COURSE: REAL ANALYSIS (Theory) **[As per Choice Based Credit System (CBCS) Scheme]** **Semester –I (M.Sc. Mathematics)**			
Course Code	**23MRA11**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Have the knowledge of basic properties of the field of real numbers, of real functions-limits of functions and their properties, series of real numbers and convergence.
- Studying Stone –Weirstrass Theorem and Cauchy criteria. Studying the differentiability of real. Functions
- The aim is to provide the development of subject matter which is honest, rigorous, at the same time not too pedantic

MODULES	**Teaching Hours**
MODULE I: The Riemann-Stieltjes Integrals: The Least Upper Bound Property (LUB Property) and the Greatest Lower Bound Property (GLB Property). Definitions and existence of integral properties of the integral function of bounded variation.	14 hours
MODULE II: Integral and differentiation. First and second Mean value theorem. Change of variables. Sequences and Series Functions. Absolute and conditional convergence of series.	12 hours
MODULE III: Uniform Convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, uniform convergence and bounded variations, Equi-continuous families of functions. The Stone-Weirstrass theorem.	14 hours
MODULE IV: Functions of Several Variables: Maxima and minima of functions of several variables, linear transformations, differentiations, the contractions principles and the inverse function theorem, the implicit function theorem and the rank theorem.	12 hours
MODULE V: Archimedean Property. Biography of Srinivas Ramanujam, Biography of Aryabhata, Biography of Bhaskaracharya, Biography of Leonhard Euler, Biography of Gottfried W Leibnitz. The Existence of Density of Rational Numbers.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- CO1: Understand the History of mathematicians and the basic concepts related to mathematics and real numbers, recognize the basic properties of the field of real numbers real functions and its limits
- CO2: Define and recognize Stone- Weirstrass theorem ability to apply the theorem in a correct mathematical way.
- CO3: If a sequence of functions converges uniformly to a function, then under certain conditions, the integral of the limit function is the limit of the integrals of the sequence of functions.
- CO4: Ability to analyze surfaces and understand their critical points, which is crucial in optimization and mathematical modeling
- CO5: Appreciating the contributions of renowned mathematicians like Ramanujan, Aryabhata, Bhaskaracharya, Euler, and Leibniz to the field of mathematics.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- H. L. Royden, P M Fitzpatrick, Real Analysis, PHI Publication, (2010).
- Shanti Narayn, Elements of Real Analysis, S. Chand Publication, (1986).
- S. C Malik, Principles of Real Analysis, New age international Publications, (2017).
- Walter Rudin, Principles of Mathematical Analysis, (1976).
- S. L. Gupta and N. R. Gupta: Principles of Real Analysis, Second Edition, Pearson Education (2003).
- C. Goffman, Real functions, Holt, Rinehart and Winston Inc. New York (1953).

COURSE: ALGEBRA-I (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MAL12**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- This approach to teaching algebra should help students attach meaning to the abstract concepts of algebra.
- These standards require students to use algebra as a tool for representing and solving a variety of practical problems.
- Tables and graphs will be used to interpret algebraic expressions, equations and inequalities and to analyze behaviors of functions.
- Graphing calculators, computers and other appropriate technology tools will be used to assist in teaching and learning.

MODULES	Teaching Hours
MODULE I: Natural numbers, Properties of natural numbers, Natural numbers as a Well-ordered set, Sets. Power set, factor, divisibility, Peason's Axiom (Statement) The integers Relatively prime, First and second principle of induction, fundamental theorem of arithmetic.	14 hours
MODULE II: Equivalence relation Conjugacy, self-conjugate, normalized class equation permutation groups and their properties Group, subgroup-definition, monoid sub-monoid, normal sub group elementary properties, Normal subgroup and quotient group, Group homomorphisms, Isomorphism theorems and the correspondence theorem.	12 hours
MODULE III Cauchy's Theorem Cyclic group, Center of a group and commutate subgroup of a group solvable group, Sylow's theorems and its applications, direct product products and types, finite abelian groups have direct product of cyclic group.	14 hours
MODULE IV: Ring Definition sub ring and types, Field of quotients of an integral domain, Euclidean Rings, Fermat's theorem, Einstein Criterion, Unique Factorization Theorem and Domain, Modulus and rings.	12 hours
MODULE V: Extension Fields, Algebraic and Transcendental extensions, Roots of Polynomial splitting Fields, Finite Fields, Perfect Fields, Simple Fields.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Students will demonstrate a comprehensive understanding of fundamental concepts in number theory.

CO2: Students with a solid foundation in group theory, and will develop analytical skills essential for advanced studies in abstract algebra and related fields.

CO3: Students will be proficient in applying Cauchy's Theorem to determine the existence of elements of prime order in groups

CO4: Students will demonstrate proficiency in defining rings and subrings, various types of rings, thus gaining a foundational understanding of algebraic structures and their applications in mathematics and related disciplines.

CO5: Students will be adept at understanding extension fields, thus acquiring a comprehensive understanding of field theory and its applications in algebraic structures and related areas of mathematics.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- C. C. Pinter, Set Theory, Addison-Wesley Publishing Co. Reading, Massechusetts (1971).
- I. N. Herstein, Topics in Algebra, 2nd Edition, John-Wiley & Sons, New York (1975).
- Y. F. Lin & S. Y. T. Lin, Set Theory-An Intuitive Approach, Houghton Mifflin Company, Boston (1974).
- Surjit Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publishing House (1990).
- S. K. Jain, P. B. Bhattacharya & S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press (1997).
- J. J. Rotman, The Theory of Groups, an Introduction, Allya & Bacon (1965).
- S. Maclane & G. Birkhoff, Algebra, Mc Millan Co., New York (1967).
- S. M. Srivastava, A Course on Borel Sets (Chapter – I), Springer-Verlag, New York (1998).
- M. Artin, Algebra, Prentice Hall of India (2004).

COURSE: ORDINARY DIFFERENTIAL EQUATIONS (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MOD13**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Understand the basics of differential equation, they identify the different form of ordinary differential equations and applications.
- Understand the new techniques to solve the differential equation

MODULES	Teaching Hours
MODULE I: Ordinary differential equation: Differential equation and classification Linear-Differential equation, fundamental sets of solution and their standard properties, the Wronskian, existence and uniqueness theorem. Singular solution of first order ODE's, System of First order PDE	14 hours
MODULE II: Introduction The Adjoint equation self-Adjoint equation and standard properties, the Sturm theorem Abel's formula sturm separation theorem sturm comparison theorem Conversion of standard theorem from normal form	14 hours
MODULE III: Boundary Value problems: Two-point Boundary value problems, Sturm-Liouville problem, Solution by Green's function Eigen Function and expansion formula, comparison and separation theorem on the zeroth solution of the Sturm-Liouville equations.	12 hours
MODULE IV: Riccati's Equation: Riccati's differential equations, General solution of Riccati's equation, a theorem on particular integrals a of Riccati's equations, illustrative examples.	12 hours
MODULE V: Power Series Solution of Differential Equation: Basic concepts of power series solutions, Examples, Power series solutions about an ordinary point, examples, The working rule of Frobenius method, Examples, Existence theorem, uniqueness theorem, existence theorem and uniqueness theorem (The general case).	12 hours

Course Outcomes:

After studying this course, students will be able to:

- CO1: A determinant used to determine linear independence of solutions of a linear homogeneous differential equation.
- CO2: the context of linear operators, an adjoint equation is the dual of a given equation. It provides a way to study properties such as self-ad jointness and eigenvalues of linear operators.
- CO3: The study of second-order linear ordinary differential equations. It involves finding eigenvalues and eigenfunctions for a Sturm-Liouville operator, which is a differential operator of a specific form
- CO4: Based on power series method understand the regular, singular and ordinary point.
- CO5: Solve the eigen value and eigen vector and finding the working rule of orthogonality.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- E.A. Coddington, Introduction to Ordinary Differential Equations (1961).
- Boyce and Diprima, Elementary Differential Equations and Boundary Value Problems, J.Wiley (1965).
- Gupta, Malik and mittal, differential equation 3ed, (1995).
- G.F.Simmons, Introduction to Differential Equations, Tata McGraw (2017).

COURSE: GRAPH THEORY (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MGT14**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable the students to:

- Learn basics about graph theory and can draw graphs.
- Learn core ideas in Plane graph and its real-world applications.
- Practice creative problem solving and improve skills in this area.
- Learn about coloring, edge coloring, vertex coloring and can know its application.

MODULES	Teaching Hours
MODULE I: Graph, Degree of a vertex spanning sub graph, induced sub graph, walk, trail, path, cycle, girth circumference, component, isomorphism, cut vertex, bridge, regular graph, complimentary of a graph, self-complimentary graph, complete graph, bipartite graph, complete bipartite graph.	**14 hours**
MODULE II: Planar Graph: Operations on graph, combinatorial & geometrical graphs, planar graph, plane graph, maximal planar graph, detection of planarity, sub division of graph, inner vertex set, inner vertex number, outer planar minimally non outer planar graph.	**14 hours**
MODULE III: crossing number and thickness of a graph, coloring, color class chromatic number of a graph, Bi-Chromatic graph, vertex coloring, vertex coloring algorithm, simple sequential algorithm, welsh- Powell algorithm smallest last sequential algorithm.	**12 hours**
MODULE IV: Edge coloring of a plane map Four color problem edge covering number vertex covering number, vertex independence number, edge independence number. Factor of G, n-factorization, 2-facotization,	**12 hours**
MODULE V: Dominating numbers, dominating sets and total dominating sets, total dominating number.	**12 hours**

Course Outcomes:

After studying this course.

CO1: Students will gain proficiency in understanding and analyzing basic parameters of graphs, providing them with foundational knowledge in graph theory applicable across various domains.

CO2: Students will develop a solid understanding of the fundamental concepts in graph theory with a focus on trees, they will also gain proficiency in analysing forests and their properties, providing them with essential knowledge applicable in computer science.

CO3: Students will acquire a thorough understanding of cut points, bridges, and blocks in graphs, including the analysis of block graphs and cut point graphs. one-factorizations, providing them with essential tools for analysing and solving problems in graph theory and related areas.

CO4: Students will comprehend the concepts of Eulerian and Hamiltonian graphs, through theoretical understanding and practical application, they will develop proficiency in analysing and solving problems related to these concepts

CO5: Students will apply graph theory to real-life scenarios enabling them to develop practical problem-solving skills and analytical thinking abilities applicable in various domains including logistics, telecommunications, scheduling, and resource allocation.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- M. Behzad, G. Charatrand and L. Lesniak-Foster: Graphs and Digraphs, Wadsworth, Belmont, Calif (1981).
- Narasing Deo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, India (1995).
- J. A. Bondy and U. S. R. Murthy: Graph Theory with Applications, MacMillan, London (1976).
- F. Buckley and F. Harary: Distance in Graphs, Addison-Wesley (1990).
- Diestel: Graph Theory, Springer-Verlag, Berlin (2002).
- R. Gould: Graph Theory, the Benjamin / Cummings Publ. Co. Inc. Calif (1988).
- F. Harary: Graph Theory, Addison Wesley, Reading mass (1969).

<table>
<tr><td colspan="4">COURSE: DISCRETE MATHEMATICS (Theory)
[As per Choice Based Credit System (CBCS) Scheme]
Semester –I (M.Sc. Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MDM15</td><td>Maximum Marks (CIE)</td><td>50</td></tr>
<tr><td>Number of Teaching Hours/Week</td><td>04</td><td>Maximum Marks (SEE)</td><td>50</td></tr>
<tr><td>Total No of Teaching Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives: this course will enable students to:
• Demonstrate their understanding by using mathematical terminology and notation.
• Construct correct direct and indirect proofs.
• Apply logical reasoning to solve a variety of problems.
• Use finite-state machines to model computer operations</td></tr>
<tr><td colspan="3">MODULES</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">MODULE I: Boolean Algebra and Lattices: Partially ordered sets. Lattices, distributive, complemented lattices. Boolean lattice and algebra, unions and finite functions and Boolean algebra. Boolean functions and Boolean expressions, Propositional calculus, design and implementation of digital networks and switching circuits</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE II: Combinatorics: Basic counting principles, permutations and combinations, principles of inclusion and exclusion, recurrence relations and generating functions, applications. Pigeonhole Principle</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE III: Graphs: Basic terminology multi- graphs, weighted graphs, paths and circuits, Eulerian and Hamiltonian paths and circuits</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE IV: Adjacency and incidence matrices, minimal paths, trees, transport networks, applications-flow charts and state transition graphs.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE V: Coding Theory: Semi groups, monoids and group codes and group codes, Coding of binary information and error detection, decoding and error correction.</td><td>12 hours</td></tr>
</table>

Course Outcomes:

After studying this course, students will be able to:

- CO1: Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees.
- CO2: Communicate both technical and non-technical information in a range of forms (written, oral, electronic, graphic,) and work as an effective team member.
- C03: Able to model and solve real world problems using graphs and trees and ability to apply mathematical logic to solve Problems
- C04: Transport networks involve the study and analysis of systems used for transporting goods, people, or information.
- C05: In coding theory, group codes are codes constructed from groups. These codes are used for error detection and correction in data transmission and storage systems.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- C. L. Liu: Elements of discrete Mathematics, McGraw Hill, International (1986).
- B. Kolman, R. C. Busby and S. Ross: Discrete Mathematical structures, Prentice Hall of India, New Delhi (1998).
- J. P. Tremblay and R. Manohar: Discrete Mathematical structure with Applications to Computer Science, Tata McGraw Hill Edition (1997).
- N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India (1974).
- F. Harary, Graph Theory, Narosa Publishing House, New Delhi (2001).
- L. Lovasz, J. Pelikan, K. Vesztergombi, Discrete Mathematics, Springer, Second Edition (2004).
- V. Krishnamurthy, Combinatorics, Theory and Applications, Affiliated East-West Press Pvt. Ltd (2008).

COURSE: SCILAB (Practical) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MSL17**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**02**
CREDITS-02			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts.
- understand Scilab and its roles in problem solving techniques in research
- Understand and develop well-structured programs using Scilab.
- Solve complicated problems easily in Scilab.
- Save time in calculation and drawing graphs for their research
- To learn the basic data structures through implementing in Scilab

1	Introduction to Numerical Computation
2	History and installations.
3	Command Prompts.
4	Working with Scilab and Scilab files.
5	Formatting command prompt display.
6	Pre define constants.
7	Common mathematical Functions.
8	Operators, Variables.
9	Boolean Data.
10	Working with numbers system (Complex Number, real number).
11	Working with Arrays.
12	Working with Matrix Operations.
13	Finding Roots for sets of Linear Equations.
14	Plotting

Course Outcomes:

After studying this course, students will be able to:

CO1: Students will gain a strong command of the Scilab environment, including its interface, commands, and functionalities, enabling them to efficiently navigate and utilize the software for scientific computing tasks.

CO2: Students will develop problem-solving skills by applying Scilab to solve complex engineering, mathematical, and scientific problems, including simulation of dynamic systems, numerical simulations, and computational modeling.

CO3: Students will explore collaborative computing techniques using Scilab, including sharing code, collaborating on projects, and utilizing version control systems, facilitating teamwork and collaboration in scientific computing projects.

CO4: Students will learn optimization techniques to improve the performance of their Scilab code, including profiling, vectorization, and parallel computing, enabling them to efficiently handle large datasets and complex computations.

CO5: Students through case studies and real-world examples, participants will gain insights into the practical applications of Scilab across various fields such as engineering, physics, biology, equipping them with valuable skills for their future academic and professional endeavors.

Question Paper Pattern:

- The question paper having two questions each question marks.
- 15% for Procedure and write up.
- 70% for conducting the practical (Program and Theatrical solution, graph and Result).
- 15% viva-voce.

COURSE: DISCRETE MATHEMATICS (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MDM15**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Demonstrate their understanding by using mathematical terminology and notation.
- Construct correct direct and indirect proofs.
- Apply logical reasoning to solve a variety of problems.
- Use finite-state machines to model computer operations

MODULES	Teaching Hours
MODULE I: Boolean Algebra and Lattices: Partially ordered sets. Lattices, distributive, complemented lattices. Boolean lattice and algebra, unions and finite functions and Boolean algebra. Boolean functions and Boolean expressions, Propositional calculus, design and implementation of digital networks and switching circuits	14 hours
MODULE II: Combinatorics: Basic counting principles, permutations and combinations, principles of inclusion and exclusion, recurrence relations and generating functions, applications. Pigeonhole Principle	12 hours
MODULE III: Graphs: Basic terminology multi- graphs, weighted graphs, paths and circuits, Eulerian and Hamiltonian paths and circuits	12 hours
MODULE IV: Adjacency and incidence matrices, minimal paths, trees, transport networks, applications-flow charts and state transition graphs.	14 hours
MODULE V: Coding Theory: Semi groups, monoids and group codes and group codes, Coding of binary information and error detection, decoding and error correction.	12 hours

Course Outcomes:

CO1: Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees.

CO2: Communicate both technical and non-technical information in a range of forms (written, oral, electronic, graphic,) and work as an effective team member.

C03: Able to model and solve real world problems using graphs and trees
And ability to apply mathematical logic to solve Problems

C04: Transport networks involve the study and analysis of systems used for transporting goods, people, or information.

C05: In coding theory, group codes are codes constructed from groups. These codes are used for error detection and correction in data transmission and storage systems.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of three sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- C. L. Liu: Elements of discrete Mathematics, McGraw Hill, International (1986).
- B. Kolman, R. C. Busby and S. Ross: Discrete Mathematical structures, Prentice Hall of India, New Delhi (1998).
- J. P. Tremblay and R. Manohar: Discrete Mathematical structure with Applications to Computer Science, Tata McGraw Hill Edition (1997).
- N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India (1974).
- F. Harary, Graph Theory, Narosa Publishing House, New Delhi (2001).
- L. Lovasz, J. Pelikan, K. Vesztergombi, Discrete Mathematics, Springer, Second Edition (2004).
- V. Krishnamurthy, Combinatorics, Theory and Applications, Affiliated East-West Press Pvt. Ltd (2008).

COURSE: FUZZY SETS AND FUZZY SYSTEM (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MFS16**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- To develop familiarity with the physical concepts and facility with the mathematical methods of Fuzzy sets.
- Develop skills in formulating and solving Fuzzy sets problems.
- To gain an understanding of the history and knowledge of physics and the Fuzzy sets principles that shape our world.

MODULES	Teaching Hours
MODULE I: Basic Fuzzy concept: introduction. Crisp set, Fuzzy sets, types of Fuzzy sets, basic, concepts, properties of cuts, preparation of fuzzy sets, extension principle of fuzzy sets.	12 hours
MODULE II: Fuzzy Relations on Sets and Fuzzy Sets, Operation Fuzzy sets: Types of operations Fuzzy complements, Fuzzy intersections, Properties of the Min-Max Composition	14 hours
MODULE III: t-co-norms, combinations, aggregation operations Compositions of Fuzzy Relations Fuzzy Arithmetic Fuzzy Numbers Linguistic variables, Linguistic table Arithmetic operations on Fuzzy numbers Lattice of Fuzzy numbers,	14 hours
MODULE IV: Fuzzy equations Fuzzy Relations and Fuzzy Graphs, Properties of the Min-Max Composition Fuzzy Analysis, Fuzzy Functions on Fuzzy Sets, Extreme of Fuzzy Functions ,	12 hours
MODULE V: Fuzzy Logic and Approximate Reasoning, Classical Logics Revisited, Approximate and Plausible Reasoning, Fuzzy Languages, Support Logic Programming and Fril.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Understanding the basic concepts of fuzzy set theory, including fuzzy sets, membership functions, and fuzzy set operations.

CO2: fuzzy logic operations such as fuzzy conjunction, fuzzy disjunction, fuzzy implication, and fuzzy negation.

CO3: designing and implementing fuzzy logic systems, including fuzzy inference systems (FIS), fuzzy rule-based systems, and Mamdani and Sugeno models.

CO4: Understanding fuzzy approximation techniques, including fuzzy regression analysis and fuzzy interpolation methods.

CO5: Understanding fuzzy approximation techniques, including fuzzy regression analysis and fuzzy interpolation methods.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of three sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- George J.Klor and Yuan Fuzzy set and Fuzzy logic theory and applications. PHI George J.Klor and Tina a. Fotger. Fuzzy set unceratinity and information PHI (1994).
- Kaufman A., introduction to Fuzzy set subset-vol Academic press (1975).
- Driankov D and others, An introduction to Fuzzy set (1993).
- B.Kosko & others, Fuzzy logic with engineering Applications, PHI (1997).

COURSE: PROBABILITY AND STATISTICS (Theory) [As per Choice Based Credit System (CBCS) Scheme] Semester –I (M.Sc. Mathematics)			
Course Code	**23MPS17**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives:

- The main objective of the paper is to provide fundamental concepts of statistical tools and techniques to use in the fields of mathematical, physical, life sciences.
- This paper focuses on types of statistical data, measures of central tendency, dispersion, skewness and kurtosis and correlation analysis.
- This paper enables the students to decide the correct statistical concepts used in given situation. Some of the advanced concepts of statistics like estimation, Testing and design of experiments are introduced here.
- This paper enables the students to apply the various statistical techniques easily in practice.

MODULES	Teaching Hours
MODULE I: Concept of probability, random experiment, sample space, events and their type, empirical definition of probability, addition law, conditional probability, Bayes' rule Random variables and their types, the concept of population of values of a random variable, parameters probability distribution of a random variable.	11 hours
MODULE II: The probability function, probability mass function and probability density function. Some standard discrete probability distributions-Bernoulli, Binomial and Poisson. Some standard continuous distributions-Normal distribution and its properties. Normal, t, F and chi-square tables. Estimation: The concept of a random sample, statistics and estimators with examples.	11 hours
MODULE III: Statistical hypothesis and its types, critical region, test procedure and its types, types of errors, level of significance, optimum test procedure. One sample inference-testing for the mean of a normal distribution with known variance (normal test) and unknown variance (t-test), testing for the variance of a normal population.	10 hours
MODULE IV: Testing for the equality of means of two independent normal populations with a common unknown variance (t-test), paired t-test, testing for the significance of correlation, testing for the equality of variances of two independent normal populations (F-test).	8 hours
MODULE V: Principles of experimentation, Analysis of variance, CRD, RBD & LSD and analysis of variance in these designs.	8 hours

Course Outcomes:

CO1: Probability is a measure of the likelihood that an event will occur. The probability distribution of a random variable describes the probabilities associated with each possible value of the random variable.

CO2: Understanding the properties and applications of standard discrete and continuous probability distributions.

CO3: Ability to choose appropriate test procedures based on the nature of the data and the assumptions underlying the statistical analysis

CO4: Understanding the appropriate use of different statistical tests for comparing means, variances, and correlations.

CO5: Proficiency in selecting appropriate experimental designs based on the research objectives and constraints.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of three sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- D.N. Elhance, Fundamentals of Statistics, Kitab Mahal, Allahabad (1959).
- S.C. Gupta, Fundamentals of statistics, Himalaya Publishing House, Bombay (1993).
- Parimal Mukhopadhyay, (2005): Applied Statistics, Books and flied (P) Ltd., Kolkata.
- Das M.N. Statistical Methods and concepts, Wiley Eastern Ltd (1993).
- R. Rangaswamy: A Text Book of Agricultural Statistics, New Age International Publishers Ltd. Bombay, (1995).
- D.G. Kleinbaum, Kupper, L.L., & Moregentern, H. Epidemiological Research (1982).
- Medhi, J. Statistical methods: An Introductory Text, Wiley Eastern, New Delhi, and Quantitative methods. Belmont, CA:Wadworth, (1992).

<table>
<tr><td colspan="4">COURSE: PARTIAL DIFFERENTIAL EQUATIONS
[As per Choice Based Credit System (CBCS) Scheme]
Semester –II (Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MPD21</td><td>Maximum Marks (CIE)</td><td>50</td></tr>
<tr><td>Number of Teaching Hours/Week</td><td>04</td><td>Maximum Marks (SEE)</td><td>50</td></tr>
<tr><td>Total No of Teaching Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives:
This course will enable students to:
Introduce students to partial differential equations, and solve linear Partial Differential with different methods.
Introduce students to some physical problems in Engineering and Biological models that Results in partial differential equations.</td></tr>
<tr><td colspan="3">MODULES</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">MODULE I: Partial Differential Equations of First Order: Introduction, classification of the first order partial differential equations, solution of partial differential equations of the first order, integral surfaces passing through curve Surface orthogonal to a given system of surfaces, geometrical proof of Lagrange's differential equation, non-linear partial differential equations of the first order, compatible systems of first order equations, condition of compatibility particular case examples Jacobi's method examples, the method of characteristics for semi linear, quasilinear equations</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE II: Partial Differential Equations of Second Order: Origin of second order equations, classification of Partial Differential Equations, Partial differential equation of second order with variable coefficient and its different types</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE III: Laplace: Wave equation: Introduction one dimensional wave equation in rectangular co-ordinates, two-dimensional wave equations in rectangular co-ordinates Laplace equation in rectangular co-ordinates, diffusion equation, solution of a linear partial differential equation by separation of variables, solution of one dimensional wave equation by separation of variables, solution of two dimensional wave equation by separation of variables, solution of two dimensional Laplace equation by separation of variables in rectangular co-ordinates,</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE IV: Reduction of PDE to canonical form: Introduction classification of linear partial differential equation of second order in two independent variables, reduction of canonical forms by Laplace transformation, working method for reducing a hyperbolic, parabolic and elliptic equation to its canonical form</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE V: Non-Linear Partial Differential Equations: Charpit's Method-examples, Jacobi's Method-Examples, Monge's Method: Type1-Rr+Ss+Tt=V leads to two distinct intermediate integrals and both of them are used to get the desired solution, type2-Rr+Ss+Tt=V leads to two distinct intermediate integrals</td><td>12 hours</td></tr>
</table>

and only one is employed to get the desired result.	

Course Outcomes:

After studying this course, students will:

CO1: Understanding the classification and solution techniques for first-order partial differential equations.

CO2: Ability to classify partial differential equations based on their order, linearity, and coefficients.

CO3: Understanding the behavior of waves, diffusion processes, and harmonic functions described by partial differential equations.

CO4: Ability to apply boundary and initial conditions to obtain solutions in the Laplace domain and subsequently invert them to obtain solutions in the original domain.

CO5: Proficiency in applying Charpit's, Jacobi's, and Monge's methods to solve specific types of PDEs.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Ian. Sneddon, Elements of Partial Differential equations, International Student Edition.
- F.John, Partial Differential Equations, Springer.
- P.Prasad,R.Ravindran, Introduction to Partial Differential Equations, New.
- Gupta, Malik and Mittal, Differential equations 3rd Edition, Pragati Prakashan, 1995.
- T. Amarnath, an Elementary Course on Partial differential Equations, Narosa.

<table>
<tr><td colspan="4">COURSE: LINEAR ALGEBRA
[As per Choice Based Credit System (CBCS) Scheme]
Semester –II (Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MLA22</td><td>Maximum Marks (CIE)</td><td>50</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>04</td><td>Maximum Marks (SEE)</td><td>50</td></tr>
<tr><td>Total No of Lecturer Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives: this course will enable students to:
Approach to teaching algebra should help students attach meaning to the abstract concepts of algebra.
Standards require students to use algebra as a tool for representing and solving a variety of practical problems.
Tables and graphs will be used to interpret algebraic expressions, equations and inequalities and to analyze behaviors of functions.
Graphing calculators, computers and other appropriate technology tools will be used to assist in teaching and learning.</td></tr>
<tr><td colspan="3">MODULES</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">MODULE I:
Linear Algebra: Linear transformation, Algebra of linear transformation, Characteristic roots, interpretation in terms of matrices, vector space.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE II:
Canonical forms: Triangular Nilpotent, Jordan and rational, trace, transpose and determinant of linear transformation Jordan Forms, The Rational Forms, Bilinear Forms, Definition and Examples, The matrix of a Bilinear Form, Orthogonality, and Classification of Bilinear Forms.</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE III :
Functional and dual spaces: inner product space orthogonal sets, Hermitian Modulery and normal transformations, bilinear, quadratic and Hermitian forms.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE IV: Number theory: Divisibility, Linear Diophantine equation, quadratic congruence.</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE V: Quadratic residues: sum of two squares, arithmetic functions, Mu, Tau, Phi and Sigma functions, symmetric matrices. Biography of Mathematicians (Srinivas Ramanujam, Aryabhata, Bhaskaracharya, Leonhard Euler, Cottfried W Leibnitz, J.B.J Fourier).</td><td>12 hours</td></tr>
</table>

Course Outcomes:

After studying this course, students will be able to:

CO1: Understanding the fundamental concepts of linear algebra, including linear transformations and vector spaces.

CO2: Ability to compute and interpret properties of matrices, including the trace, transpose, and determinant.

CO3: Proficiency in working with inner product spaces and understanding the concepts of orthogonality and orthonormality.

CO4: Application of number theory concepts in cryptography, computer science, and other areas of mathematics such as algebraic number theory and arithmetic geometry.

CO5: Knowledge of the life and contributions of prominent mathematicians, including Srinivasa Ramanujan, Aryabhata, Bhaskaracharya, and Leonhard Euler, to the development of mathematics.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- I. N. Herstein, Topics in Algebra, 2nd Edition, John – Wiley & Sons. New York (1975).
- Surjit Singh & Qazi Zameeruddin, Modern Algebra, Vikas publishing House (1990).
- S. K. Jain, P. B. Bhattacharya & S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press (1997).
- J. J. Rotman, Galois Theory, 2nd Edition, Universitext, Springer – Verlag (1998).
- I. N. Herstein, Abstract Algebra, Maxwell – McMillan Publication (1990).

<table>
<tr><td colspan="4">COURSE: COMPLEX ANALYSIS
[As per Choice Based Credit System (CBCS) Scheme]
Semester –II (Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MCA23</td><td>Maximum Marks (CIE)</td><td>50</td></tr>
<tr><td>Number of Teaching Hours/Week</td><td>04</td><td>Maximum Marks (SEE)</td><td>50</td></tr>
<tr><td>Total No of Teaching Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives: this course will enable students to:
• Learn the geometry of complex numbers, mappings in the complex plane, the theory of multi-valued functions, and the calculus of functions of single complex. Equip students with necessary knowledge and skills to enable them handle mathematical operations, analyses and problems involving complex numbers.</td></tr>
<tr><td colspan="3">MODULES</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">MODULE I: Analytic functions, Cauchy–Riemann equations, Harmonic functions, Harmonic conjugate functions, and their relation to analytic functions.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE II: Complex integration complex valued functions contours, contour integrals, Cauchy-Gourat Theorem, Cauchy integral formula Morera's theorem Liouville's theorem, Fundamental theorem of algebra,</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE III: Power Series congruence of sequence and series, power series and analytic function Taylor's series, laurent's series, absolute and uniform convergence, integration and differentiation of power series</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE IV: Taylor and Laurent's expansions, Singularities, Poles, Removable and Isolated essential singularities, Classification of singularities using Laurent's expansion.</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE V: Behavior of an analytic function in the neighborhood of a singularity. Principles of analytic continuation. Residue theorem and contour integrals. Argument principle. Rouch's theorem. Its applications</td><td>12 hours</td></tr>
</table>

Course Outcomes:

After studying this course, students will be able to:

CO1: Know basic mathematical operations with complex numbers in Cartesian and polar forms.

CO2: Determine continuity/differentiability/analyticity of a function and find the derivative of a function.

CO3: Ability to determine the convergence of power series and understand the concepts of absolute and uniform convergence.

CO4: To classify singularities using Laurent's expansion, which provides insights into the behavior of functions near singular points.

CO5: Applying the residue theorem and contour integrals to evaluate complex integrals.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- L. V. Ahlfors, Complex Analysis, Second Edition, McGraw Hill Book Co., New York (1966).
- John B. Conway, Functions of one Complex variable (second edition) SpringerVerlag, New York (1973).
- E. C. Titchruarsh, Theory of Functions, (second edition) Oxford university Press, N. J. Fairlawn (1939).
- T. O. Moore and E. H. Hadlock, Complex Analysis, Allied Publishers Ltd. (1993).
- Serge Lang, Complex Analysis, Addison – Wesley, Publishing Company (1997).

COURSE: OPERATIONS RESEARCH-I [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**23MORO24**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: The Subject of Operation research has being growing theoretically and a wide-ranging application in the field of engineering, business, Management, economics and medical sciences etc. It is introduced to the students as a job-oriented course.

- The main aim of this paper is to introduce the fundamentals of operations research and its techniques used in different fields of interest. Operation research is most important in planning, scheduling, and cost and job control for the efficient and economical conduct of industrial Endeavour.

MODULES	Teaching Hours
Module I: Linear Programming: Basic Concepts, convex sets, Open and Closed spaces, Simplex, formulation of linear problems (LPP), Feasible solution, basic feasible solutions, optimal solutions, Graphical Methods, Simplex method, Big-M method.	14 hours
Module II: Transportation Problem: Mathematical Formulation, existence of feasible solution, Transportation table, Initial basic feasible solutions, North-West Corner Rule, Row minima-method, Column minima method, Matrix minima Method, Vogel's Approximation method (VAM), Transportation Algorithm, degeneracy in transportation problem, unbalanced transportation Problem.	14 hours
Module III: Assignment problems: Mathematical Formulation, Assignment algorithm, routing problem, Travelling Salesman problem.	12 hours
Module IV: Networks: Network Minimization, Shortest Route problem, shortest route algorithms for acyclic networks, Maximal Flow problem, Linear programming Representation of Networks.	12 hours
Module V: Integer Programming: Methods of Integer Programming problems, Cutting method, Gromory's fractional cut Algorithm.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Develop operational research models from the verbal description of the real system and to solve linear programming problems using graphical methods, the simplex method, and the Big-M method.

CO2: Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.

CO3: Understandable to the decision-making processes in Management Engineering.

CO4: Analyzing and interpreting solutions to network optimization problems to make informed decisions in practical settings.

CO5: Analyze the efficiency and effectiveness of different methods for solving integer programming problems and select appropriate approaches based on problem characteristics

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).
- S. Kalavati, Operation Research, Vikas pub. (2001)
- Kanti Swarup, Gupta, P.K. and Manmohan: Operations Research, S.Chand and Sons (1980).
- G. Hadley, Linear Programming, Narosa publishing house, New Delhi, (1987).

COURSE: ADVANCED MEASURE THEORY [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**23MAM25**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Gain understanding of the measure theory and definition and main properties of the integral.
- To construct Lebesgue's measure on the real line and in *n*-dimensional Euclidean space.
- To explain the basic advanced directions of the theory.
- The course introduces the basic mathematical framework underlying its rigorous analysis, and is therefore meant to provide some of the tools which will be used in more advanced courses in probability.
- This makes it one of the cornerstones of modern mathematics, with direct application to the theory of integration, probability theory and analysis.

MODULES	Teaching Hours
MODULE I Ring of a set, σ-algebra of sets, T space, Caratheodory's postulates of outer measure, measurable set, problems, related to measure function, ring of set σ-algebra of sets	**12 hours**
MODULE II: Lebesgue, measure of a set, exterior and interior measure, Borel measurable set	**14 hours**
MODULE III: Measurable function, almost everywhere, equivalent function, characteristic function Borel measurable measurability of functions	**14 hours**
MODULE IV: Lebesgue, integral of function, first mean value theorem, convergence in measure, reisz's theorem, D.F. Egoroff's theorem, lebesgue, bounded convergence theorem, fatou's lemma, Absolute continuous function, indefinite integration and differentiation	**12 hours**
MODULE V: Signed measure, positive and negative sets Hahn de-composition theorem, singular measure, Jordan decomposition, absolutely continuous measure function.	**12 hours**

Course outcomes:

After studying this course, students will be able to:

C01: Able to work with rings and σ-algebras of sets, comprehend the construction of measures, and apply measure theory to solve problems in various mathematical contexts.

CO2: An applying measure functions to calculate the size of sets in various contexts.

CO3: Students should understand the definition and properties of measurable functions and be able to determine whether a given function is measurable or not.

CO4: Recognizing the fundamental concepts of certain current mathematical theories

CO5: Establishing the main links between those theories, explaining them and motivating them by examples.

Question Paper Pattern:

- The question paper having Five questions
- Each full question consisting of 10 marks.
- There will be 2 full questions (with maximum of two sub questions) from each Module.
- The student will have to answer 5 full questions.

Reference Books

- H.L.Royden: Real Analysis (Chapter 1,3,4,5 and 6).3rd
- Edition,MacMillan,NewYork(1963)
- Inder Kumar Rana, Measure Theory and Integration, Narosa.
- C.Goffman : Real Functions,Holt,Rinehart and Winston Inc.New York (1953)
- P.K.Jain and V.P.Gupta : Lebesgue Measure and Integration, Wiley Eastern Ltd.(1986)
- P.Halmos, Measure Theory, Narosa Publishers.

COURSE: FUZZY LOGIC AND APPLICATIONS [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**23MFA26**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives:

- The Subject of fuzzy logic and application has been growing theoretically and wide ranging applications in the field of engineering, business, Management, economics and medical sciences etc. It is introduced to the students as a job-oriented course.
- It helps to understand the different lounges in fuzzy and its applications.

MODULES	Teaching Hours
Module I: Basic Concept of Fuzzy Sets: Introduction. Crisp set, Fuzzy sets. Types of Fuzzy sets. Basic concepts, properties of a cuts, representation of Fuzzy sets, extension principle of Fuzzy sets.	12 hours
Module II: Operations on Fuzzy sets: Types of operations Fuzzy complements, Fuzzy intersections, norms. Fuzzy unions. T-co-norms, combinations, aggregation operations.	12 hours
Module III: Fuzzy Arithmetic: Fuzzy numbers, Linguistic variables, Arithmetic operations on Fuzzy numbers, Lattice of Fuzzy numbers, Fuzzy equations.	14 hours
Module IV: Fuzzy Relations: Crisp Versus fuzzy relations. Projections and cylindrical extension, Binary fuzzy relations, on a single set.	12 hours
Module V: Fuzzy and approximate reasoning: Linguistic variables, fuzzy logic, classical logic revisited, linguistic truth table, approximate and possible reasoning, fuzzy laungveges, support logic programming and frill.	14 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Develop a report that describes the knowledge of fuzzy and logic, its applications.

CO2: Students should be able to apply fuzzy operations to solve problems involving uncertainty, ambiguity, and imprecision in various domains, such as decision making, pattern recognition, and control systems.

CO3: Able to analyses the lattice structure formed by fuzzy numbers under certain operations, including identifying properties such as completeness, distributivity, and compactness.

CO4: Fuzzy relations provide a more flexible framework for modelling relationships that are inherently imprecise, allowing for more realistic representations of real-world phenomena.

C05: The incorporation of linguistic variables and fuzzy logic enables more natural and flexible problem-solving approaches.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Groge J. Klor. And Yuan Fuzzy Logic, Theory and Applications. PHI. Georgo J. Klir and Tina a, Fotger Fuzzy sets uncertainly and information, PHI (1994).
- Kaufmann, A., Introduction to the theory of Fuzzy subsets-vol. Academic press (1975).
- Driankov D and others. An introduction to Fuzzy control.
- B. Kosko and others, Fuzzy logic with Engineering Applications. PHI.

COURSE: OPERATIONS RESEARCH [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**23MOR27**	**IA Marks**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			
Course Objectives: this course will enable students to: This Module aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.			

MODULES	Teaching Hours
Module I Linear Programming: Basic Concepts, convex sets, Open and Closed spaces, Simplex, formulation of linear problems (LPP), Feasible solution, basic feasible solutions, optimal solutions, Graphical Methods, Simplex method, Big-M method.	14 hours
Module II: Mathematical Formulation, existence of feasible solution, Transportation table, Initial basic feasible solutions, North-West Corner Rule, Row minima-method, Column minima method, Matrix minima Method, Vogel's Approximation method (VAM).	12 hours
Module III: Transportation Algorithm, degeneracy in transportation problem, unbalanced transportation Assignment problems: Mathematical Formulation, Assignment algorithm, routing problem, Travelling Salesman problem.	14 hours
Module IV: Networks: Network Minimization, Shortest Route problem, shortest route algorithms for acyclic networks, Maximal Flow problem, Linear programming Representation of Networks.	12 hours
Module V Integer Programming: methods of Integer Programming problems, Cutting method, Gromory's fractional cut Algorithm, Mixed Integer Programming Problems, Branch and Bound Method.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Identify and develop operational research models from the verbal description of the real system.

CO2: Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.

CO3: Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

CO4: Explain the major concepts in the functional areas of accounting, marketing, finance, and management.

CO5: Describe and explain the ethical obligations and responsibilities of business.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).

COURSE: Python Lab [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**23MPL27**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**3**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**48**	**Exam Hours**	**03**
CREDITS-02			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts.
- To understand computer programming and its roles in problem solving
- To understand and develop well-structured programs using Python.
- To learn the basic data structures through implementing in Python

I	History and Development of Python.
II	Basic Commands of Python.
III	Data Types, Installation of Python.
IV	Operators.
V	Conditional Control & Looping Statements.
1	Write a Program for Conversion of Temperature from Fahrenheit to Celsius.
2	Write a Program to read the radius of circle and compute its area and circumference.
3	Write a Program to read five-digit numbers and print in its reverse order.
4	Write a Program to pick the largest of three numbers.
5	Write a Program to print the given three numbers a, b, c in ascending order.
6	Write a Program to find the root of the quadratic equation.
7	Write a Program to find whether the given year is leap year or not.
8	Program to find whether the given three points (x1, y1), (x2, y2) and (x3, y3) are collinear or not.
9	Program to add two compatible matrices.
10	Program to compute product of two compatible matrices.
11	Program to find the smallest element in an array.
12	Program to sort the in ascending order.
13	Write a C program to calculate the Fibonacci series.
14	Program to find the definite integral of given function by using trapezoidal rule.
15	Program to find the definite integral of given function by Simpson’s 1/3 rule.

Course Outcomes:

After studying this course, students will be able to:

CO1: Problem solving through computer programming

CO2: Write clear, elementary Python Program.

CO3: Understand algorithmic thinking and apply it to programming.

CO4: Understand problem-solving techniques.

CO5: Code with Arithmetic, increment, decrement, assignment, relational, equality and logical operators.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

COURSE: TOPOLOGY [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**23MTP31**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Learn the fundamental applications in set.
- Learn the fundamentals of algebraic topology
- Be prepared to begin with all concepts of topology and its applications in research.

MODULES	Teaching Hours
MODULE I: Topological Spaces: Definition of topology, types of topologies, neighborhoods, closed sets, closure operations and their equivalence, neighborhood systems, limit points, closure, interior, and boundary of a set.	14 hours
MODULE II: Base, sub base, sub space, continuous map, open and closed maps. **Separation Axioms**: T_0, T_1, T_2, spaces, regular spaces, normal space, Urysohn's characterization of normality, T3, T4, T5, spaces.	14 hours
MODULE III: Countability axioms, Separable space, And convergence of a sequence, **Connectedness:** Connected and disconnected spaces, components, connectedness and continuous map.	12 hours
MODULE IV: Compactness: cover, sub cover, compactness, characterizations, Heine-Borel theorem, compactness, and continuous map, finite intersection property, one point-compactification.	12 hours
MODULE V: Metric space: Metric on a set, open spheres, topology induced by a metric, equivalent metric spaces, diameter, continuity. **Lindelof space:** Lindelofness and countability, continuity and other Properties of Lindelofness.	12 hours

Course Outcomes:

After studying the course students can:

CO1**:** Analysis of fundamental concepts such as neighborhoods, closed sets, closure operations, and limit points, which are essential in various branches of mathematics and theoretical physics.

CO2: Learning topology enhances problem-solving skills by providing rigorous frameworks for reasoning about the properties of spaces and relationships between them.

CO3: understanding of the fundamental properties of topological spaces and their relationships.

CO4: Concepts related to cover, compactness, and characterizations, such as the Heine-Borel theorem and the finite intersection property, gives a deeper understanding of the notion of compactness in topology.

CO5: Understanding of metric spaces, which are important structures in analysis and geometry.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, (1963).
- J. T. Munkers: A First Course in Topology, PHI, (1998).
- W. J. Pervin: Foundations of General Topology, AP, (1972).
- J. L. Kelly: General Topology, Van Nostrand, (1955).
- J. Dugundji: Topology USB Pub. New Delhi, Allyn & Bacon, (1997).
- K D Joshi: Introduction to General Topology, New Age Intn. (P) Ltd, (1983).
- Willard: General Topology, Hocking and Young Pub.
- Mundars C.F: Algebric topology, academic press.
- W. Massey: Introduction to algebraic Topology, New Delhi.

COURSE: COMPUTATIONAL NUMERICAL METHODS [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**23MCN32**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:
The objective will be to train students to understand why the methods work, what type of errors to expect and when an application might lead to difficulties. In particular,

MODULES	Teaching Hours
MODULE I: Gauss Elimination, Jacobie's Method, LU decomposition Gauss Jordan's Method Gauss Seidel Method, Graeffe's root squaring method Birge-Vieta method, Bairstow Method Power Method	**14 hours**
MODULE II: Numerical Solution of Ordinary Differential Equation IVP Taylor's Series method, Euler's Method, Modified Euler's method, Explicit Runge-Kutta Methods, I and II order Runge-Kutta methods, Runge-Kutta IV order method, Runge-Kutta method for simultaneous	**14 hours**
MODULE III: higher order differential equations Multi Step Methods, Adam Bash forth's and Milne's Predictor-Corrector Method, **Solution of BVP:** Finite Difference Method, Shooting Method	**10 hours**
MODULE IV: Numerical Solution of Partial Differential Equation: **Parabolic PDE:** Crank-Nicholson method, Gauss Seidal iterative scheme for Crank-Nicholson method, Successive Over Relaxation (SOR), ADI method, Parabolic equation in cylindrical & spherical co-ordinates.	**13 hours**
MODULE V: Elliptical PDE: Laplace Equation, Poisson Equation, Explicit Finite difference method, Implicit Method, Derivative Boundary Condition, Iterative Method, Hyperbolic PDE, method of Characteristic.	**13 hours**

Course Outcomes:

After studying this course, students will be able to:

CO1: Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.

CO2: Learnt how to obtain numerical solution of nonlinear equations using bisection, secant, Newton and fixed-point iteration methods.

CO3: A Solve system of linear equations numerically using direct and iterative methods.

CO4: Learning and applying numerical methods for PDEs enhances computational skills, including programming and algorithm development, which are essential in modern scientific research and engineering practices.

CO5: Understanding difference methods, iterative methods, and the method of characteristics provides powerful tools for approximating solutions to a wide range of partial differential equations encountered in various fields of science and engineering.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- R. K. Jain, S. R. K. Iyengar and M. K. Jain, Numerical methods for scientific and Engineering computation, Wiley Eastern (2001).
- S. D. Conte and Carl De Boor, introduction to Numerical Analysis, McGraw Hill C. E. Froberg, Introduction to Numerical Analysis Addison Wesley (1995).
- Atkinson K.E, An Introduction to Numerical Analysis, 3 rd Ed, John Weiley and sons (1989).
- Hilderband F. B Introduction to Numerical Analysis Ed 5, Tata McGraw Hill, (1986).

<table>
<tr><td colspan="4">COURSE: FLUID MECHANICS
[As per Choice Based Credit System (CBCS) Scheme]
Semester –III (Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MFM33</td><td>Maximum Marks (CIE)</td><td>50</td></tr>
<tr><td>Number of Teaching Hours/Week</td><td>04</td><td>Maximum Marks (SEE)</td><td>50</td></tr>
<tr><td>Total No of Teaching Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives: this course will enable students to:
Provide a strong foundation in Fluid Mechanics to the students of various engineering disciplines and applied mathematics.
Introduce fundamental aspects of fluid flow behaviour. Also understand basic principles of various mechanical operations, construction and working of the equipments.
Study analytical solutions to variety of simplified problems</td></tr>
<tr><td colspan="3">MODULES</td><td>Teaching Hours</td></tr>
<tr><td colspan="3">MODULE I:
Motion of In-viscous fluids: Introduction, Basic Definitions and types of flows, Lagrange’s and Euler’s equation of motion, Equation of continuity, Applications of Fluid Mechanics, Local and individual time rate of change.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE II: Boundary surface: Euler’s and Lagrange’s equation of continuity, equations of continuity in different co-ordinates, symmetrical forms of equations of continuity, Boundary conditions on velocity, temperate and pressure.</td><td>14 hours</td></tr>
<tr><td colspan="3">MODULE III: Equation of motion: pressure equation, Bernoulli’s equation, Helmholtz Vorticity equation for impulsive action, equation for impulsive action, Kelvin circulation theorem.</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE IV: Sources, Sinks, doublets and their images, complex potential, image with respect to a straight line, image with respect to a circle, Milne-Thomson circle theorem, Blasius equation (theorem), equation of motion of circular cylinder with circulation.</td><td>12 hours</td></tr>
<tr><td colspan="3">MODULE V: General theory of Ir-rotational motion: Ir-rotational motion, kinetic energy of finite liquid, kinetic energy of infinite liquid, Kelvin’s minimum energy theorem, mean value of potential function, Green’s theorem.</td><td>12 hours</td></tr>
</table>

Course Outcomes:

After studying this course.

CO1: The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems. Further they would develop dimensionless groups that help in scale-up and scale-down of fluid flow systems.

CO2: Euler's and Lagrange's equations of continuity provides a fundamental understanding of the conservation of mass principle in fluid dynamics, which is essential for analyzing and solving problems in fluid mechanics.

CO3: Students will be able to apply Bernoulli principle and compute pressure drop in flow systems of different configurations.

CO4: Students can develop their carrier in fluid mechanics research field.

CO5: Understanding the mean value of potential functions is relevant in potential flow theory and fluid dynamics, particularly in the context of solving Laplace's equation and understanding flow properties.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- F. Charlton, Fluid Dynamics, C. B. S Publisher Delhi (1985).
- G. K. Batchelor, an Introduction to Fluid Dynamics, Cambridge. (2012).
- Frank M.White, Fluid Mechanics, McGraw Hill, (2011).
- Pijush K. Kundu, lra M. Cohen, David R. Dowling, Fluid Mechanics. (2012).
- Er. R. K. Rajput, A text Book of fluid Mechanics, S. Chand. (2008).
- Yunus A Cengel, John M Cimbala, Fluid mechanicsd fundamentals and applications, (2012).
- A.C.Erign: Mechanics of continua
- W. Prager: Mechanics of continuous media
- A.L.Chorin and A Marsden: A Mathematical introduction to fluid dynamics, springer, Verlag, New Yark, (1993).
- L.D.Landav and E.M.Lipchil: Fluid mechanics, Pragamon press, Londan (1985).
- R.K Rathy : An introduction to fluid dynamics, oxford and IBH pub. Company New Delhi (1976).
- W. H. Besaint, and A. s. Ramsey: A treatise of Hydrodynamics, part II CBS Publishers Delhi, (1988).
- J. L. Bansal, Viscous Fluid Dynamics (1977).
- A. D. Young: Boundary Layers AJAA education Series, Washington. DC (1989).

COURSE: OPERATIONS RESEARCH-II [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**23MORO34**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			
Course Objectives: this course will enable students to: This Module aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.			

MODULES	Teaching Hours
MODULE I: Linear Programming-I: Artificial variables, Solution of Linear Program Problems (LPP) By method of penalty and two-phase simplex method Duality in Linear.	14 hours
MODULE II: Linear Programming-II: Programming concept of Duality, properties, fundamental theorem of Duality, Duality Simplex method, and sensitivity analysis.	14 hours
MODULE III: Theory of Games: Introduction, Maxmini-Minimax principle mixed strategies, Graphical solution of 2 X N and M X 2 games Dominance property.	12 hours
MODULE IV: Queuing theory: Introduction Queue Discipline, Distribution of Inter-Arrival times and service times, queue classification, steady state solution of Markovian Queuing models M/M/1, M/M/1 with limited waiting space.	12 hours
MODULE V: Simulation: Introduction, elements of Simulation model, Event type generation of random Phenomena, Monte-Carlo Technique, steps in simulation, simulation language.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: The application of these methods leads to the determination of optimal solutions to linear programming problems, maximizing or minimizing the objective function subject to constraints.

CO2: Understanding duality provides deeper insights into the structure of linear programming problems and their solutions.

CO3: Recognizing dominance properties allows for simplification of game analysis and identification of optimal strategies.

CO4: Understanding queue discipline helps in designing efficient queuing systems that meet specific performance objectives and customer expectations.

CO5: Simulation facilitates decision-making by providing insights into system behavior and performance under different conditions.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).

COURSE: RESEARCH METHODOLOGY [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**23MRM35**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives:

The main objective of this course is to introduce the basic concepts in research methodology in social science. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

MODULES	Teaching Hours
MODULE I: Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of Research - Concept, Construct, Definition, Variable. Research Process.	14 hours
MODULE II: Problem Identification & Formulation - Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good Hypothesis- Null Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance.	14 hours
MODULE III: Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	12 hours
MODULE IV: Qualitative and Quantitative Research: Qualitative research - Quantitative research - Concept of measurement, causality, generalization, replication. Merging the two approaches.	12 hours
MODULE V: Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample- Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample- Practical considerations in sampling and sample size.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Understanding the foundations of research equips individuals with the knowledge and skills to conduct rigorous and systematic investigations in various fields.

CO2: Effective hypothesis testing contributes to the advancement of knowledge, informs decision-making, and addresses practical problems in various fields of study.

CO3: Understanding research design is essential for conducting rigorous and valid research.

CO4: Understanding measurement, causality, generalization, and replication enhances the validity, reliability, and credibility of research findings.

CO5: Proper sample size determination ensures that research studies have adequate statistical power to detect meaningful effects and produce reliable results.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions.
- Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
- Research Methodology- C. R. Kothari
- Select references from the Internet

<table>
<tr><td colspan="4">COURSE : DIFFERENTIAL GEOMETRY
[as per Choice Based Credit System (CBCS) Scheme]
Semester –III (Mathematics)</td></tr>
<tr><td>Course Code</td><td>23MDG35</td><td>IA Marks</td><td>50</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>03</td><td>Exam Marks</td><td>50</td></tr>
<tr><td>Total No of Lecturer Hours</td><td>64</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS-04</td></tr>
<tr><td colspan="4">Course Objectives: this course will enable:
To provide an introduction to the differential geometry of curves and surfaces in space, both in its local and global aspects, with special emphasis on a geometric point of view, as a basis for further study or for applications (especially in physics, chemistry, civil and electrical engineering, graphics).
Students should be able to communicate mathematics both orally and in well written sentences and should be able to explain solutions to problems.</td></tr>
</table>

MODULES	Teaching Hours
MODULE I: Euclidean spaces, tangent vectors, vector fields, directional derivatives, curve in E3, 1- Forms, differential forms, mappings on Euclidean spaces, derivative map, dot product in E3, frame fields.	14 hours
MODULE II: Cross product of tangent vectors, curves in E3, arc length, reparameterization, Frenet formulas, Frenet frame field, curvature, torsion and bitorsion of a MODULE speed curve.	12 hours
MODULE III: Arbitrary speed curves, Frenet formulas for arbitrary speed curves, covariant derivatives, Frame field in E3, connection forms of a frame field, Carton's structural equations	14 hours
MODULE IV: Calculus on a surface, co-ordinate patch, proper patch, surfaces in E3, Monge patch, examples, differentiable functions and tangent and normal vector fields on a surface. Mapping of surfaces, topological properties of surfaces, Manifolds.	12 hours
MODULE V: Shape operators, Normal curvature, Gaussian curvature, computational techniques special curves in surfaces.	12 hours

Course Outcomes:

After studying this course, students will be able to:

CO1: Explain the concepts and language of differential geometry and its role in modern mathematics.

CO2: Concepts provides a comprehensive framework for studying and analyzing curves in three-dimensional space

CO3: Understanding arbitrary speed curves and their Frenet formulas expands the toolkit for analyzing and parameterizing curves with variable speeds

CO4: To explain and apply the concepts and techniques of differential geometry of curves and surfaces.

CO5: Understanding shape operators, normal curvature, and Gaussian curvature provides insight into the geometric properties of surfaces and their behavior in different directions.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Barrett O. Neill, Elementary Differential Geometry, Academic Press, New York(1998)
- Andrev Priestly, Differential Geometry, Springer, (2001).
- Nirmala Prakash, Differential Geometry an Integral approach, Tata McGraw Hill, New Delhi (2001).
- T. J. Willmore, An introduction to Differential Geometry, Oxford University Press(1999).
- S. Kumaresan, Differential Geometry and Lie Groups, TRIM Series, HBA, (2002)

COURSE: COMPUTATIONAL NUMERICAL METHODS LAB [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**23MCNL38**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**04**
CREDITS-02			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts of CNM.
- To understand computer programming and its roles in problem solving
- To understand and develop well-structured problems
- To learn the basic data structures through implement.

1	Introduction.
2	Installation and basic operations
3	Trapezoidal Rule
4	Simpson 1/3rd rule
5	Simpson 3/8th rule
6	Bisection Method.
7	Newton's Raphson Method
8	Gauss Elimination Method
9	Gauss Seidel Iteration Method
10	Eigen value Eigen vector
11	Given's Method
12	Forward Difference Table
13	Backward Difference Table

Course Outcomes:

After studying this course, students will be able to:

- Problem solving through computer programming
- Write clear, elementary Mathematical Software programs.
- Understand algorithmic thinking and apply it to programming.
- Understand problem-solving techniques.
- Code with Arithmetic, increment, decrement, assignment, relational, equality and logical operators.
- Also can implement in research problem solving.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

COURSE: PROJECT [As per Choice Based Credit System (CBCS) Scheme] Semester –IV (Mathematics)			
Course Code	**23MPJP41**	**Maximum Marks (CIE)**	**100**
Number of Tutorial Hours/Week	**12**	**Maximum Marks (SEE)**	**100**
Total No of Teaching Hours		**Exam Hours**	**03**
CREDITS-08			

COURSE: INTERNSHIP [As per Choice Based Credit System (CBCS) Scheme] Semester –IV (Mathematics)			
Course Code	**23MINT42**	**Maximum Marks (CIE)**	**100**
Number of Tutorial Hours/Week	**08**	**Maximum Marks (SEE)**	**100**
Total No of Teaching Hours		**Exam Hours**	**03**
CREDITS-12			

COURSE: Skill Enhancement/ Computational Lab (Practical) [As per Choice Based Credit System (CBCS) Scheme] Semester –IV (Mathematics)			
Course Code	**23MSEP43**	**Maximum Marks (CIE)**	**50**
Number of Tutorial Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours		**Exam Hours**	**03**
CREDITS-02			