangents	5
2.1.2-V	Generating Lines	5
2.1.2-VI	General equation of Second degree in three variables	5

Suggested Readings:

1. **Advanced Analytical Geometry: Chakravorty, J. G. and Ghosh, P. R. (U. N. Dhur and Sons)**
2. **Analytical Geometry and Vector Algebra: N. Datta and R. N. Jana (Shreedhar Prakashani)**
3. **Analytical Geometry of two and three Dimensions: Das, A. N. (New Central Book Agency)**
4. **Analytical Geometry of two and three Dimensions and Vector Analysis: R. M. Khan (New Central Book Agency)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

2.1 Analytical Geometry (Major): Code: MTMMAJ-2 Marks 45(S.E)+15(I.E) [Credit 4]

2.1.1 Analytical Geometry of Two Dimensions

Unit 2.1.1-I: Transformation of Rectangular Axes: Translation, Rotation and their combinations. Theory of Invariants.

Unit 2.1.1-II: Pair of Straight Lines: Condition that the general equation of second degree in two variables may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of angle bisectors. Equation of pair of straight lines joining the origin to the points in which a line meets a conic.

Unit 2.1.1-III: General Equation of Second Degree (in two variables): Finding the nature of a conic using discriminant. Reduction to canonical forms and classification of conics.

Unit 2.1.1-IV: Tangents: Pair of tangents from an external point to different conics. Chord of contact of tangents.

Unit 2.1.1-V: Pole and Polar: Equation of polar with respect to different conics. Pole of a straight line with respect to different conics. Conjugate points and conjugate lines.

Unit 2.1.1-VI: Polar Equations: Polar equations of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equations of tangent, normal, chord of contact.

2.1.2 Analytical Geometry of Three Dimensions

Unit 2.1.2-I: Plane and Straight Line: Brief overview of plane and straight line.

Unit 2.1.2-II: Sphere: General equation of sphere and circle. Sphere through given points. Intersection of two spheres. Tangent plane, normal, radical plane.

Unit 2.1.2-III: Central and Non-central Conicoids: Cone and Cylinder. Ellipsoid, Hyperboloid and Paraboloid.

Unit 2.1.2-IV: Tangents: Tangent line and tangent plane at a point on a central conicoid. Condition of tangency. Reciprocal cone and enveloping cone.

Unit 2.1.2-V: Generating Lines: Generators and ruled surface. Equations and basic properties of generating lines of hyperboloid of one sheet and hyperbolic paraboloid.

Unit 2.1.2-VI: General Equation of Second Degree (in three variables): Reduction to canonical forms and classification of quadrics.

Course Title: Classical Algebra and Modern Algebra

Course Code: **MTMMIN-2**

Course Type: Minor

Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)

Total Credit:04 (Theory: 03+Tutorial: 01)

Total no. of Lectures: 65 (Lectures: 50 + Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Classical Algebra**.
2. **To help the students understand the concepts of Modern Algebra**.

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Classical Algebra in Cryptography.**
2. **The students will be able to apply the concepts of Classical Algebra in Computer graphics.**
3. **The students will be able to apply the concepts of Modern Algebra in Engineering.**
4. **The students will be able to apply the concepts of Modern Algebra in Finance and economics.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
2.2.1-I	Complex Numbers	10
2.2.1-II	Theory of Equations	15
2.2.2-I	Algebraic Structure	10
2.2.2-II	Group	15
2.2.2-III	Ring and Field	15

Suggested Readings:

1. **Advanced Higher Algebra: Das, A. N. (Books and Allied)**
2. **Advanced Higher Algebra: Chakravorty, J. G. and Ghosh, P. R. (U. N. Dhur and Sons)**
3. **Algebra: R. M. Khan (New Central Book Agency)**
4. **Higher Algebra- Classical: S. K. Mapa (Sarat Book House)**
5. **A First Course in Abstract Algebra: John B. Fraleigh (Pearson Education)**
6. **Topics in Abstract Algebra: M. K. Sen, S. Ghosh, P. Mukhopadhyay (Universities Press)**
7. **Abstract Algebra: N. P. Chaudhuri (Tata McGraw Hill)**

Suggested Continuous EvaluationMethods	Mark
Project/Assignment/Internal Class Test	15

Course content:

2.2 Classical Algebra and Modern Algebra (Minor) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMIN-2 Marks 45(S.E)+15(I.E) [Credit 4]

2.2.1 Classical Algebra

Unit 2.2.1-I: Complex Numbers: De-Moivre's theorem and its applications. Exponential, sine, cosine and logarithm of a complex number. Inverse circular and hyperbolic functions.

Unit 2.2.1-II: Theory of Equations: Polynomials (with real coefficients) and synthetic division. Fundamental theorem of Classical Algebra (statement only). Every algebraic equation of degree n has exactly n roots. Nature of roots of an equation (surds or complex roots occur in pairs). Number of roots (odd/even) of $f(x) = 0$ in (a, b) depending on the signs of $f(a)$ and $f(b)$. Statements of Rolle's theorem, Descartes' rule of signs and their direct applications. Relation between roots and co-efficients. Transformations of equations. Cardan's method of solving a cubic equation.

2.2.2 Modern Algebra

Unit 2.2.2-I: Algebraic Structure: Binary operations on sets. Identity element. Inverse element. Groupoid, Semi-group and Monoid (definitions and examples only).

Unit 2.2.2-II: Group: Definitions, examples and elementary properties of Group and Sub-group. Necessary and sufficient conditions for a subset of a Group to be a Subgroup (statement and applications only). Even and odd permutations, inverse of a permutation and permutation groups.

Unit 2.2.2-III: Ring and Field: Definitions and examples of Ring, Field, Subring and Subfield. Basic theorems and simple problems.

Course Title: Foundation Course in Mathematics-II
Course Code: MTMSEC-2
Course Type: Skill Enhancement Course
Total Marks: 45 (End Semester Exam: 30 + Tutorial Test: 15)
Total Credit: 03 (Theory: 02+Tutorial: 01)
Total no. of Lectures: 50 (Lectures: 35+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of calculus.**
2. **To help the students understand the concepts of different number systems.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of calculus to calculate the profit and loss with respect to business using graphs.**
2. **The students will calculate Distance, Velocity, Acceleration using the concepts of Integral calculus.**
3. **The students will calculate area between curves using the concepts of Integral calculus.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
2.3-I	Differential Calculus	20
2.3-II	Integral Calculus	20
2.3-III	Positional Number System	10

Suggested Readings:

1. **An Introduction to Analysis: Integral Calculus, R. K. Ghosh and K. C. Maity (New Central Book Agency)**
2. **An Introduction to Analysis- Differential Calculus, Part I and II: R. K. Ghosh and K. C. Maity(New Central Book Agency))**
3. **Differential Calculus: B. C. Das and B. N. Mukherjee (U. N. Dhur and Sons)**
4. **Differential Calculus: Shanti Narayan (S. Chand and Co.)**
5. **Application of Calculus: Sunil Kr. Maity and Sitansu Bandyopadhyay (Academic Publishers)**
6. **Integral Calculus: Shanti Narayan (S. Chand and Co.)**
7. **Numerical Analysis: S. A. Mollah (Books and Allied)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

2.3 Foundation Course in Mathematics-II (Skill Enhancement Course): Code: MTMSEC-2 Marks 30(S.E)+15(I.E) [Credit 3]

Unit 2.3-I: Differential Calculus: Hyperbolic functions and their derivatives. Higher order derivatives, Leibnitz rule and its applications to different functions ($e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, etc.). Envelopes and Asymptotes.

Unit 2.3-II: Integral Calculus: Reduction formulae for the integration of different functions ($\sin^n x$, $\cos^n x$, $\tan^n x$, $\sec^n x$, $(\log x)^n$, $\sin^n x\cos^m x$, etc.). Parametric equations, parametrizing a curve, arc length of a curve and area of surface of revolution.

Unit 2.3-III: Positional Number System: Decimal, Binary, Octal and Hexadecimal systems. Conversion of a number from one system to another. Binary arithmetic.

Course Title: Theory of Equations and Inequalities

Course Code: MTMMDC-2

Course Type: Multi-Disciplinary Course

Total Marks: 45 (End Semester Exam: 30 + Tutorial Test: 15)

Total Credit:03 (Theory: 02+Tutorial: 01)

Total no. of Lectures: 50 (Lectures: 35+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Theory of Equations**
2. **To help the students understand the concepts of Inequalities.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Theory of equations in Engineering.**
2. **The students will be able to apply the concepts of Theory of equations in Cryptography.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
2.4-I	Polynomial Equations	40
2.4-II	Inequalities	10

Suggested Readings:

1. **W. S. Burnstine and A. W. Panton, Theory of equations**
2. **Uspensky, James Victor, Theory of Equations (McGraw-Hill), 1963**
3. **Dickson, Leonard E., Elementary Theory of Equations (Internet Archive), originally 1914**
4. **Advanced Higher Algebra: Das, A.N. (Books and Allied)**
5. **Advanced Higher Algebra: Chakravorty, J.G. and Ghosh, P. R(U.N. Dhur and Sons)**
6. **Algebra: R.M. Khan(New Central Book Agency)**
7. **Higher Algebra-Classical: S. K. Mapa (Sarat Book House)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

2.4 Theory of Equations and Inequalities (Multi-Disciplinary Course) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMDC-2 Marks 30(S.E)+15(I.E) [Credit 3]

Unit 2.4-I: Polynomial Equations: Polynomials (with real coefficients) and synthetic division. Fundamental theorem of Classical Algebra (statement only). Every algebraic equation of degree n has exactly n roots. Nature of roots of an equation (surds or complex roots occur in pairs). Number of roots (odd/even) of $f(x) = 0$ in (a, b) depending on the signs of $f(a)$ and $f(b)$. Statements of Rolle's theorem, Descartes' rule of signs and their direct applications. Relation between roots and co-efficients. Transformations of equations. Cardan's method of solving a cubic equation. Reciprocal equations.

Unit 2.4-II: Inequalities: A.M.$\geq$ G.M.$\geq$ H.M. Cauchy's inequality and related simple problems.

SEMESTER 3

Course Title: Real Analysis-I

Course Code: **MTMMAJ-3**

Course Type: MAJOR

Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)

Total Credit:04 (Theory: 03+Tutorial: 01)

Total no. of Lectures:65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts ofreal analysis**
2. **To help the students understand the application of real analysis**.

Course Learning Outcomes:

1. **The students will be able to apply the concepts of real analysis inmeasure theory.**
2. **The students will be able to apply the conceptsof real analysis in computer and network simulations.**
3. **The students will be able to apply the concepts of real analysis in axiomatic probability**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
3.1-I	Fundamental Properties of $\mathbb{R}$	15
3.1-II	Sequences	25
3.1-III	Series	25

Suggested Readings:

1. **Mathematical Analysis: S. C. Malik, S. Arora (New Age International)**
2. **Mathematical Analysis-Problems and Solutions: Sitansu Bandyopadhyay (AcademicPublishers)**
3. **A Course of Mathematical Analysis: Shanti Narayan (S. Chand and Co.)**
4. **Introduction to Real Analysis: D. R. Sherbert and R. G. Bartle (Wiley)**
5. **Topics In Real Analysis: Mukherjee, S (Academic Publishers)**
6. **Elements of Real Analysis: S. Narayan, M. D. Raisinghania (S. Chand and Co.)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

3.1 Real Analysis-I (Major): Code: MTMMAJ-3 Marks 45(S.E)+15(I.E) [Credit 4]

Unit 3.1-I: Fundamental Properties of $\mathbb{R}$: Review of Algebraic and Order Properties of $\mathbb{R}$, ε neighbourhood of a point in $\mathbb{R}$. Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima. Completeness Property of $\mathbb{R}$ and its equivalent properties. The Archimedean Property, Density property of Rational (and Irrational) numbers in $\mathbb{R}$, Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Bolzano-Weierstrass theorem for sets, compact sets in $\mathbb{R}$, Heine-Borel Theorem.

Unit 3.1-II: Sequences: Bounded sequence, Convergent sequence, Limit of a sequence, liminf, limsup. Limit Theorems. Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria. Monotone Subsequence Theorem (statement only), Bolzano-Weierstrass Theorem for Sequences. Cauchy sequence, Cauchys Convergence Criterion.

Unit 3.1-III: Series: convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchys nth root test, Integral test. Alternating series, Leibniz test. Absolute and Conditional convergence.

Course Title:Abstract Algebra-I

Course Code: **MTMMAJ-4**

Course Type: MAJOR

Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)

Total Credit:04 **(Theory: 03+Tutorial: 01)**

Total no. of Lectures:65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Algebra.**
2. **To help the students understand the applications of Algebra**.

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Algebra in Engineering.**
2. **The students will be able to apply the concepts of Algebra in Finance and economics.**
3. **The students will be able to apply the concepts of Algebra in physics and computer science**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
3.2-I	Groups	15
3.2-II	Subgroups	15
3.2-III	Cyclic groups and Cosets	10
3.2-IV	Product of Groups	10
3.2-V	Group Homomorphism	10
3.2-VI	Automorphism	5

Suggested Readings:

1. **Higher Algebra- Abstract and Linear: S. K. Mapa (Sarat Book House)**
2. **A First Course in Abstract Algebra: John B. Fraleigh (Pearson Education)**
3. **Topics in Abstract Algebra: M. K. Sen, S. Ghosh, P. Mukhopadhyay (Universities Press)**
4. **Abstract Algebra: N. P. Chaudhuri (Tata McGraw Hill)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

3.2 Abstract Algebra-I (Major): Code: MTMMAJ-4 Marks 45(S.E)+15(I.E) [Credit 4]

Unit 3.2-I: Groups: Elementary properties of groups, Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices).

Unit 3.2-II: Subgroups: Definition and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit 3.2-III: Cyclic groups and Costes: Properties of cyclic groups, classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagranges theorem and consequences including Fermats Little theorem.

Unit 3.2-IV: Product of Groups: External direct product of a finite number of groups, normal subgroups, factor groups, Cauchys theorem for finite Abelian groups.

Unit 3.2-V: Group homomorphism: Properties of homomorphisms, Cayleys theorem, properties of isomorphism, First, Second and Third isomorphism theorems.

Unit 3.2-VI: Automorphism: Inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

Course Title: Linear Algebra and Boolean Algebra
Course Code: MTMMIN-3
Course Type: MINOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit:04 (Theory: 03+Tutorial: 01)
Total no. of Lectures:65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Linear Algebra.**
2. **To help the students understand the concepts Boolean Algebra.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Linear Algebra in Cryptography.**
2. **The students will be able to apply the concepts ofLinear Algebra in the theory of games.**
3. **The students will be able to apply the concepts of Boolean Algebra in computer science.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
3.3.1-I	Vector Space	25
3.3.1-II	Quadratic Form	15
3.3.2	Boolean Algebra	25

Suggested Readings:

1. **Higher Algebra- Abstract and Linear: S. K. Mapa (Sarat Book House)**
2. **Kumaresan, S., *Linear Algebra-A Geometric approach*, Prentice-Hall of India, New Delhi, 2001.**
3. **Friedberg S.H, Insel A.J. and Spence L.E., *Linear Algebra*, 4th Edition, Prentice-Hall of India, New Delhi, 2004**
4. **Hoffman K. and Kunze R., *Linear Algebra*, 2nd Edition, Prentice-Hall of India, New Delhi, 2000.**
5. **Discrete Mathematics (with Graph Theory): E. G. Goodaire and M. M. Permenter (Prentice Hall of India)**
6. **Discrete Mathematics: J. K. Sharma (Macmillan)**
7. **Selected Topics on Discrete Mathematics: S. Kar (U. N. Dhur and Sons)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

3.3 Linear Algebra and Boolean Algebra (Minor) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMIN-3 Marks 45(S.E)+15(I.E) [Credit 4]

3.3.1 Linear Algebra

Unit 3.3.1-I: Vector Space: Definitions and examples of Vector Space over a Field. Vector and scalar. Linear combinations, linear span, linear dependence and independence of a finite set of vectors. Generator, basis and dimension of a Vector Space. Problems on formation of basis of a Vector Space (proof is not required). Subspace. Necessary and sufficient condition for a subset of a vector space to be a subspace(statement and applications only).

Unit 3.3.1-II: Quadratic Form: Real Quadratic Form involving not more than three variables (problems only).

3.3.2 Boolean Algebra

Unit 3.3.2: Definition (using Huntington postulates) and examples (including algebra of sets and Switching Algebra). Principle of duality and other important properties. Boolean functions and truth table. Disjunctive and Conjunctive Normal Forms (DNF and CNF). Conversion from DNF to CNF (and vice-versa). Applications of Boolean Algebra in designing of simple switching circuits.

Course Title: Basic C-Programming
Course Code:MTMSEC-3
Course Type:Skill Enhancement Course
Total Marks: 45 (End Semester Exam: 30 + Tutorial Test: 15)
Total Credit:03 (Theory: 02+Tutorial: 01)
Total no. of Lectures: 50 (Lectures: 35+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of C programming.**
2. **To help the students understand the applications of C programming.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of C programmingin Operating Systems.**
2. **The students will be able to apply the concepts ofC programmingin Embedded Systems.**
3. **The students will be able to apply the concepts of C programming in Compilers and interpreters.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**
5. **Practical classes**

Unit	Topic	No. of Lectures
3.4-I	Computer Fundamentals	10
3.4-II	Introduction to C-Programming	25
3.4-III	Applications of C-Programming	15

Suggested Readings:

1. **Fundamentals of Computers: E. Balagurusamy (Tata McGraw Hill)**
2. **Programming in ANSI C: E. Balagurusamy (Tata McGraw-Hill)**
3. **Let us C : Yashwant Kanetkar (BPB Publications)**
4. **Programming in C: V. Krishnamoorthy and K. R. Radhakrishnan (Tata McGraw Hill)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test/practical	15

Course content:

3.4 Basic C-Programming (Skill Enhancement Course): Code: MTMSEC-3 Marks 30(S.E)+15(I.E) [Credit 3]

Unit 3.4-I: Computer Fundamentals: Basic terminologies (BIT, BYTE, NIBBLE, WORD) and coding of data (ASCII, BCD, EBCDIC, etc.) Concepts of Machine language, Assembly language and High level languages. Compiler and Interpreter. Object and Source Program. Algorithm and Flow chart.

Unit 3.4-II: Introduction to C-Programming: Character set, Key words, Constant and Variables, Data Types. Operators, expressions and statements. Managing input and output operations. Decision making and branching. Decision making and looping. Arrays (upto two dimensions). Header file and library functions. User defined functions.

Unit 3.4-III: Applications of C-Programming: Construction of C-programs for

(i) Finding area and perimeter.

(ii) Finding solutions of quadratic equations.

(iii) Finding sum of first n natural numbers and approximate sum of convergent infinite series.

(iv) Finding factorial.

(v) Prime number checking.

(vi) Finding maximum/minimum among three numbers.

(vii) Printing Fibonacci series.

(viii) Finding L.C.M. and G.C.D.

(ix) Sorting of numbers.

(x) Addition of two matrices.

Course Title: Graph Theory
Course Code: MTMMDC-3
Course Type: Multi-Disciplinary Course
Total Marks: 45 (End Semester Exam: 30 + Tutorial Test: 15)
Total Credit: 03 (Theory: 02+Tutorial: 01)
Total no. of Lectures: 50 (Lectures: 35+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Graph theory.**
2. **To help the students understand the applications of Graph theory.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Graph theory in Computer Science.**
2. **The students will be able to apply the concepts of Graph theory in designing of circuit connections.**
3. **The students will be able to apply the concepts of Graph theory used for parsing of a language tree.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
3.5-I	Graphs	15
3.5-II	Euler graphs	10
3.5-III	Planar graphs	10
3.5-IV	Tree	15

Suggested Readings:

1. **Introduction to Graph Theory: Douglas B. West (Prentice Hall of India)**
2. **Graph Theory: N. S. Deo (Prentice Hall of India)**
3. **Discrete Mathematics (with Graph Theory): E. G. Goodaire and M. M. Permenter (Prentice Hall of India)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

3.5 Graph Theory (Multi-Disciplinary Course) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMDC-3 Marks 30 (S.E)+15 (I.E) [Credit 3]

Unit 3.5-I: Graphs: Undirected graphs. Directed graphs. Basic properties. Walk, Path, Cycle, Trail. Connected graphs. Components of a graph. Complete graph. Complement of a graph. Bipartite graphs. Necessary and sufficient condition for a Bipartite graph.

Unit 3.5-II: Euler graphs: Necessary and sufficient condition for a graph to be Euler graph. Konigsberg Bridge Problem.

Unit 3.5-III: Planar graphs: Eulers formula for a planar graph. To show: the graphs K_5 and $K_{3,3}$ are non-planar.

Unit 3.5-IV: Tree: Basic properties. Spanning tree. Minimal Spanning tree. Kruskals algorithm. Prims Algorithm. Rooted tree. Binary tree.

SEMESTER 4

Course Title: Real Analysis-II and Metric Space-I
Course Code: MTMMAJ-5
Course Type: MAJOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit:04 (Theory: 03+Tutorial: 01)
Total no. of Lectures:65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Real analysis**
2. **To help the students understand the concepts of Metric Space.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of real analysis in measure theory.**
2. **The students will be able to apply the concepts of real analysis in computer and network simulations.**
3. **The students will be able to apply the concepts of real analysis in axiomatic probability**
4. **The students will be able to apply the concepts of Metric Space in internet search engines and image classification.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
4.1.1-I	Limit and Continuity	10
4.1.1-II	Differentiability of a Function	20
4.1.1-III	Expansion of Function	20
4.1.2	Metric Space	15

Suggested Readings:

1. **Mathematical Analysis: S. C. Malik, S. Arora (New Age International)**
2. **Mathematical Analysis-Problems and Solutions: Sitansu Bandyopadhyay (Academic Publishers)**
3. **Introduction to Real Analysis: D. R. Sherbert and R. G. Bartle (Wiley)**
4. **Introduction to Real Analysis, S. K. Mapa (Sarat Book Distributors)**
5. **Elements of Real Analysis: S. Narayan, M. D. Raisinghania (S. Chand and Co.)**
6. **S. Kumaresan, Topology of Metric Spaces, Second Edition.**
7. **Elements of Metric Spaces: M. N. Mukherjee (Academic Publishers)**

Suggested Continuous EvaluationMethods	Mark
Project/Assignment/Internal Class Test	15

Course content:

4.1 Real Analysis-II and Metric Space-I (Major): Code: MTMMAJ-5 Marks 45(S.E)+15(I.E) [Credit 4]

4.1.1 Real Analysis

Unit 4.1.1-I: Limit and Continuity: Limit theorems, sequential criterion for limits. Infinite limits and limits at infinity. Continuous functions. Algebra of continuous functions. sequential criterion for continuity and discontinuity. intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, theorems on uniform continuity.

Unit 4.1.1-II: Differentiability of a Function: Algebra of differentiable functions. Relative extremum, interior extremum, Rolle's theorem. Mean value theorems, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Application of differential calculus: Curvature

Unit 4.1.1-III: Expansion of Function: Taylor's theorem with Lagrange's and Cauchy's form of remainder. Applications of Taylor's theorem. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\log(1+x)$ and $(1+x)^n$.

4.1.2 Metric Space

Unit 4.1.2: Definition and examples of Metric Spaces. Neighbourhoods. Limit points. Interior points. Open and Closed sets. Closure and Interior. Boundary points. Subspace of Metric Space.

Course Title: Linear Algebra-I
Course Code: MTMMAJ-6
Course Type: MAJOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit: 04 (Theory: 03+Tutorial: 01)
Total no. of Lectures: 65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Linear Algebra.**
2. **To help the students understand the applications of Linear Algebra.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Linear Algebra in Cryptography.**
2. **The students will be able to apply the concepts of Linear Algebra in the theory of games.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
4.2-I	Vector Space	25
4.2-II	Row space and Column space of a matrix	5
4.2-III	System of Linear Equations	10
4.2-IV	Eigen Value and Eigen Vector	10
4.2-V	Inner Product Spaces and norms	15

Suggested Readings:

1. **Higher Algebra- Abstract and Linear: S. K. Mapa (Sarat Book House)**
2. **Kumaresan, S., *Linear Algebra-A Geometric approach*, Prentice-Hall of India, New Delhi, 2001.**
3. **Friedberg S.H, Insel A.J. and Spence L.E., *Linear Algebra*, 4th Edition, Prentice-Hall of India, New Delhi, 2004**
4. **Hoffman K. and Kunze R., *Linear Algebra*, 2nd Edition, Prentice-Hall of India, New Delhi, 2000.**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

4.2 Linear Algebra-I (Major): Code: MTMMAJ-6 Marks 45(S.E)+15(I.E) [Credit 4]

Unit 4.2-I: Vector Space: Definition and examples, subspaces, union, intersection, sum and direct sum of subspaces, linear combination, linear span, linear independence and dependence. Basis and dimension. Finite dimensional spaces: existence theorem for basis, invariance of number of vectors in a basis, extension and replacement theorems.

Unit 4.2-II: Row space and Column space of a matrix: Definitions. Row rank, column rank and their equality with rank of a matrix. Statements of relevant theorems.

Unit 4.2-III: System of Linear Equations: Consistency. System of linear equations as matrix equations and the invariance of its solution sets under row equivalence. Number of solutions. Solution by matrix method (when possible). Dimension of the solution space of a system of homogeneous linear equations and applications of relevant results/theorems.

Unit 4.2-IV: Eigen Value and Eigen Vector: Characteristic equations of a square matrix. Definition and simple properties of Eigen values and Eigen vectors, Cayley-Hamilton theorem and its use in finding the inverse of a matrix. Diagonalisation of matrices.

Unit 4.2-V: Inner Product Spaces and norms: Definition and examples, Norm, triangle inequality, Cauchy-Schwartz inequality. Orthogonal vectors and orthogonal complements. Orthonormal sets and bases. Gram-Schmidt orthogonalization method. Orthogonal complements.

Course Title: Ordinary Differential Equations-I
Course Code: MTMMAJ-7
Course Type: MAJOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit: 04 (Theory: 03+Tutorial: 01)
Total no. of Lectures: 65 (Lectures: 50 + Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Ordinary Differential Equations.**
2. **To help the students understand the applications of Ordinary Differential Equations.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Ordinary Differential Equations to calculate the movement or flow of electricity.**
2. **The students will be able to apply the concepts Ordinary Differential Equations to calculate motion of an object to and fro like a pendulum.**
3. **The students will be able to apply the concepts of Ordinary Differential Equations to explain thermodynamics concepts.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
4.3-I	Equations of First Order and First Degree	10
4.3-II	Equations of First Order but not of First Degree	10
4.3-III	Applications	10
4.3-IV	Higher Order Linear Equations with Constant Coefficients	10
4.3-V	Second Order Linear Equations with Variable Coefficients	10
4.3-VI	Eigen-value Problems	5
4.3-VII	Simultaneous Linear Differential Equations	5
4.3-VIII	Total Differential Equation	5

Suggested Readings:

1. **Differential Equations, S. L. Ross (John Wiley and Sons)**
2. **Differential Equations: Chakravorty, J. G. and Ghosh, P. R. (U. N. Dhur and Sons).**
3. **An Introduction to Differential Equations: R. K. Ghosh and K. C. Maity (New Central Book Agency)**
4. **Differential Equation and Laplace Transform: Das, A. N. (New Central Book Agency)**
5. **Differential Equations: G. F. Simmons (Tata McGraw Hill).**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

4.3 Ordinary Differential Equations-I (Major): Code: MTMMAJ-7 Marks 45(S.E)+15(I.E) [Credit 4]

Unit 4.3-I: Equations of First Order and First Degree: Statement of existence and uniqueness theorem. Exact equation and condition for exactness. Integrating factor and rules for finding integrating factors (statements of relevant results only). Solutions of linear equations (by various methods) and Bernoullis equation.

Unit 4.3-II: Equations of First Order but not of First Degree: Clairauts equation. Singular solution.

Unit 4.3-III: Applications: Geometric applications. Orthogonal trajectories

Unit 4.3-IV: Higher Order Linear Equations with Constant Coefficients: Complementary function. Particulars integral. Method of undetermined coefficients. Symbolic operator D. Method of variation of parameters. Eulers homogeneous equation and reduction to an equation of constant coefficients.

Unit 4.3-V: Second Order Linear Equations with Variable Coefficients: Reduction of order when one solution of the homogeneous part is known. Complete solution. Method of variation of parameters. Reduction to Normal form. Change of dependent and independent variables.

Unit 4.3-VI: Eigen-value Problems: Eigen-functions and eigen-values. Simple eigen-value problems.

Unit 4.3-VII: Simultaneous Linear Differential Equations: Methods of solving simultaneous linear differential equations of various types.

Unit 4.3-VIII: Total Differential Equation: Pfaffian differential equation. Condition for integrability.

Course Title: Discrete Mathematics, Boolean Algebra and Numerical Analysis-I
Course Code: MTMMAJ-8
Course Type: MAJOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit: 04 (Theory: 03+Tutorial: 01)
Total no. of Lectures: 65 (Lectures: 50 + Tutorial: 15)

Course Objective:

1. **To help the students understand the concepts of Discrete Mathematics and Boolean Algebra.**
2. **To help the students understand the applications of Numerical analysis.**

Course Learning Outcomes:

1. **The students will be able to apply the concepts of Numerical analysis in Machine Learning and Data Analysis.**
2. **The students will be able to apply the concepts of Discrete Mathematics in artificial intelligence.**
3. **The students will be able to apply the concepts of Boolean Algebra in computer science.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
4.4.1-I	Combinatorics	10
4.4.1-II	Posets and Lattices	10
4.4.2	Boolean Algebra	10
4.4.3-I	Numbers and Errors	10
4.4.3-II	Interpolation	10
4.4.3-III	Numerical Integration	15

Suggested Readings:

1. **Discrete Mathematics (with Graph Theory): E. G. Goodaire and M. M. Permenter (Prentice Hall of India)**
2. **Discrete Mathematics: J. K. Sharma (Macmillan)**
3. **Selected Topics on Discrete Mathematics: S. Kar (U. N. Dhur and Sons)**
4. **Numerical Analysis: Das, A. N. (U. N. Dhur and Sons)**
5. **Numerical Analysis: N. Datta and R. N. Jana (Shreedhar Prakashani).**
6. **Numerical Analysis: S. A. Mollah (Books and Allied)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

4.4 Discrete Mathematics, Boolean Algebra and Numerical Analysis-I (Major): Code: MTMMAJ-8 Marks 45(S.E)+15(I.E) [Credit 4]

4.4.1 Discrete Mathematics

Unit 4.4.1-I: Combinatorics: Principle of inclusion and exclusion. Pigeonhole principle. Finite combinatorics. Generating functions. Partitions. Recurrence relations. Linear difference equations with constant coefficients.

Unit 4.4.1-II: Posets and Lattices: Partial and linear orderings. Chains and antichains. Lattices. Distributive lattices. Complementation.

4.4.2 Boolean Algebra

Unit 4.4.2: Definition (using Huntington postulates) and examples (including algebra of sets and Switching Algebra). Principle of duality and other important properties. Boolean functions and truth table. Disjunctive and Conjunctive Normal Forms (DNF and CNF). Conversion from DNF to CNF (and vice-versa). Applications of Boolean Algebra in designing of simple switching circuits.

4.4.3 Numerical Analysis-I

Unit 4.4.3-I: Numbers and Errors: Algorithms, Convergence, Errors: Relative, Absolute, Round off and Truncation.

Unit 4.4.3-II: Interpolation: Lagrange's method and Newton's divided difference methods. Error bounds. Finite difference operators. Newton's forward and backward Difference interpolations. Stirling's and Bessel's formulae. Numerical differentiation: Methods based on Newton's forward and backward differences. Error in interpolation.

Unit 4.4.3-III: Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Weddle's rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule, Composite Weddle's rule, Gauss quadrature formula.

Course Title: Differential Calculus and Integral Calculus
Course Code: MTMMIN-4
Course Type: MINOR
Total Marks: 60 (End Semester Exam: 45 + Tutorial Test: 15)
Total Credit: 04 (Theory: 03+Tutorial: 01)
Total no. of Lectures: 65 (Lectures: 50+ Tutorial: 15)

Course Objective:

1. **The students will be able to apply the concepts of differential calculus to calculate the profit and loss with respect to business using graphs.**
2. **The students will be able to apply the concepts of differential calculus to calculate the rate of change of the temperature.**
3. **The students will calculate area between curves using the concepts of Integral calculus.**

Teaching Learning Approach:

1. **Lecture based learning**
2. **Technology based learning**
3. **Group learning**
4. **Tutorial classes**

Unit	Topic	No. of Lectures
4.5.1-I	Sequence	15
4.5.1-II	Series	10
4.5.1-III	Expansion of Functions	10
4.5.1-IV	Functions of two variables	10
4.5.2-I	Reduction formulae	5
4.5.2-II	Double integral	5
4.5.2-III	Applications	10

Suggested Readings:

1. **Differential Calculus: B. C. Das and B. N. Mukherjee (U. N. Dhur and Sons)**
2. **Differential Calculus: Shanti Narayan (S. Chand and Co.)**
3. **Application of Calculus: Sunil Kr. Maity and Sitansu Bandyopadhyay (Academic Publishers)**
4. **Application of Calculus: Debasish Sengupta (Books and Allied)**
5. **Integral Calculus: Shanti Narayan (S. Chand and Co.)**
6. **Integral Calculus - Differential Equations: B. C. Das and B. N. Mukherjee (U. N. Dhur and Sons)**

Suggested Continuous Evaluation Methods	Mark
Project/Assignment/Internal Class Test	15

Course content:

4.5 Differential Calculus and Integral Calculus(Minor) (FOR THE STUDENTS OF OTHER DEPARTMENTS): Code: MTMMIN-4 Marks 45(S.E)+15(I.E) [Credit 4]

4.5.1 Differential Calculus

Unit 4.5.1-I: Sequence: Definition of bounds of a sequence and monotone sequence. Limit of a sequence. Statements of limit theorems. Concepts of convergence and divergence of monotone sequences, relevant theorems and their applications. Statements of Sandwich theorem and Cauchy's general principle of convergence and their applications.

Unit 4.5.1-II: Series: Infinite series of constant terms. Concepts of convergence and divergence . Cauchy's principle as applied to infinite series (application only). Series of positive terms. Statements of Comparison test, D' Alembert's ratio test and Cauchy's root test and their applications. Alternating series. Statement of Leibnitz's test and its applications.

Unit 4.5.1-III: Expansion of Functions: Mean value theorems. Statements of Taylor's and Maclaurin's theorems with Lagrange's and Cauchy's form of reminders. Maclaurin's infinite series for different functions (e^x, $\sin x$, $\cos x$ etc.).

Unit 4.5.1-IV: Functions of two variables: Limit and continuity (definitions only). Partial derivatives, exact differentials (emphasis on solving of problems only). Statements of Schwartz's and Young's theorems on commutativity of mixed partial derivatives. Euler's theorem on homogeneous function.

4.5.2 Integral Calculus

Unit 4.5.2-I: Reduction formulae: Reduction formulae and associated problems.

Unit 4.5.2-II: Double integral: Working knowledge of Double integral.

Unit 4.5.2-III: Applications: rectification, quadrature, surface areas of solids formed by revolution of plane curve and areas (problems only).