24MAT0101T: Basic Algebra and Number Theory

Semester: I **Marks (External): 70**
Credits: 4-0-0 **Marks (Internal): 30**
Hours/Week: 4 **Maximum Marks (Total): 100**
Course Type: DSC **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Outcomes: After completing this course, the students will be able to:
CO 1. Calculate the rank, eigen values and the minimal polynomial of a matrix.
CO 2. Use rank as a tool to check the consistency of a system of linear equations.
CO 3. Get knowledge about Euler's ϕ function, Fermat's theorem, Chinese's remainder theorem and Gauss reciprocity law.
CO 4. Know about some number theoretical functions and their properties.

Unit - I

Elementary operations on matrices. Rank of a matrix Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Unit - II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Relations between the roots and coefficients of general polynomial in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots.

Unit - III

Divisibility, greatest common divisor, least common multiple of numbers. Primes, Fundamental theorem of arithmetic, Linear congruences, Chinese remainder theorem, Fermat's theorem. Wilson's theorem and its converse.

Unit - IV

Complete and reduced residue system modulo m. Euler's ϕ function. Euler's generalization of Fermat's theorem. Quadratic residues. Legendre symbols. Gauss lemma. Gauss reciprocity law. Greatest integer function. The number of divisors and the sum of divisors of a natural number n (The functions d(n) and σ(n)).

Books Recommended:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications (1994).
2. S. Narayan & P.K.Mittal: A Text Books of Matrices, S. Chand Publication (2010).
3. D.M. Burton: Elementary Number Theory, McGraw-Hill Companies (2011).

24MIC0125T: Fundamentals of Computers

Semester: I **Marks (External): 35**
Credits: 2-0-0 **Marks (Internal): 15**
Hours/Week: 2 **Maximum Marks (Total): 50**
Course Type: MIC **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: At the end of this course, the students will be able to learn:
CO1: How computers receive, store, and process data to generate useful information.
CO2: How to classify computers based on operating principles, applications, and size.
CO3: Use of computers in different fields.
CO4: Role of Central Processing Unit (CPU) in a computer system, and the concept of memory and its representation.
CO5: The importance of computer codes.
CO6: Concept of computer arithmetic and different types of binary arithmetic operations.

Unit - I

Computer: Definition, Characteristics of computers, Basic applications of computers, Classifications of computers.
Components of computer system: Central processing unit (CPU), Input/output devices, Computer memory - primary and secondary memory, Magnetic and optical storage devices.

Unit - II

Computer Codes: Positional number system, Different types of positional number systems: Decimal, binary, octal, hexadecimal numbers and their inter-conversions.
Computer Arithmetic: Computer arithmetic and different types of binary arithmetic operations, Signed and unsigned number representation, Complements of binary numbers and different types of representations for integer and floating-point numbers.

Books Recommended:

1. E. Balagurusamy: Computing Fundamentals and C Programming, 2nd Edition, Tata McGraw Hill (2018).
2. P. Norton: Introduction to Computers, 7th Edition, McGraw-Hill (2017).
3. A. Leon, M. Leon: Introduction to Computers, 1st Edition, Vikas Publishing House, New Delhi (2009).
4. V. Rajaraman, N. Adebala: Fundamentals of Computers, 6th Edition, PHI (2014).
5. P.K. Sinha, P. Sinha: Computer Fundamentals, 8th Edition, BPB (2004).

24MDC0121T(i): Elementary Mathematics - I

Semester: I **Marks (External): 50**
Credit: 3-0-0 **Marks (Internal): 25**
Hours/ week: 3 **Max. Marks (Total): 75**
Course type: MDC **Examination Duration: 2.5 Hrs**

Note: The Examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course outcomes:

CO 1. To familiar with the properties satisfied by a collection of objects.
CO 2. To know about the straight lines and trigonometrical function.
CO 3. To know about different types of arrangements of given objects. Also to know about binomial expansions.
CO 4. To familiar with applications of graphs in solutions of linear Inequalities in two variables.

Unit – I

Sets, Relations and Functions : Sets and their Representations, The Empty Set, Finite and Infinite Sets, Equal Sets, Subsets, Universal Set, Venn Diagrams, Operations on Sets, Complement of a Set, Practical Problems on Union and Intersection of Two Sets, Cartesian Product of Sets, Relations, Functions.
Sequences and Series: Sequences, Series, Arithmetic Progression (A.P.), Geometric Progression (G.P.), Relationship between A.M. and G.M.

Unit – II

Straight Lines: Introduction, Slope of a Line, Various Forms of the Equation of a Line, General Equation of a Line, Distance of a Point From a Line.
Trigonometric Functions: Angles, Trigonometric Functions, Trigonometric Functions of Sum and Difference of Two Angles, Trigonometric Equations.
Linear Inequalities: Inequalities, Algebraic Solutions of Linear Inequalities in One Variable and their Graphical Representation, Graphical Solutions of Linear Inequalities in Two Variables, Solutions of System of Linear Inequalities in Two Variables.

Unit – III

Permutations and Combinations: Fundamental Principle of Counting, Permutations, Combinations.
Binomial Theorem: Introduction, Binomial Theorem for Positive Integral Indices, General and Middle Terms.
Probability: Introduction, Random Experiments, Event, Axiomatic Approach to Probability, Addition Theorems on Probability, Conditional Probability, Multiplicative Law of Probability.

Books Recommended:

1. Mathematics Text Book for Class XI, National Council of Educational Research and Training.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd, Allahabad.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons.
4. Ivo Duntsch and Gunther Gediga, Set, Relations, Functions, Methodos Publishers.

24MDC0121T(ii): Elementary Statistics - I

Semester: I **Marks (External): 50**
Credits: 3-0-0 **Marks (Internal): 25**
Hours/Week: 3 **Maximum Marks (Total): 75**
Course Type: MDC **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:
CO1: Demonstrate the tabular and graphical representations of data based on variables.
CO2: Calculate measures of central tendency such as mean, median, mode and explain their properties.
CO3: Calculate measures of dispersion, skewness and kurtosis, moments and apply their use in studying various characteristics of data.
CO4: Establish a formulation helping to predict one variable in terms of the other, i.e. correlation and linear regression.

Unit - I

Introduction of Statistics, types of data, Scales of measurement. Collection, classification and tabulation of data. Presentation of data: histograms, frequency polygon, frequency curve and ogives. Stem- and- Leaf and Box plots. Measures of Central Tendency and Location: Mean, median, mode, geometric mean, harmonic mean, partition values.

Unit - II

Measures of Dispersion: Absolute and relative measures of range, quartile deviation, mean deviation, standard deviation (σ), coefficient of variation. Moments, Skewness and Kurtosis: Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Charlier's checks, Concepts of Skewness and Kurtosis.

Unit - III

Scatter diagram, Karl Pearson Coefficient (r) of correlation and rank correlation coefficient. Linear Regression: Concept of regression, principle of least squares and fitting of straight line, derivation of two lines of regression, properties of regression coefficients, Angle between two lines of regression. Difference between correlation and regression.

Books Recommended:

1. A. M. Gun, M. K. Gupta and B. Dasgupta, Fundamentals of Statistics, Vol-II, World Press (2016).
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics (Twelfth Edition), Sultan Chand & Sons (2020).
3. S. Bernstein and R. Bernstein, Elements of Statistics-I: Descriptive Statistics and Probability, Schaum's Outline Series, McGraw Hill (2020).
4. Neil A. Weiss, Introductory Statistics (Tenth Edition), Pearson (2016).
5. Sheldon M. Ross, Introductory Statistics (Fourth Edition), Academic Press (2017).

24MDC0121T(iii): Basic Linear Algebra

Semester: I **Marks (External): 50**
Credits: 3-0-0 **Marks (Internal): 25**
Hours/Week: 3 **Maximum Marks (Total): 75**
Course Type: MDC **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:
CO1: Know about different types of matrices and their properties.
CO2: Solve homogeneous and non- homogeneous systems of linear equations using matrices.
CO3: Find eigen values, eigen vectors and quadratic form of a matrix.
CO4: Explain the concepts of vector spaces, bases, dimensions and their properties.
CO5: Determine the linear independence and dependence of vectors, the rank and nullity of a linear transformation.

Unit - I

Matrices: Introduction, Basic Definitions, Elementary Operations on a Matrix, Rank of a Matrix, Equivalent Matrices, Echelon and Triangular Forms of a Matrix, Normal Form (Canonical Form) of a Matrix, Solutions of Homogeneous and Non- Homogeneous Systems of Linear Equations using Rank of a matrix and Gaussian Elimination Method. Definitions of Orthogonal, Idempotent and Partition Matrices.

Unit - II

Eigen Values and Eigen Vectors: Characteristic Matrix, Characteristic Polynomial, Characteristic Equation, Eigen values and Eigen vectors, Basic Properties of Eigen values and Eigen vectors, Cayley-Hamilton Theorem and its use in finding inverse of a matrix.
Quadratic Form of Matrix: Definition, Matrix Form of a Quadratic Form, Rank of the Quadratic Form, Singular and Non-singular Quadratic Forms, Diagonalization of a Quadratic Form, Definite and Semi-definite Quadratic Forms.

Unit - III

Vector Spaces: Introduction, Vector Spaces, Subspaces, Linear Combinations, Linear Dependence and Independence of Vectors, Spanning Sets, Linear Spans, Basis and Dimension.
Linear Transformations: Definition and Properties of Linear Transformations, Kernel and Image of a Linear Transformation, Rank and Nullity of a Linear Transformation, Singular and Non-singular Linear Transformations.

Books Recommended:

1. Seymour Lipschutz, Marc Lars Lipson, *Linear Algebra*, McGraw Hill, 2009.
2. Gilbert Strang, *Linear Algebra and its Applications*, Cengage India Private Limited, 2005.
3. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., New Delhi, 1975.
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, *Basic Abstract Algebra*, Cambridge University Press, 1994.
5. Vivek Sahai and Vikas Bist, *Algebra*, Narosa Publishing House, 2008.
6. I.S. Luther and I.B.S. Passi, *Algebra, Vol.-II*, Narosa Publishing House, 1997.

24SEC0120T(i): Numerical Methods

Semester: I **Marks (External): 50**
Credits: 3-0-0 **Marks (Internal): 25**
Hours/Week: 3 **Maximum Marks (Total): 75**
Course Type: SEC **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:

CO1: Investigate the solution of nonlinear equations by graphical method and various iterative methods.

CO2: Find the numerical solution of a system of linear equations using various direct and iterative methods.

CO3: Interpolate the value of a function for any intermediate value of the independent variable in a given set of data points.

CO4: Calculate the value of the derivative of a function at some assigned value of independent variable and to estimate a definite integral by using various numerical methods.

Unit - I

Solution of Algebraic and Transcendental Equations: Introduction, Graphical method to find approximate roots, Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method. Some important deductions from Newton-Raphson formula.

Solution of Linear Simultaneous Equations: Introduction of a linear system of equations and type of solutions.

Direct Methods of Solution: Cramer's Rule, Matrix inversion method, Gauss elimination method, Gauss-Jordan method, LU Decomposition method.

Iterative Methods of Solution: Jacobi's method, Gauss-Seidal method.

Unit - II

Finite Differences: Finite difference operators and their relations. Differences of a polynomial.

Interpolation with Equal Intervals: Newton's forward interpolation formula, Newton's backward interpolation formula, Gauss' forward interpolation formula, Gauss' backward interpolation formula, Bessel's formula, Stirling's formula.

Interpolation with Unequal Intervals: Lagrange's interpolation formula, Newton's divided difference formula.

Unit - III

Numerical Differentiation: Derivatives using Newton's forward difference formula, Newton's backward difference formula, Gauss' forward difference formula, Gauss' backward difference formula, Bessel's formula, Stirling's formula, Newton's divided difference formula.

Numerical Integration: Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Boole's and Weddle's rules.

Books Recommended:

1. B.S. Grewal: Numerical Methods in Engineering and Science, Khanna Publishers (Ninth Edition), New Delhi (2010).
2. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
3. S.S. Shastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
4. C.E. Froberg: Introduction to Numerical Analysis (Second Edition), Addison-Wesley Educational Publishers Inc., New Jersey (1970).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

24SEC0120T(ii): Numerical Ability Enhancement Skills

Semester: I | **Marks (External): 50**
Credits: 3-0-0 | **Marks (Internal): 25**
Hours/Week: 3 | **Maximum Marks (Total): 75**
Course Type: SEC | **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:

1. Understand number systems, fundamental arithmetical operations, use of BODMAS rule and solve typical expressions fast and accurately.
2. Have a deeper and comprehensive understanding of the concepts of percentage, profit and loss, simple and compound interest, partnership, alligation or mixture and acquire skill to use this knowledge in real life problems.
3. Acquire skill to identify types of given sequences/series and apply suitable method to find a particular term, sum of specific number of terms and apply this learning in real life mathematical problems.
4. Familiarize and get acquainted with data interpretation & various measures of central tendency for the available data and draw the inferences/results.

Unit - I

Number systems, Operations on numbers, Tests for divisibility of natural numbers, Number of zeros in an expression, Prime number divisor rule, Decimals and fractions, Squares and square roots, Cubes and cube roots, Surds and indices, Use of BODMAS, HCF and LCM, Logarithms.

Unit - II

Ratio, proportion and variation, Percentage, Profit, loss and discount, Partnership, Simple and compound interest, Growth and depreciation of value and population, Alligations and mixtures.

Unit - III

Progressions: Arithmetic progression, Geometric progression, Harmonic progression with their simple and basic practical applications, Number series completion. Basic ideas of permutations and combinations, Events and sample space, Probability. Data interpretation: Raw and grouped data, Bar graphs, Pie graphs, Line graphs, Mean, Median, Mode.

Books Recommended:

1. R. S. Aggarwal (2022). Quantitative Aptitude. S. Chand & Company Limited, New Delhi.
2. A. Guha (2020). Quantitative Aptitude (7th Edition). McGraw Hill Education.
3. J.V. Dyke, J. Rogers and H. Adams (2011). Fundamentals of Mathematics (10th Edition). Cengage Learning.
4. A.S. Tussy, R. D. Gustafson and D. R. Koenig (2011). Basic Mathematics for College Students (4th Edition). Brooks /Cole, Cengage Learning.
5. A. Sharma (2023). Quantitative Aptitude for CAT (10th Edition). McGraw Hill Education Pvt. Ltd.
6. Textbook of Mathematics for Class X, National Council of Educational Research and Training, New Delhi.
7. Textbook of Mathematics for Class XI, National Council of Educational Research and Training, New Delhi.

24MAT0201T: Calculus

Semester: II | **Marks (External): 70**
Credits: 4-0-0 | **Marks (Internal): 30**
Hours/Week: 4 | **Maximum Marks (Total): 100**
Course Type: DSC | **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course outcomes: After completing this course, the students will be able to:

CO1: Describe the concept of continuity, uniform continuity, properties of continuous functions.
CO2: Understand the Mean value theorems, Taylor's and Maclaurin theorems.
CO3: Trace the curve in cartesian coordinates and evaluate the limits by using L'Hospital's rule.
CO4: Calculate the partial derivatives of the functions having two or more independent variables.

Unit - I

Continuity, Sequential Continuity, Properties of continuous functions, Intermediate value theorem, Uniform continuity, Chain rule of differentiability. Darboux intermediate value theorem for derivatives. Lagrange's mean value theorem and their geometrical interpretations. Cauchy's mean value theorem.

Unit - II

Taylor's and Maclaurin's theorem with Lagrange's and Cauchy' forms of remainders. Asymptotes in Cartesian coordinates, Intersection of curve and its asymptotes, Asymptotes in polar coordinates. Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Radius of curvature for pedal curves.

Unit - III

Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps. Tracing of curves in Cartesian coordinates. Indeterminate forms: L'Hospital's rule for evaluation of intermediate forms

Unit - IV

Limit and continuity of real valued functions of two variables. Partial differentiation: Homogenous functions & Euler's theorem on homogeneous functions, Total Differentials, Composite functions & implicit functions. Change of variables method.

Books Recommended:

1. G. B. Thomas and R. L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, (1998).
2. S.C. Malik and S. Arora , Mathematical Analysis, New age international publisher, 5th Edition, (2017).
3. S. Narayan, A Course in Mathematical Analysis, S.Chand and company, New Delhi, (2005).

24MIC0225T: Basics of Artificial Intelligence

Semester: II | **Marks (External): 35**
Credits: 2-0-0 | **Marks (Internal): 15**
Hours/Week: 2 | **Maximum Marks (Total): 50**
Course Type: MIC | **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: At the end of this course, the students will be able to learn:
CO1: Understand the concept of Artificial Intelligence and its key features.
CO2: Evaluate the advantages, disadvantages of Artificial intelligence system
CO3: Understand the challenges and ramification of Human-AI augmentation
CO4: Analyze the implication of applying AI systems to organizations and future of work.

Unit - I

Overview of Artificial Intelligence: Introduction to AI, Importance of AI, History and key milestone of AI, scope and Application areas of AI, Risk and Benefits of AI, Differentiating AI from human Intelligence, Sub field of AI: Machine learning, Supervised learning, Unsupervised learning, Reinforcement learning, Introduction to Data science, Comparison between machine learning and Data Science.

Unit - II

Ethical and Social implications of AI: Bias and Fairness in AI Systems, Privacy and Data Protection concerns in AI, Impact of AI on Employment and the Workforce, AI and Social Inequality, Emerging trends and Future Direction in AI, Introduction to Neural Networks.

Books Recommended:

1. Rupak Bhattacharyya, Joy Adhikary, Artificial Intelligence for Everyone, Dr. Dhar's Academy.
2. Saptarsi Goswami, Amit Kumar Das, Amlan Chakrabarti ,AI for Everyone: A Beginner's Handbook for Artificial Intelligence, Pearson Education,2024.
3. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, McGraw Hill Education, 2009.
4. Rajiv Chopra, Artificial Intelligence (A Practical Approach), S Chand Publishing, 2012.
5. Stuart Russel and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 2015.

24MDC0221T(i): Elementary Mathematics - II

Semester: II | **Marks (External): 50**
Credit: 3-0-0 | **Marks (Internal): 25**
Hours/ week: 3 | **Max. Marks (Total): 75**
Course type: MDC | **Examination Duration: 2.5 Hrs**

Note: The Examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course outcomes:

CO 1. To familiar with the different types of arrangement and their applications.
CO 2. To know about the rate of change of one variable quantity with respect to another. The results discussed in the chapter have many applications in Business, and in extreme value problems of functions.
CO 3. Solutions of many scientific problems come from the solutions of differential equations associated with them, therefore, in the present section we come to know about differential equations and their solutions.
CO 4. To familiar with rate of change of a variable when it is a function of more than one variable.

Unit – I

Matrix Algebra: Introduction, types of matrices, addition and multiplication of matrices, transpose of a matrix, concept of elementary row and column operations. Determinant and its properties, minors, cofactors. Application of determinants in finding area of a triangle. Adjoint and inverse of a square matrix. Solutions of homogeneous and non-homogeneous linear equations and condition for solution.

Unit – II

Differential Calculus: Differentiation of standard functions including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation.
Integral Calculus: Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, partial fractions and substitution. Formal evaluation of definite integrals.

Unit– III

Ordinary Differential Equations: Definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Leibnitz form) and differential equations reducible to these types, Linear differential equation of order greater than one with constant coefficients, complementary function and particular integrals.
Partial Differential Equations: Introduction of partial differentiation of first and second order. Introduction and formation of P.D.E., solution of P.D.E., linear equations of first order (Lagrange's partial differential equations only).

Books Recommended:

1. Mathematics :Text Book for Class XII, National Council of Educational Research and Training.
2. Shanti Narayan : Differential and Integral Calculus, S. Chand.
3. Shanti Narayan : A Textbook of Matrices, S. Chand.
4. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw Hill.

24MDC0221T(ii): Elementary Statistics - II

Semester: II | **Marks (External): 50**
Credits: 3-0-0 | **Marks (Internal): 25**
Hours/Week: 3 | **Maximum Marks (Total): 75**
Course Type: MDC | **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:

CO1: Gain the deeper knowledge and understanding of probability theory, distribution function, probability mass & density functions and learn to use those for problem solving.
CO2: Understand the concepts of joint probability distribution function, mathematical expectation and generating functions.
CO3: Acquire the mathematical and statistical knowledge of Binomial & Poisson distributions and their applications in real life statistical models.
CO4: Acquire the knowledge about curvilinear regression and to solve problems of curve fitting using the method of least squares.

Unit - I

Probability: Basic concepts of probability, experiments, trial, outcome, sample space, event, operations of events, mutually exclusive and exhaustive events, equally likely and favourable events with examples, Mathematical, Statistical and Axiomatic definitions of probability, their merits and demerits. Properties of probability based on axiomatic definition, Conditional probability and independence of events, Addition and multiplication theorems for 'n' events, Boole's inequality. Bayes' theorem with its application. **Random Variables:** Definition of random variable, discrete and continuous random variables, functions of random variables, probability mass function and probability density function with illustrations. Distribution function and its properties, Independence of random variables.

Unit - II

Two dimensional random variable: Joint Probability, Joint Probability Mass function, Marginal and conditional Probability Function, Joint Probability distribution function, Joint continuous density function, Marginal and conditional probability density function, Conditional cumulative Distribution.
Mathematical Expectation: Mathematical expectation of a function of a random variable, Raw and central moments, covariance using mathematical expectation with examples, Addition and multiplication theorems of expectation.
Generating Functions: Moment generating function (m.g.f), cumulant generating function (c.g.f), and their properties with applications.

Unit - III

Discrete Distributions: Binomial and Poisson distributions, 1st to 4th moments about origin and moments about mean. M.G.F, C.G.F, mean, variance, Approximating Binomial distribution to Poisson distribution.
Curvilinear Regression: Fitting of second degree parabola, Fitting of exponential curve ($y = ae^{bx}$), Fitting of curve ($y = ax^b$), Fitting of curve ($y = ab^x$), Fitting of curve ($xy^a = b$).

Books Recommended:

1. A. M. Gun, M. K. Gupta and B. Dasgupta, Fundamentals of Statistics, Vol-II, World Press (2016).
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics (Twelfth Edition), Sultan Chand & Sons (2020).
3. S. Bernstein and R. Bernstein, Elements of Statistics-I: Descriptive Statistics and Probability, Schaum's Outline Series, McGraw Hill (2020).
4. Neil A. Weiss, Introductory Statistics (Tenth Edition), Pearson (2016).
5. Sheldon M. Ross, Introductory Statistics (Fourth Edition), Academic Press (2017).

24MDC0221T(iii): Probability and Sampling Theory

Semester: II | **Marks (External): 50**
Credits: 3-0-0 | **Marks (Internal): 25**
Hours/Week: 3 | **Maximum Marks (Total): 75**
Course Type: MDC | **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:

CO1: Gain the deeper knowledge and understanding of random variables, distribution functions, mathematical expectation and generating functions.
CO2: Acquire the mathematical and statistical knowledge of some discrete and continuous probability distributions and their applications in real life statistical models.
CO3: Understand the basic concepts of theory of estimation and its properties.
CO4: Demonstrate the concept of parameter, statistic, sampling distribution of a statistic and its standard error.
CO5: Learn the procedure for testing of hypothesis for large samples and small samples.
CO6: Discuss various properties of Chi- square, t and F distributions.

Unit - I

Random Variables: Discrete and continuous random variables, Properties of random variables, Probability mass function, Probability density function and cumulative distribution function, Distribution function and its properties. Two Dimensional Random Variables: Discrete and continuous type, Joint, Marginal and Conditional Probability mass function, Probability density function and cumulative distribution function, Independence of random variables. Mathematical Expectation and Generating Functions: Expectation of random variables and its properties. Raw and central moments, Covariance, Moment generating function, cumulative generating function.

Unit - II

Discrete Probability Distributions: Bernoulli, Binomial and Poisson distributions with their properties. Continuous Probability Distributions: Rectangular, Exponential and Normal probability distributions with their properties. Weak law of large numbers and Central limit theorem. Theory of Estimation: Concepts of point and interval estimation, Bias in estimators, Basic properties of Estimators: Unbiasedness, consistency, efficiency, MVUE. Derivation of maximum likelihood method of estimation.

Unit - III

Sampling Theory: Definitions of random sample, parameter, statistic, standard errors of sample mean and sample variance, Statistical hypothesis, Null and alternative hypotheses, Level of significance, Type I and Type II errors, Critical region, One -tailed and two tailed tests, Critical values. Test of significance for large samples: Test of significance for single population mean, Test of significance for difference between two population mean, Test of significance for difference between two population standard deviations. Sampling Distribution: Chi-square distribution, t-distribution, F-distribution and their properties. Sampling distribution of sample mean. Chi- square Test of goodness of fit. Test of significance for small samples: Test the significance of the mean of a random sample, Test the difference between mean of two independent samples, Test the difference between mean of two dependent samples (Paired t-test). F-test for equality of two population variances.

Books Recommended:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, 4th Edition, Sultan Chand and Sons, Delhi, 2014.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand and Sons, New Delhi, 2020.
3. H. C. Taneja, Statistical Methods for Engineering and Sciences, IK International Pvt. Ltd., 2013.
4. A. M. Gun, M. K. Gupta & B. Dasgupta, Fundamentals of Statistics, World Press Private, 2013.
5. V. Hogg and T. Craig, Introduction to Mathematical Statistics, 7th Edition, Pearson Education Limited, 2014.
6. R. Murray Spiegel, John J. Schiller and R. Alu Srinivasan, Probability and Statistics, Schaum's Outline Series, McGraw Hill Education, 2009.
7. V. K. Rohatgi, A.K. Md. E. Saleh, An Introduction to Probability and Statistics, John Wiley and Sons, 2015.

24SEC0220T(i): Special Functions and Transform Techniques

Semester: II | **Marks (External): 50**
Credits: 3-0-0 | **Marks (Internal): 25**
Hours/Week: 3 | **Maximum Marks (Total): 75**
Course Type: SEC | **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:
CO1: Derive the solution of differential equations in the form of power series.
CO2: Discuss various special functions represented by different series.
CO3: Understand the basic concept and properties of Fourier and Laplace transforms.
CO4: Evaluate the Fourier and Laplace transforms of some elementary functions.
CO5: Solve ordinary/partial differential equations using the appropriate transform techniques.
CO6: Apply the concepts of special functions and transform techniques to solve physical problems arising in various scientific fields.

Unit - I

Series Solution of Differential Equations: Definition of Power series, Radius of convergence, Ordinary and singular points of differential equations, Frobenius method. Bessel's Equation and Functions: Bessel's equation and its solution, Bessel's functions and their properties- Recurrence relations and generating functions.

Unit - II

Legendre's Equation: Legendre's differential equation and its solution, Legendre's Polynomials and functions, Rodrigue's formula for Legendre's Polynomials, Generating function, Recurrence relations. Fourier Transforms: Definition, Properties of Fourier transforms- Linearity, Scaling, Shifting, and Modulation; Convolution theorem, Fourier transforms of the derivatives, Solution of partial differential equations using Fourier transforms.

Unit - III

Laplace Transforms: Definition, Laplace transform of some elementary functions, Linear property of Laplace transform, Shifting and Scaling properties, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Inverse Laplace transforms, Convolution theorem, Inverse Laplace transforms of derivatives and integrals, Solution of ordinary differential equations using Laplace transform.

Books Recommended:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons Inc., New York, 2006.
2. A.R. Forsyth, A Treatise on Differential Equations, 6th Edition, Macmillan and Co. Ltd., London, 1929.
3. I.N. Sneddon, Special Functions of Mathematical Physics & Chemistry, Oliver and Boyd: Interscience Publishers, 1966.
4. W.W. Bell, Special Functions for Scientists and Engineers, Dover Publication, 2004.
5. I.N. Sneddon, The Use of Integral Transforms, 1st Edition, McGraw Hill Education, 1972.
6. M.R. Spiegel, Laplace Transforms, 1st Edition, Schaum's Outlines Series, McGraw Hill Education, 1965.
7. L. Debnath and D. Bhatta, Integral Transforms and Their Applications, 3rd Edition, CRC Press, Boca Raton, 2015.

24SEC0220T(ii): Quantitative Aptitude

Semester: II | **Marks (External): 50**
Credits: 3-0-0 | **Marks (Internal): 25**
Hours/Week: 3 | **Maximum Marks (Total): 75**
Course Type: SEC | **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the learner will be able to:

CO1: Comprehend the formulation of equations for specific mathematical problems and use mathematical skills to solve those.

CO2: Acquire the knowledge to analyze and solve the problems related to average, time & distance, work & time, work & wages and apply those in real life situations.

CO3: Get deeper knowledge and understanding of concepts of Trigonometric ratios and identities and use this knowledge to perform assigned tasks of solving such problems.

CO4: Familiarize and get acquainted with the problems related to perimeter, area and volume of different geometrical shapes.

Unit - I

Linear equations, Quadratic equations, System of algebraic equations in two variables and their applications in simple problems, Problems based on ages, Clocks, Calendar.

Unit - II

Average, Average speed problems. Time, speed and distance: Problems based on trains, boats and streams, Pipes and cistern. Work and time: Problems based on work and time, Work and wages.

Unit - III

Trigonometry: Trigonometric ratios and trigonometric identities, Problems based on height and distance. Area and perimeter of triangles and circle, Area and perimeter of quadrilaterals (Square, Rectangle, Parallelogram, Rhombus, Trapezium), Volume and surface area of Cube, Cuboid, Cylinder, Cone, Sphere.

Books Recommended:

1. R. S. Aggarwal (2022). Quantitative Aptitude. S. Chand & Company Limited, New Delhi.
2. A. Guha (2020). Quantitative Aptitude (7th Edition). McGraw Hill Education.
3. J.V. Dyke, J. Rogers and H. Adams (2011). Fundamentals of Mathematics (10th Edition). Cengage Learning.
4. A.S. Tussy, R. D. Gustafson and D. R. Koenig (2011). Basic Mathematics for College Students (4th Edition). Brooks /Cole, Cengage Learning.
5. A. Sharma (2023). Quantitative Aptitude for CAT (10th Edition). McGraw Hill Education Pvt. Ltd.
6. Textbook of Mathematics for Class X, National Council of Educational Research and Training, New Delhi.

24VAC0208T: Mathematics in India: From Vedic Period to Modern Times

Semester: II | **Marks (External): 35**
Credits: 2-0-0 | **Marks (Internal): 15**
Hours/Week: 2 | **Maximum Marks (Total): 50**
Course Type: VAC | **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: After completing this course, the students will be able to:
CO1: Have knowledge about the development of Indian Mathematics in the ancient and vedic period.
CO2: Have knowledge of the contribution of great Indian Mathematicians during the ancient, vedic and modern times.
CO3: Get knowledge of prestigious medals and awards given in the field of mathematics.

Unit - I

Mathematics in Ancient India: Indian contribution to decimal system and place value. Development of sulva geometry in vedic period. Chandas Sutra of Pingla and Binary Arithmetic. Contribution of Aryabhata, Brahmagupta, Bhaskaracharya-II, Mahavir Aharya. (Recommended book [1])
Mathematics in Medieval India: Overview of the historical backgrounds and contribution of Kerala School of Mathematics. Contribution of Nilakantha Somaya Ji and Jyesthadeva. (Recommended book [1])

Unit - II

Mathematics in Modern Times: Contributions of modern Mathematicians from India: Srinivasa Ramanujan, Bharti Krishan Tirth Ji, Kaprekar, Satyaendra Nath Bose, Manjul Bhargava, Harish Chandra and Shakuntala Devi.
Medals and prizes in Mathematics: Fields Medal, Abel Prize, Ramanujan Prize, Lilavati Award.

Books Recommended:

1. G.G. Emch, R. Sridharan and M.D. Srinivas (2005). Contribution to the History of Indian Mathematics. Hindustan Book Agency (India).
2. C. N. Srinivasiengar (1967). History of Mathematics in India. The World Press Pvt. Ltd., Calcutta, (India).
3. A.K. Bag (1979). A Cultural History of Mathematics in Ancient India. Chaukhamba Orientalia, Varansi, (India).
4. Ramakalyani V. Sita Sunder Ram (2021). History and Development of Mathematics in India. National Mission for Mathematics and DK Printworld (P) Ltd. New Delhi, (India).

24MAT0301T: Differential Equations

Semester: III **Marks (External): 70**
Credits: 4-0-0 **Marks (Internal): 30**
Hours/Week: 4 **Maximum Marks (Total): 100**
Course Type: DSC **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: The objective is to familiarize the students with the concepts of Ordinary Differential Equations and Partial Differential Equations and their uses.

Unit – I

Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.

Unit – II

Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous linear form. Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Method of variations of parameters.

Unit – III

Partial differential equations: Formation, Order and Degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, Singular solution, General solution. Solution of Lagrange's linear equations, Charpit's general method of solution. Jacobi's method.

Unit – IV

Linear partial differential equations of second and higher orders,Linear homogeneous and non-homogeneous differential equations with constant coefficients, Partial differential equation with variable coefficients reducible to equations with constant coefficients, their complimentary functions and particular integrals.

Books Recommended:

1. S.L. Ross, Differential Equations, 3rd Edition, John Wiley & Sons Ross, (2004).
2. I. N. Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, (1988).
3. D.A. Murray, Introductory Course in Differential Equations. Orient Longaman (India). (1967).
4. J.N. Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosa publishing house, (2009).

Course Outcomes: After completing this course, the learner will be able to:

CO1: define differential equations of first and higher orders.
CO2: form differential equations of various orders.
CO3: Solve differential equations with constant/ variable coefficients.
CO4: Apply the concepts of differential equations in solving physical problems.

24MIC0325T: Integral Transform Techniques

Semester: III | **Marks (External): 70**
Credits: 4-0-0 | **Marks (Internal): 30**
Hours/Week: 4 | **Maximum Marks (Total): 100**
Course Type: MIC | **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: To provide in-depth understanding of some integral transform techniques namely Laplace, Fourier, Mellin and Hankel transforms along with their applications.

Unit – I

Laplace Transform: Definition, Laplace transform of some elementary functions, Linearity property, Shifting and scaling properties, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Inverse Laplace transforms, Convolution theorem, Solution of ordinary differential equations using Laplace transform.

Unit – II

Fourier Transform: Definition and Properties of Fourier transforms: linearity, scaling, shifting, Modulation, Convolution theorem, Fourier transforms of the derivatives, Relation between Fourier and Laplace transforms, Solution of partial differential equations using Fourier transforms.

Unit – III

Mellin Transform: Definition and elementary properties of Mellin transform, Mellin transforms of derivatives and integrals, Inverse Mellin transform, Mellin inversion theorem.

Unit – IV

Hankel Transform: Definition and elementary properties of Hankel transform, Hankel transforms of derivatives of function, Hankel transforms of some elementary functions, Use of Hankel transform in the solution of partial differential equations.

Books Recommended:

1. M.R. Spiegel, Laplace Transforms, 1st Edition, McGraw Hill, Schaum's Outlines Series, (1965).
2. I.N. Sneddon, The Use of Integral Transforms, 1st Edition, McGraw Hill, (1972).
3. A.R. Forsyth, A Treatise on Differential Equations, CBS Publishers and Distributors, (2005).
4. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons Inc., New York, (2006).
5. L. Debnath and D. Bhatta, Integral Transforms and Their Applications, 3rd Edition, CRC Press, (2015).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Understand the basic concept of some transform techniques namely Laplace, Fourier, Mellin and Hankel transforms.
CO2: Evaluate the transforms of some elementary functions.
CO3: Solve ordinary/partial differential equations using appropriate transform techniques.
CO4: Apply the transform techniques to solve physical problems arising in various scientific fields.

24VOC0325T: Interpolation Techniques

Semester: III | **Marks (External): 35**
Credits: 2-0-0 | **Marks (Internal): 15**
Hours/Week: 2 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To acquaint the students with the concepts of finite difference operators and various interpolation techniques for solving different mathematical problems numerically.

Unit – I

Finite Differences: Finite difference operators and their relations, Differences of a polynomial, Finding the missing terms and effect of error in a difference tabular values.
Interpolation with Equal Intervals: Newton's forward and Newton's backward interpolation formulae, Gauss's forward and Gauss's backward interpolation formulae, Sterling's interpolation formula, Bessel's interpolation formula, Laplace-Everett's interpolation formula.

Unit – II

Interpolation with Unequal Intervals: Divided differences and their properties, Newton's divided difference interpolation formula, Lagrange's interpolation formula.
Iteration and Inverse Interpolations: Interpolation by iteration, Inverse interpolation. **Bivariate Interpolation:** Lagrange's bivariate interpolation, Newton's bivariate interpolation.

Books Recommended:

1. B.S. Grewal: Numerical Methods in Engineering and Science (Ninth Edition), Khanna Publishers, New Delhi (2010).
2. S.S. Sastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
3. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
4. Babu Ram: Numerical Methods (First Edition), Pearson Publication (2009).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define the fundamental concepts related to various finite difference operators and interpolation techniques.
CO2: Understand and explain basic properties of various finite difference operators and interpolation techniques.
CO3: Apply different interpolation techniques to solve numerical problems in the field of mathematics.
CO4: Analyze the utility of various finite difference operators and interpolation techniques to model real life problems.
CO5: Evaluate the numerical solutions of mathematical problems using appropriate interpolation techniques.

24VOC0325P: Interpolation Techniques Lab

Semester: III | **Marks (External Practical): 35**
Credits: 0-0-2 | **Marks (Internal Assessment): 15**
Hours/Week: 4 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 3 Hours**

Course Objectives: To develop skills for obtaining the numerical solutions of various mathematical problems using different interpolation techniques with the help of C Programming Language.

List of Programs:

Write down and execute the following programs using C Programming Language:

1. To generate the forward difference table of the given data
2. To generate the backward difference table of the given data
3. To interpolate the data using Newton's forward interpolation method
4. To interpolate the data using Newton's backward interpolation method
5. To interpolate the data using Gauss's forward interpolation method
6. To interpolate the data using Gauss's backward interpolation method
7. To interpolate the data using Sterling's interpolation method
8. To interpolate the data using Bessel's interpolation method
9. To interpolate the data using Laplace-Everett's interpolation method
10. To interpolate the data using Newton's divided difference interpolation method
11. To interpolate the data using Lagrange's interpolation method
12. To interpolate the data using Inverse interpolation method
13. To interpolate the data using Interpolation by iteration method
14. To interpolate the data using Bivariate interpolation method

Note: Atleast ten programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of syllabus.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie: The C Programming Language (Second Edition), Pearson Education India (2015).
2. V. Rajaraman: Computer Programming in C (Second Edition), Prentice Hall of India (2019).
3. B.S. Gottfried: Theory and Problems of Programming with C (Third Edition), Schaum's Outlines Series, McGraw Hill Education (2017).
4. E. Balagurusamy: Programming in ANSI C (Sixth Edition), McGraw Hill Education (India) Pvt. Ltd. (2012).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Memorize and describe various data types and file handling functions in C language
CO2: Translate given algorithm to a working and correct program in C language
CO3: Apply different tools/commands for developing programs in C language
CO4: Compare and contrast different algorithms to solve mathematical problems using C language
CO5: Evaluate the numerical solutions of mathematical problems using C programming language
CO6: Assemble object oriented features of C programming language in developing the programs to solve real world problems

24MDC0321T (i): Multidisciplinary Mathematics

Semester: III	**Marks (External):50**
Credits: 3-0-0	**Marks (Internal): 25**
Hours/Week: 3	**Maximum Marks (Total): 75**
Course Type: MDC	**Examination Duration: 2.5 Hours**

Note: The examiner is requested to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks i.e. 12.5 marks.

Course Objectives: To enhance Mathematical skills of students of other disciplines.

Unit I

Matrices and Determinants- Definition of a matrix, Order, Equality, Types of matrices, Operations on matrices- addition, multiplication, multiplication with a scalar and their simple properties. Minors, Cofactors, Properties of determinants and applications of determinants in finding the area of a triangle, Adjoint and inverse of a square matrix, Solutions of simultaneous linear equations.

Unit II

Straight lines- Slope of a line, Angle between two lines, Different forms of equation of a line- Parallel to co-ordinate axes, Point-slope form, Slope-intercept form, Two-point form, General form, Distance of a point from a straight line, Standard form of a circle and its properties.

Unit III

Scatter diagram, Karl Pearson Coefficient (r) of correlation and rank correlation coefficient, Linear Regression- Concept of regression, Principle of least squares- fitting of straight line, Two lines of regression, Properties of regression coefficients, Angle between two lines of regression, Difference between correlation and regression.

Recommended Books:

1. C. Y. Young (2021). Algebra and Trigonometry. Wiley.
2. S.L. Loney (2016). The Elements of Coordinate Geometry (Cartesian Coordinates) (2nd Edition). G.K. Publication Private Limited.
3. Seymour Lipschutz and Marc Lars Lipson (2013). Linear Algebra. (4th Edition) Schaum's Outline Series, McGraw-Hill.
4. J. V. Dyke, J. Rogers and H. Adams (2011). Fundamentals of Mathematics (10th Edition), Brooks/Cole.

Course Outcomes: After completing this course, the students will be able to:

CO1: Understand the basic concepts of matrices and determinants.

CO2: Have the procedural knowledge of the concepts of matrices and determinants to solve simultaneous linear equations.

CO3: Have the conceptual knowledge of straight lines and circles such as slope of a line, angle between two lines and various forms of a straight line and a circle.

CO4: Establish a formulation helping to predict one variable in terms of the other, i.e. correlation and linear regression.

24MDC0321T(ii): Calculus and Optimization

(Already Approved)

Semester: III **Marks (External): 50**
Credits: 3-0-0 **Marks (Internal): 25**
Hours/Week: 3 **Maximum Marks (Total): 75**
Course Type: MDC **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Outcomes: After completing this course, the students will be able to:
CO1: Describe the concepts of limits, continuity, differentiability of a function, and their properties.
CO2: Evaluate the indeterminate forms using L' Hospital's rule.
CO3: Acquire the knowledge and understanding about the partial differentiation, maxima and minima of the functions having two or more independent variables.
CO4: Explain the basic concepts of linear programming problems and its dual.
CO5: Solve linear programming problems using different methods, namely graphical method, simplex method and dual simplex method.

Unit - I

Functions of Single Variable: Definition of the limit of a function, Basic properties of limits, Continuous functions, Classification of discontinuities, Differentiability, Successive differentiation, Leibnitz's theorem, Maclaurin's and Taylor's series expansions, Indeterminate forms, L' Hospital's rule for evaluation of indeterminate forms.

Unit - II

Functions of Two Variables: Limit and continuity of real valued functions of two variables, Partial differentiation, Total Differentials, Composite functions and implicit functions, Change of variables method, Homogenous functions, Euler's theorem on homogeneous functions, Taylor's theorem for functions of two variables, Maxima, Minima and saddle points of two variables functions, Lagrange's method of multipliers for the evaluation of maxima and minima of functions of two variables.

Unit - III

Optimization: Linear Programming - Definitions and Basic Concepts, Formulation of a Linear Programming Problem, Solution of Linear Programming Problems using Graphical Method, Simplex Method and Dual Simplex Method.

Books Recommended:

1. Shanti Narayan, *A Course in Mathematical Analysis,* S. Chand and Company, New Delhi, 2005.
2. S.C. Malik and S. Arora, *Mathematical Analysis,* 5th Edition, New Age International Publisher, 2017.
3. Shanti Narayan, *Differential Calculus,* S. Chand Publishing Company, 2005.
4. Murray R. Spiegel, *Theory and Problems of Advanced Calculus*, Schaum's Publishing Co., New York, 1974.
5. G. Prasad, *Differential Calculus*, Pothishala Pvt. Ltd., Allahabad, 2016.
6. W. Winston and M. Ventataraman, *Introduction to Mathematical Programming*, 4th Edition, Duxbury, 2003.
7. G. Hadley, *Linear Programming*, Addison-Wesley Publishing Company, 1978

24SEC0320T (ii): Vector Calculus and Solid Geometry

Semester: III **Marks (External): 50**
Credits: 3-0-0 **Marks (Internal): 25**
Hours/Week: 3 **Maximum Marks (Total): 75**
Course Type: SEC **Examination Duration: 2.5 Hours**

Note: The examiner is required to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks, i.e. 12.5 marks.

Course Objectives: To familiarize the students with the basic concepts of vector calculus and solid geometry alongwith their applications.

Unit – I

Scalar and vector product of three vectors, product of four vectors. Reciprocal vectors. Vector differentiation. Scalar valued point functions, Vector valued point functions, Derivative along a curve. Gradient of a scalar point function, Geometrical interpretation of grad Φ. Divergence and curl of vector point function. Laplacian operator.

Unit – II

Directional derivatives. Vector integration; Line integral, Surface integral, Volume integral. Gauss divergence theorem, Green's theorem, Stokes' theorem and problems based on these theorems.

Unit – III

General equation of second degree. Tracing of conics.
Sphere: Plane section of a sphere, Sphere through a given circle, Intersection of two spheres.
Cones. Right circular cone and enveloping cone.
Cylinder: Right circular cylinder and enveloping cylinder.

Books Recommended:

1. Murrary R. Spiegal, Vector Analysis, Schaum Publishing Company, New York, (1959).
2. N. Saran and S.N. Nigam, Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad, (1990).
3. Shanti Narayna, A Text Book of Vector Calculus. S. Chand & Co., New Delhi, (2003).
4. R.J.T. Bell, An Elementary Treatise on Coordinate Geometry of Three Dimensions, MacMillan India Ltd. (1994).
5. P.K. Jain and Khalil Ahmad: A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. (1999).

Course Outcomes: After completing this course, the learner will be able to

CO1: Develop general interest in directions as well as magnitude in advance level of learning of vector calculus.
CO2: Learn basic vector ideas about gradient, divergence, curl and directional derivatives.
CO3: Evaluate integrals using applications of Gauss divergence theorem, Green's theorem and Stokes' theorem.
CO4: Sketch various curves.
CO5: Solve the equation of a sphere, cone and cylinder under given conditions.

24MAT0401T: Mechanics

Semester: IV **Marks (External) : 70**
Credits: 4-0-0 **Marks (Internal) : 30**
Hours/Week: 4 **Maximum Marks (Total): 100**
Course Type: DSC **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each**.** In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: To familiarize the students with the basic concepts of Mechanics alongwith applications.

Unit – I

Composition of two forces acting at a point, Resolution of force, Triangle law of forces, $\lambda - \mu$ theorem, Lami's theorem, Polygon law of forces, Theorem of resolved parts, Conditions of equilibrium of concurrent forces, Parallel forces, Centre of parallel forces, Moment about a point, Moment about a line.

Unit – II

Moment of a couple, Equilibrium of two couples, Resultant of two couples, Resultant of a force and a couple, Resolution of a force into a force and a couple, Friction, Laws of statical friction, Coefficient of friction, Angle of friction, Cone of friction, Problems based on equilibrium of rods and ladders, Forces in three dimensions, Conditions of equilibrium of rigid body, Poinsot's central axis.

Unit – III

Velocity and acceleration along plane curve, Radial and transverse velocities and accelerations, Tangential and normal velocities and accelerations, Relative velocity and acceleration, Simple harmonic motion, Velocity and position of a particle executing simple harmonic motion, Amplitude, periodic time and frequency of Simple harmonic motion.

Unit – IV

Mass, Momentum and Force, Newton's laws of motion, Motion of a body resting on a horizontal plane, Motion of two bodies connected by a string, Work, Power and Energy, Principle of Conservation of Energy.

Books Recommended:

1. S.L. Loney, An Elementary Treatise on Statics, Cambridge University Press (2016).
2. R.S. Verma, A Text Book on Statics, Fifth edition, Pothishala Pvt. Ltd., Allahabad (1962).
3. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press (1998).
4. F. Chorlton, Dynamics, Second Edition, CBS Publishers, New Delhi (1983).
5. A.S. Ramsey, Dynamics Part-1 & 2, Cambridge University Press (1962).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Understand the concept of concurrent and parallel forces.
CO2: Gain knowledge about friction and forces in three dimensions.
CO3: Find velocity and acceleration along plane curve.
CO4: Calculate momentum, force and energy.
CO5: Apply the concepts to solve physical problems arising in various scientific fields.

24VOC0425T: Numerical Solution of Linear and Non-linear Equations

Semester: IV **Marks (External): 35**
Credits: 2-0-0 **Marks (Internal): 15**
Hours/Week: 2 **Maximum Marks (Total): 50**
Course Type: MIC(VOC) **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To familiarize the students with some techniques for solving algebraic and transcendental equations, linear and nonlinear equations numerically.

Unit – I

Solution of Algebraic and Transcendental Equations: Introduction, Graphical method to find approximate roots, Fixed point iteration method, Bisection method, Regula-Falsi method, Secant method, Newton-Raphson's method, Newton's iterative method for finding pth root of a number. **Iterative Methods for System of Non-linear Equations:** Complex roots of non-linear equations, Solution of simultaneous non-linear equations.

Unit – II

Simultaneous Linear Algebraic Equations: Introduction of a linear system of equations and types of solutions. **Direct Methods of Solution:** Gauss-elimination method, Gauss-Jordan method, Triangularization method (LU decomposition method), Crout's method, Cholesky Decomposition method. **Iterative Methods of Solution:** Jacobi's method, Gauss-Seidal's method, Relaxation method. **Eigen Value Problems:** Power method, Jacobi's method, Given's method.

Books Recommended:

1. B.S. Grewal: Numerical Methods in Engineering and Science (Ninth Edition), Khanna Publishers, New Delhi (2010).
2. S.S. Sastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
3. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
4. Babu Ram: Numerical Methods (First Edition), Pearson Publication (2009).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define the fundamental concepts related to eigen value problems, linear and non-linear equations.

CO2: Understand basic properties and methods to obtain the solution of eigen value problems, linear and non-linear equations.

CO3: Apply different methods related to eigen value problems, linear and non-linear equations to solve numerical problems in the field of mathematics.

CO4: Analyze the utility of eigen value problems, linear and non-linear equations to model physical problems arising in various scientific fields.

CO5: Evaluate the solutions of mathematical problems numerically using appropriate numerical techniques.

24VOC0425P: Numerical Solution of Linear and Non-linear Equations Lab

Semester: IV | **Marks (External Practical): 35**
Credits: 0-0-2 | **Marks (Internal Assessment): 15**
Hours/Week: 4 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 3 Hours**

Course Objectives: To develop skills for obtaining the numerical solutions of algebraic and transcendental equations, linear and nonlinear equations using C Programming Language.

List of Programs:

Write down and execute the following programs using C Programming Language:

1. To find the root of algebraic and transcendental equations using Fixed point iteration method
2. To find the root of algebraic and transcendental equations using Bisection method
3. To find the root of algebraic and transcendental equations using Regula- Falsi method
4. To find the root of algebraic and transcendental equations using Secant method
5. To find the root of algebraic and transcendental equations using Newton- Raphson method
6. To find the pth root of a number using Newton's iterative method
7. To solve the system of linear equations using Gauss Elimination method
8. To solve the system of linear equations using Gauss - Jordan method
9. To solve the system of linear equations using Crout's method
10. To solve the system of linear equations using Gauss - Jacobi method
11. To solve the system of linear equations using Gauss - Seidel method
12. To find the numerically largest eigen value and the corresponding eigen vector of a matrix using Power method

Note: Atleast ten programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of syllabus.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie: The C Programming Language (Second Edition), Pearson Education India (2015).
2. V. Rajaraman: Computer Programming in C (Second Edition), Prentice Hall of India (2019).
3. B.S. Gottfried: Theory and Problems of Programming with C (Third Edition), Schaum's Outlines Series, McGraw Hill Education (2017).
4. E. Balagurusamy: Programming in ANSI C (Sixth Edition), McGraw Hill Education (India) Pvt. Ltd. (2012).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Memorize and describe various data types and file handling functions in C language
CO2: Translate given algorithm to a working and correct program in C language
CO3: Apply different tools/commands for developing programs in C language
CO4: Compare and contrast different algorithms to solve mathematical problems using C language
CO5: Evaluate the numerical solutions of mathematical problems using C programming language
CO6: Assemble object oriented features of C programming language in developing the programs to solve real world problems

24VAC0408T: Mathematics in Everyday Life

(Already Approved)

Semester: IV	**Marks (External): 35**
Credits: 2-0-0	**Marks (Internal): 15**
Hours/Week: 2	**Maximum Marks (Total): 50**
Course Type: VAC	**Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Outcomes: After completing this course, the learner will be able to:

CO1: develop general interest in Mathematics as a discipline.
CO2: make predictions and draw conclusions based on statistical data.
CO3: develop problem solving skills and apply mathematical concepts to real life situations.
CO4: familiarize the students with basics of probability, random variable & its probability distribution.

Unit - I

Simple interest, Compound interest, Equated monthly installment (EMI), Direct tax calculation (Simple problems), Profit and loss, Work, time and distance, Percentage, Ratio and proportion, Trigonometric Functions: Angles, trigonometric functions of sum and difference of two angles, trigonometric equations.

Unit - II

Sequence and series: Arithmetic progression, Arithmetic mean, Geometric progression, sum of n terms of G.P., Infinite G.P. & its sum, Geometric mean, Relation between A.M. & G.M., Permutation and combinations (simple applications), Mean, Mode, Median, Standard deviation, Variance, Bar graphs, Pie Charts, Probability: Sample space, event, types of events, algebra of events, probability of an event,

Books Recommended:

1. Richa Aggarwal (2019), How to Crack Test of Arithmetic, Arihant Publications.
2. Mritunjay Kumar (2015), Business Mathematics, Vikas Publishing House.
3. S. C Gupta and V. K. Kapoor (2020), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
4. Jaikishan and Premkishan (2022), How to Crack Test of Reasoning in all Competitive Exams., Arihant Publications.

24MAT0501T: Real Analysis

Semester: V **Marks (External): 70**
Credits: 4-0-0 **Marks (Internal): 30**
Hours/Week: 4 **Maximum Marks (Total): 100**
Course Type: DSC **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: To acquaint the students with the topics of sequence and series of numbers, Riemann Integral, Metric Spaces and its properties.

Unit – I

Sequences and subsequences. Convergence of sequences. Cauchy general principle of convergence. Infinite series: Convergence and divergence of infinite series, Comparison Tests of series of positive terms. D-Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Gauss's Test, Cauchy's integral test.

Unit – II

Riemann integral: Definition and examples, Existence theorems of Riemann's integral, Riemann's sum, Properties of Riemann's integral, Integrability of continuous and monotonic functions, The Fundamental theorem of integral calculus.

Unit – III

Definition and examples of metric spaces, open and closed sets, closure and interior sets, subspace of a metric space. Complete metric space, Cantor's intersection theorem, Completeness. First and second category spaces, Baire's category theorem, separable space, first and second countable spaces.

Unit – IV

Compactness of metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity and compactness. Connectedness: separated sets, connected and disconnected sets. components, continuity and connectedness.

Books Recommended:

1. R.R. Goldberg, Real Analysis, Oxford & IBH publishing Co., New Delhi, 1970.
2. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, 1996.
3. Satish Shirali and Harkrishan L. Vasudeva, Metric Spaces, Springer, 2006.
4. D.A. Brannan, A First Course in Mathematical Analysis, Cambridge University Press, New York, 2006.
5. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, John Wiley & Sons Inc., USA, 2011.
6. C.G. Denlinger, Elements of Real Analysis, 1st Ed., Jones and Bartlett Publishers, UK, 2011.
7. P.K. Jain, Metric Spaces, 3rd Ed., Narosa, India, 2019.
8. D. Gopal, A. Deshmukh, A.S. Ranadive and S. Yadav, An Introduction to Metric Spaces, 1st Ed., CRC Press, 2021.
9. S.C. Malik, Principles of Real Analysis, 5th Ed., New Age International Pvt. Ltd., New Delhi, 2021.

Course outcomes: After completing this course, the learner will be able to:

CO1: Define the convergence and divergence of the sequence and series of real numbers.
CO2: Get the knowledge of Riemann integral and related theorems.
CO3: Gain knowledge of metric spaces, related concepts and completeness of metric spaces.
CO4: Understand the concepts of compactness and connectedness of metric spaces and related theorems.

24VOC0525T: Computational Techniques

Semester: V **Marks (External): 35**
Credits: 2-0-0 **Marks (Internal): 15**
Hours/Week: 2 **Maximum Marks (Total): 50**
Course Type: MIC(VOC) **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To provide comprehensive understanding of finite difference operators, various interpolation techniques, numerical differentiation and integration for solving different mathematical problems numerically.

Unit – I

Finite Differences: Finite difference operators and their relations, Differences of a polynomial, Finding the missing terms and effect of error in a difference tabular values.
Interpolation with Equal Intervals: Newton's forward and Newton's backward interpolation formulae, Gauss's forward and Gauss's backward interpolation formulae, Sterling's interpolation formula, Bessel's interpolation formula.
Interpolation with Unequal Intervals: Divided differences and their properties, Newton's divided difference interpolation formula, Lagrange's interpolation formula.

Unit – II

Numerical Differentiation: Derivatives using Newton's forward difference interpolation formula, Newton's backward difference interpolation formula, Gauss's forward difference interpolation formula, Gauss's backward difference interpolation formula, Sterling's interpolation formula, Bessel's interpolation formula, Newton's divided difference interpolation formula.
Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Boole's rule, Weddle's rule.

Books Recommended:

1. B.S. Grewal: Numerical Methods in Engineering and Science (Ninth Edition), Khanna Publishers, New Delhi (2010).
2. S.S. Sastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
3. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
4. Babu Ram: Numerical Methods (First Edition), Pearson Publication (2009).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define the basic concepts related to various finite difference operators, interpolation techniques, numerical differentiation and integration.
CO2: Understand and explain fundamental properties of various finite difference operators, interpolation techniques, numerical differentiation and integration.
CO3: Apply different computational techniques to solve numerical problems in the field of mathematics.
CO4: Analyze the utility of various finite difference operators, interpolation techniques, numerical differentiation and integration to model real life problems.
CO5: Evaluate the solutions of mathematical problems numerically using appropriate computational techniques.

24VOC0525P: Computational Techniques Lab

Semester: V | **Marks (External Practical): 35**
Credits: 0-0-2 | **Marks (Internal Assessment): 15**
Hours/Week: 4 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 3 Hours**

Course Objectives: To familiarize the students with the numerical solutions of various mathematical problems using different computational techniques with the help of C Programming Language.

List of Programs:

Write down and execute the following programs using C Programming Language:

1. To generate the forward difference table of the given data
2. To generate the backward difference table of the given data
3. To interpolate the data using Newton's forward interpolation method
4. To interpolate the data using Newton's backward interpolation method
5. To interpolate the data using Gauss's forward interpolation method
6. To interpolate the data using Gauss's backward interpolation method
7. To interpolate the data using Newton's divided difference interpolation method
8. To interpolate the data using Lagrange's interpolation method
9. To compute derivative of a tabulated function at the initial point using Newton's forward interpolation method
10. To compute derivative of a tabulated function at the final point using Newton's backward interpolation method
11. To compute derivative of a tabulated function using Gauss's forward interpolation method
12. To compute derivative of a tabulated function using Gauss's backward interpolation method
13. To integrate numerically using Trapezoidal rule
14. To integrate numerically using Simpson's one-third rule
15. To integrate numerically using Simpson's three-eighth rule
16. To integrate numerically using Boole's rule
17. To integrate numerically using Weddle's rule

Note: Atleast ten programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of syllabus.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie: The C Programming Language (Second Edition), Pearson Education India (2015).
2. V. Rajaraman: Computer Programming in C (Second Edition), Prentice Hall of India (2019).
3. B.S. Gottfried: Theory and Problems of Programming with C (Third Edition), Schaum's Outlines Series, McGraw Hill Education (2017).
4. E. Balagurusamy: Programming in ANSI C (Sixth Edition), McGraw Hill Education (India) Pvt. Ltd. (2012).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Memorize and describe various data types and file handling functions in C language
CO2: Translate given algorithm to a working and correct program in C language
CO3: Apply different tools/commands for developing programs in C language
CO4: Compare and contrast different algorithms to solve mathematical problems using C language
CO5: Evaluate the numerical solutions of mathematical problems using C programming language
CO6: Assemble object oriented features of C programming language in developing the programs to solve real world problems

24MAT0505I: Internship

Semester: V
Credits: 4-0-0
Hours/Week: 30
120 Hours (4 Weeks)
Time: Presentation (30 Minutes)

Marks (External): 00
Marks (Internal): 100
Maximum Marks (Total): 100

Note: The evaluation of the internship shall be done by a committee comprising of at least two senior teachers appointed by the Chairperson of the Department. Marks will be awarded by the committee out of 100 marks on the basis of the report and viva-voce examination as per university rules.

24MAT0601T: Algebra

Semester: VI **Marks (External): 70**
Credits: 4-0-0 **Marks (Internal): 30**
Hours/Week: 4 **Maximum Marks (Total): 100**
Course Type: DSC **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: Students will get familiarize with the concepts of group, subgroup, vector space and their homomorphism.

Unit – I

Definition of a group with example and simple properties of groups, Subgroups and subgroup criteria, Generation of groups, Cyclic groups, Center of a group. Cosets, Left and right cosets, Index of a sub-group, Coset decomposition. Largrage's theorem and its consequences.

Unit – II

Normal subgroups, Quotient groups, Homomorphisms, Isomophisms, Automorphisms and Inner automorphisms of a group, Kernal of a homomorphism, Fundamental theorem of homomorphism and related theorems. Permutations groups. Even and odd permutations. Cayley's theorem.

Unit – III

Vector spaces, Subspaces, Sum and direct sum of subspaces, Linear span, Linearly independent and dependent subsets of a vector space. Finitely generated vector space, Extension theorem, Existence theorem for basis of a finitely generated vector space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets. Dimensions.

Unit – IV

Quotient space and its dimension. Homomorphism of vector spaces (Linear transformation), One-one, Onto linear transformation, Vector space isomorphism, Finding a linear transformation when images of basis set is given. Null space, Range space of a linear transformation, Fundamental theorem of vector space homomorphism, Rank and nullity theorem.

Books Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, (1975).
2. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House , (2006).
3. V. K. Krishnamurthy, V. P. Mainra, V.P. and J. L. Arora, An introduction to Linear Algebra, Affiliated East West Press, (1976).

Course outcomes: After completing this course, the students will be able to:

CO1: Describe the concepts of groups, subgroups, cyclic groups, and structure preserving maps between groups and their consequences.
CO2: Explain the significance of the notions of cosets, normal subgroups, and factor groups, also analyze various consequences of Lagrange's theorem.
CO3: Describe the concepts of vector spaces, subspaces, bases, dimensions, and their properties.
CO4: Determine linear independence and dependence for vectors in R^n, the rank and nullity of a linear transformation.

24MIC0625T: Modern Algebra

Semester: VI | **Marks (External): 70**
Credits: 4-0-0 | **Marks (Internal): 30**
Hours/Week: 4 | **Maximum Marks (Total): 100**
Course Type: MIC | **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: Students will get familiarize with the concepts of group, subgroup, vector space and their homomorphism.

Unit – I

Definition of a group with example and simple properties of groups, Subgroups and subgroup criteria, Generation of groups, Cyclic groups, Center of a group. Cosets, Left and right cosets, Lagrange's theorem and its consequences.

Unit – II

Introduction to rings, Subrings, Ideals, Maximal ideal, Prime ideal, Rings with zero divisors, Integral domains, Definition and examples of skew fields and fields, Quotient rings.

Unit – III

Vector spaces, Subspaces, Sum and direct sum of subspaces, Linear span, Linearly independent and dependent subsets of a vector space, Finitely generated vector space, Finite dimensional vector spaces.

Unit – IV

Definition and properties of linear transformations, Kernel and image of a linear transformation, Rank and nullity of a linear transformation, Singular and non-singular linear transformations.

Books Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, (1975).
2. I.S. Luther and I.B.S. Passi, Algebra volume-2: Rings, Narosa Publishing House, (1999).
3. P. B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, (2002).
4. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, (2006).
5. Vivek Sahai and Vikas Bist, Algebra, 4th Edition, Narosa Publishing House, (2018).

Course outcomes: After completing this course, the students will be able to:

CO1: Describe the concepts of groups, subgroups, cyclic groups, significance of the notions of cosets and also analyze various consequences of Lagrange's theorem.

CO2: Explain the concepts of rings, subrings, ideals, integral domains, skew-fields, fields and quotient rings.

CO3: Describe the concepts of vector spaces, subspaces, bases, dimensions, and their properties.

CO4: Determine linear independence and dependence for vectors in R^n, the rank and nullity of a linear transformation.

24VOC0625T: Numerical Solution of Differential Equations and Curve Fitting

Semester: VI | **Marks (External): 35**
Credits: 2-0-0 | **Marks (Internal): 15**
Hours/Week: 2 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To develop deep understanding of some techniques for solving ordinary differential equations, difference equations and curve-fitting problems numerically.

Unit – I

Numerical Solution of Ordinary Differential Equations: Single step methods - Picard's method, Taylor's series method, Euler's method, Runge-Kutta Methods; Multiple step methods - Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.
Difference Equations: Formation of difference equations, Linear difference equations, Difference equations reducible to linear form.

Unit – II

Empirical Laws and Curve-Fitting: Introduction, Graphical method, Laws reducible to the linear law, Method of group averages, Laws containing three constants ($y=a+bx+cx^2$, $y=a+bx^c$, $y=a+be^{cx}$), Principle of least squares, Method of least squares, Fitting of other curves ($y=ax^b$, $y=ae^{bx}$, $xy^a=b$), Method of moments.

Books Recommended:

1. B.S. Grewal: Numerical Methods in Engineering and Science (Ninth Edition), Khanna Publishers, New Delhi (2010).
2. S.S. Sastry: Introductory Methods of Numerical Analysis (Fifth Edition), Prentice Hall India Learning (P) Ltd., New Delhi (2012).
3. M.K Jain, S.R.K. Iyengar, R.K. Jain: Numerical Methods: Problems and Solutions (Third Edition), New Age International (P) Ltd., New Delhi (2020).
4. Babu Ram: Numerical Methods (First Edition), Pearson Publication (2009).
5. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis (Seventh Edition), Pearson Education India, Noida (2007).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define the fundamental concepts related to ordinary differential equations, difference equations and curve-fitting.
CO2: Understand basic properties and methods to obtain the solution of ordinary differential equations, difference equations and curve-fitting.
CO3: Apply different methods related to ordinary differential equations, difference equations and curve-fitting to solve numerical problems in the field of mathematics.
CO4: Analyze the utility of ordinary differential equations, difference equations and curve-fitting to model physical problems arising in various scientific fields.
CO5: Evaluate the solutions of mathematical problems numerically using appropriate numerical techniques.

24VOC0625P: Numerical Solution of Differential Equations and Curve Fitting Lab

Semester: VI | **Marks (External Practical): 35**
Credits: 0-0-2 | **Marks (Internal Assessment): 15**
Hours/Week: 4 | **Maximum Marks (Total): 50**
Course Type: MIC(VOC) | **Examination Duration: 3 Hours**

Course Objectives: To familiarize the students with the numerical solutions of ordinary differential equations, difference equations and curve-fitting problems using C Programming Language.

List of Programs:

Write down and execute the following programs using C Programming Language:

1. To find numerical solution of ordinary differential equations using Taylor's series method
2. To find numerical solution of ordinary differential equations using Euler's method
3. To find numerical solution of ordinary differential equations using Modified Euler's method
4. To find numerical solution of ordinary differential equations using Runge- Kutta method
5. To find numerical solution of ordinary differential equations using Milne-Simpson's method
6. To fit a straight line to the given data using method of least squares
7. To fit a straight line to the given data using method of group averages
8. To fit a second degree parabola to the given data using method of least squares
9. To fit a second degree parabola to the given data using method of moments
10. To find which of two fits, one straight line and the other a second degree parabola, is a closer fit to the given data
11. To fit an exponential curve to the given data
12. To fit a curve of the type $y=ax^b$, $y=ae^{bx}$, $xy^a=b$

Note: Atleast ten programs are to be performed by students from the above list. The list of programs may vary. The course coordinator may also design programs in addition to the above list/topic as per the scope and requirement of syllabus.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie: The C Programming Language (Second Edition), Pearson Education India (2015).
2. V. Rajaraman: Computer Programming in C (Second Edition), Prentice Hall of India (2019).
3. B.S. Gottfried: Theory and Problems of Programming with C (Third Edition), Schaum's Outlines Series, McGraw Hill Education (2017).
4. E. Balagurusamy: Programming in ANSI C (Sixth Edition), McGraw Hill Education (India) Pvt. Ltd. (2012).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Memorize and describe various data types and file handling functions in C language
CO2: Translate given algorithm to a working and correct program in C language
CO3: Apply different tools/commands for developing programs in C language
CO4: Compare and contrast different algorithms to solve mathematical problems using C language
CO5: Evaluate the numerical solutions of mathematical problems using C programming language
CO6: Assemble object oriented features of C programming language in developing the programs to solve real world problems

24MIC0125T: Basic Algebra

Semester: I **Marks (External): 35**
Credits: 2-0-0 **Marks (Internal): 15**
Hours/Week: 2 **Maximum Marks (Total): 50**
Course Type: MIC **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To familiarize the students with the topics of matrices, eigen values and eigen vectors, application of matrices to system of linear equations, bilinear and quadratic forms.

Unit – I

Elementary operations on matrices, Rank of a matrix, Inverse of a matrix, Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Unit – II

Applications of matrices to a system of linear homogeneous and non–homogeneous equations, Consistency of a system of linear equations, Unitary and orthogonal matrices, Bilinear and quadratic forms.

Books Recommended:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications, (1994).
2. S. Narayan and P.K. Mittal: A Text Books of Matrices, S. Chand Publication, (2010).
3. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad, (2017).

Course Outcomes: After completing this course, the students will be able to:
CO 1. Calculate the rank, eigen values, eigen vectors of a matrix.
CO 2. Check the consistency of a system of linear equations.
CO 3. Form Bilinear and quadratic forms of a matrix.
CO 4. Apply the concepts to solve physical in various fields.

24MIN0125T: Basic Algebra

Semester: I | **Marks (External): 70**
Credits: 4-0-0 | **Marks (Internal): 30**
Hours/Week: 4 | **Maximum Marks (Total): 100**
Course Type: MIN | **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: To familiarize the students with the concepts related to matrices and its applications to a system of linear equations, roots of polynomial equations, Cardon's method and Descarte's method.

Unit – I

Elementary operations on matrices, Rank of a matrix, Inverse of a matrix, Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, Eigenvectors and characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Unit – II

Applications of matrices to a system of linear homogeneous and non–homogeneous equations, Consistency of a system of linear equations, Unitary and orthogonal matrices, Bilinear and quadratic forms.

Unit – III

Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots, Common roots and multiple roots, Transformation of equations.

Unit – IV

Nature of the roots of an equation, Descarte's rule of signs, Solutions of cubic equations (Cardon's method), Biquadratic equations and their solutions.

Books Recommended:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications, (1994).
2. S. Narayan and P.K. Mittal: A Text Books of Matrices, S. Chand Publication, (2010).
3. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad, (2017).

Course Outcomes: After completing this course, the students will be able to:

CO 1. Calculate the rank, eigen values and the minimal polynomial of a matrix.
CO 2. Use rank as a tool to check the consistency of a system of linear equations.
CO 3. Find the roots of a polynomial equation.
CO 4. Apply the concepts to solve physical in various fields.

24MIC0225T: Elementary Differential Equations

Semester: II | **Marks (External): 35**
Credits: 2-0-0 | **Marks (Internal): 15**
Hours/Week: 2 | **Maximum Marks (Total): 50**
Course Type: MIC | **Examination Duration: 2 Hours**

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set, two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Course Objectives: To familiarize the students with the topics of Ordinary Differential Equations, Lagrange's and Clairaut's equations, Linear Differential Equations and Method of variations of parameters.

Unit – I

Ordinary differential equations, Exact differential equations, Integrating factors, First order higher degree equations solvable for *x, y, p,* Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form, Singular solutions.

Unit – II

Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations, Equations reducible to homogeneous linear form, Linear differential equations of second order, Transformation of the equation by changing the dependent variable, Method of variations of parameters.

Books Recommended:

1. D.A. Murray, Introductory Course in Differential Equations. Orient Longaman Pvt. Ltd., India, (1967).
2. S.L. Ross, Differential Equations, 3rd Edition, John Wiley & Sons Ross, (2004).
3. B. Rai and D.P. Chaudhary, Ordinary Differential Equations, Narosa Publishing House, (2021).

Course Outcomes: After completing this course, the learner will be able to:
CO1: Define differential equations of first and higher orders.
CO2: Form differential equations of various orders.
CO3: Solve differential equations with constant/ variable coefficients.
CO4: Apply the concepts of differential equations in solving physical problems.

24MIN0225T: Elementary Differential Equations

Semester: II | **Marks (External): 70**
Credits: 4-0-0 | **Marks (Internal): 30**
Hours/Week: 4 | **Maximum Marks (Total): 100**
Course Type: MIN | **Examination Duration: 3 Hours**

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two questions from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks.

Course Objectives: To familiarize the students with the concepts of Ordinary and Partial Differential Equations and various techniques to find the solutions of above equations.

Unit – I

Ordinary differential equations, Exact differential equations, Integrating factors, First order higher degree equations solvable for *x, y, p,* Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form, Singular solutions.

Unit – II

Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations, Equations reducible to homogeneous linear form, Linear differential equations of second order, Transformation of the equation by changing the dependent variable, Method of variations of parameters.

Unit – III

Partial differential equations, Order and Degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, Singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution.

Unit – IV

Linear partial differential equations of second and higher orders, Linear homogeneous and non-homogeneous differential equations with constant coefficients, Partial differential equation with variable coefficients reducible to equations with constant coefficients, their complementary functions and particular integrals.

Books Recommended:

1. D.A. Murray, Introductory Course in Differential Equations. Orient Longaman Pvt. Ltd., India, (1967).
2. I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, (1988).
3. S.L. Ross, Differential Equations, 3rd Edition, John Wiley & Sons Ross, (2004).
4. J.N. Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, (2009).

Course Outcomes: After completing this course, the learner will be able to:

CO1: Define differential equations of first and higher orders.
CO2: Form differential equations of various orders.
CO3: Solve differential equations with constant/ variable coefficients.
CO4: Apply the concepts of differential equations in solving physical problems.

24MDC0121T (ii): Mathematics for Professional Success-I

Semester: I	**Marks (External):50**
Credits: 3-0-0	**Marks (Internal): 25**
Hours/Week: 3	**Maximum Marks (Total): 75**
Course Type: MDC	**Examination Duration: 2.5 Hours**

Note: The examiner is requested to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks i.e. 12.5 marks.

Course Objectives: To familiarize the students with the topics number system, time and distance, time and work, probability and data representation.

Unit I

Number system, Decimal fractions, Square roots and cube roots, Problems on numbers, Problems on ages, Use of concepts of HCF and LCM, Percentage, Ratio and proportion.

Unit II

Time and distance, Time and work, Clock and calendar; Allegations or mixture, Area, Volume and surface areas, Trigonometric ratios, Height and distance, Pipes and cisterns, Boats and streams, Races and games.

Unit III

Probability, Classification of data- Frequency distribution and Tabulation, Graphical representation of data- Bar graphs, Pie charts and Line graphs, Mean, Median and Mode.

Suggested Readings:

1. R.S. Aggarwal (2022). *Quantitative Aptitude*, S. Chand Publishing.
2. S.C. Gupta and V.K. Kapoor (2020). *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.
3. A.S. Posamentier and C. Spreitzer (2018). *The Mathematics of Everyday Life.* Prometheus Books, llustrated Edition.
4. Dinesh Khattar (2008). The Pearson Guide to Objective Arithmetic for Competitive Examinations, Pearson 2nd Edition.

Course Outcomes: After completing this course, the students will be able to understand

CO1: Patterns and relationships.
CO2: Basic calculations and measurements.
CO3: About ratios and proportions.
CO4: The tabular and graphical representations of data based on variables.
CO5: Measures of central tendency such as mean, median, mode and their properties.

24MDC0221T (ii): Mathematics for Professional Success-II

Semester: II	**Marks (External):50**
Credits: 3-0-0	**Marks (Internal): 25**
Hours/Week: 3	**Maximum Marks (Total): 75**
Course Type: MDC	**Examination Duration: 2.5 Hours**

Note: The examiner is requested to set seven questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 1. All questions shall carry equal marks i.e. 12.5 marks.

Course Objectives: To familiarize the students with the topics of interest, annuity, arithmetic progression, geometric progression, harmonic progression, linear programming problems.

Unit I

Interest - Concept of present value and future value, Simple interest, Compound interest, Nominal and effective rate of interest, Depreciation and discount, Annuity- Ordinary annuity, sinking fund, annuity due, present value and future value of annuity.

Unit II

Arithmetic progression, Geometric progression, Harmonic progression, Arithmetic mean (A.M.), Geometric mean (G.M.), Harmonic mean (H.M.), Relation between A.M., G.M. and H.M.

Unit III

Formulation of linear programming problems (LPP) and their solution by graphical and Simplex methods, Applications of linear programming in solving business problems.

Suggested Readings:

1. R.S. Aggarwal (2022). *Quantitative Aptitude*, S. Chand Publishing.
2. M.K. Bhowal (2009). *Fundamentals of Business Mathematics,* Asian Books.
3. S.C. Gupta and V.K. Kapoor (2020). *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.
4. A.S. Posamentier and C. Spreitzer (2018). The Mathematics of Everyday Life, Prometheus Books, Illustrated Edition.
5. L.N.Paul (2002). *Linear Programming: An Introductory Analysis*. Tata Mcgraw Hill. New Delhi.

Course Outcomes: After completing this course, the students will be able to understand

CO1: The concepts of compound interest and annuity.
CO2: Everyday banking transactions.
CO3: The basics of Arithmetic progression, Geometric progression and Harmonic progression.
CO4: The concepts of Linear programming and develop skills of formulating and solving linear programming problems based on real world problems.