DEPARTMENT OF MATHEMATICS
FACULTY OF ARTS, SCIENCE AND HUMANITIES
PG PROGRAM (CBCS) – M.Sc. Mathematics

Course code	Name of the course	Objectives and Out Comes		Instruction Hours / Week			Credit(s)	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
SEMESTER – I										
18MMP101	Algebra	III	a, c, e	4	0	0	4	40	60	100
18MMP102	Real Analysis	I	a, g, e	4	0	0	4	40	60	100
18MMP103	Numerical Analysis	I	b, d, g	4	0	0	4	40	60	100
18MMP104	Ordinary Differential Equations	II	b, d, e	4	0	0	4	40	60	100
18MMP105A	Advanced Discrete Mathematics	III	e	4	0	0	4	40	60	100
18MMP105B	Neural networks and fuzzy logic	I	a, g							
18MMP105C	Combinatorics	II	e							
18MMP106	Mechanics	II	g	4	0	0	4	40	60	100
18MMP111	Numerical Analysis - Practical	I	a	0	0	4	2	40	60	100
Journal Paper analysis & Presentation				2	-	-	-	-	-	-
Semester Total				**26**	**0**	**4**	**26**	**280**	**420**	**700**
SEMESTER – II										
18MMP201	Complex Analysis	III	c, e	4	0	0	4	40	60	100
18MMP202	Topology	I	a, c	4	0	0	4	40	60	100
18MMP203	Optimization Techniques	III	f	4	0	0	4	40	60	100
18MMP204	Partial Differential Equations	II	d, e	4	0	0	4	40	60	100
18MMP205A	Graph theory and its applications	I	a	4	0	0	4	40	60	100
18MMP205B	Theory of Elasticity	I	a, g							
18MMP205C	Fundamentals of Actuarial Mathematics	III	b, g							
18MMP206	Fluid dynamics	II	c, f	4	0	0	4	40	60	100
18MMP211	Optimization Techniques - Practical	II	g	0	0	4	2	40	60	100
Journal Paper analysis & Presentation				2	-	-	-	-	-	-
Semester Total				**26**	**0**	**4**	**26**	**280**	**420**	**700**

Electives Courses*

Elective I		Elective II	
Course Code	**Name of the Course**	**Course Code**	**Name of the Course**
18MMP105A	Advanced Discrete Mathematics	**18MMP205A**	Graph theory and its applications
18MMP105B	Neural networks and fuzzy logic	**18MMP205B**	Theory of Elasticity
18MMP105C	Combinatorics	**18MMP205C**	Fundamentals of Actuarial Mathematics

DEPARTMENT OF MATHEMATICS
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PROGRAMME OUTCOMES (POs)

a. Solve intricate mathematical problems using the knowledge of pure and applied Mathematics.
b. Explain the knowledge of modern issues in the field of mathematics.
c. Proficiency in all lectureship exams approved by UGC.
d. Solve differential equations governing real life issues.
e. Pursue further studies and conduct research.
f. Mathematical lifelong learning through continuous professional development.
g. Employ technology in solving and understanding mathematical problems.

PROGRAM SPECIFIC OUTCOMES (PSOs)

h. Acquire knowledge of mathematics and its applications in all the fields.
i. Acquaint with the recent advances in applied mathematical sciences such as numerical computations and mathematical modeling.
j. Capable of formulating and analyzing mathematical models of real life applications.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO I : To engender problem-solving skills and apply them to the problems of pure and applied mathematics.

PEO II : To assimilate complicated mathematical concepts and arguments.

PEO III : To enhance your own learning and create mathematical thinking

MAPPING OF POs AND PEOs

POs	a	b	c	d	e	f	g	h	i	j
PEO I	X		X		X			X		X
PEO II	X			X			X			X
PEO III		X				X			X	

18MMP101	**ALGEBRA**	**Semester – I** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

1. The fundamental concepts of algebraic ring theory and fields.
2. The basic central ideas of linear algebra such as linear transformations, Eigen values, Eigen vectors, and canonical forms.

Course Outcomes (COs)

After successful completion of this course the students will be able to

1. Understand the concept and the properties of finite abelian groups.
2. Get pre-doctoral level knowledge in ring theory.
3. Attain good knowledge in field theory.
4. Define and study in details the properties of linear transformations.
5. Analyze the concept of trace and transpose.

UNIT I

GROUP STRUCTURES

Another counting principle – application of theorems – Cauchy theorem – Sylow's theorem – Direct product – Finite Abelian groups.

UNIT II

RINGS AND FIELDS

Ring Theory- Basic definition- More ideals and quotient rings- Euclidean rings-A Particular Euclidean Rings –Polynomial Rings-Polynomial over the Rational Field.

UNIT III

EXTENSION FIELDS

Fields – Extension Fields-Finite Extension of F – Some basic Definitions and Theorem – Roots of a Polynomial – More about Roots – The elements of Galois Theory.

UNIT IV

LINEAR ALGEBRA AND MATRICES

Linear Transformations-The Algebra of Linear Transformation – Characteristic Root-Matrices-Canonical Forms –Triangular form-Nilpotent Transformations–Jordan form.

UNIT V

TRANSFORMATION OF MATRICES

Trace and Transpose – Trace of T-Symmetric Matrix –Determinants–Hermitian Transformation, Unitary Transformation and Normal Transformation – Real quadratic forms.

SUGGESTED READINGS

1. Herstein.I. N.,(2013). Topics in Algebra, Third edition, Wiley and sons Pvt Ltd, Singapore.
2. Artin. M., (2009). Algebra, Pearson Prentice-Hall of India, New Delhi.
3. Fraleigh. J. B., (2008). A First Course in Abstract Algebra , Seventh edition , Pearson Education Ltd, New Delhi.
4. Kenneth Hoffman., Ray Kunze., (2003). Linear Algebra, Second edition, Prentice Hall of India Pvt Ltd, New Delhi.
5. Vashista.A.R., (2005). Modern Algebra, Krishna Prakashan Media Pvt Ltd, Meerut.

Semester – I

18MMP102 REAL ANALYSIS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The basic principles of real analysis.
- How to identify sets with various properties such as finiteness, countability, infiniteness, uncountability.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Get specific skill in Riemann Stieltjes integral and Lebesgue integral.
2. Enrich their knowledge of measure theory and extremum problems.
3. Solve given problems at a high level of abstraction based on logical and structured reasoning.
4. Attain knowledge in infinite series.

UNIT I

THE RIEMANN – STIELTJES INTEGRAL

Introduction – Basic Definitions – Linear Properties – Integration by parts – Change of variable in a Riemann – Stieltjes Integral – Reduction to a Riemann Integral – Step functions as integrators – Reduction of a Riemann – Stieltjes Integral to a finite sum – Monotonically increasing – Additive and linear properties – Riemann condition – Comparison theorems – Integrators of bounded variation – Sufficient condition for Riemann Stieltjes integral.

UNIT II

INFINITE SERIES AND INFINITE PRODUCTS

Introduction – Basic definitions – Ratio test and root test – Dirichlet test and Able's test –Rearrangement of series – Riemann's theorem on conditionally convergent series – Sub series - Double sequences – Double series – Multiplication of series – Cesaro summability.

UNIT III

SEQUENCES OF FUNCTIONS

Basic definitions – Uniform convergence and continuity - Uniform convergence of infinite series of functions – Uniform convergence and Riemann – Stieltjes integration – Non uniformly convergent sequence – Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series.

UNIT IV

THE LEBESGUE INTEGRAL

Introduction- The class of Lebesgue – integrable functions on a general interval- Basic properties of the Lebesgue integral- Lebesgue integration and sets of measure zero- The Levi monotone convergence theorem- The Lebesgue dominated convergence theorem- Applications of Lebesgue dominated convergence theorem- Lebesgue integrals on unbounded intervals as limit of integrals on bounded intervals- Improper Riemann integrals- Measurable functions.

UNIT V

IMPLICIT FUNCTIONS AND EXTREMUM PROBLEMS

Introduction – Functions with non zero Jacobian determinant – Inverse function theorem – Implicit function theorem – Extrema of real valued functions of one variable and several variables

SUGGESTED READINGS

1. Rudin. W., (1976) .Principles of Mathematical Analysis, Mcgraw Hill, New york.
2. Balli. N.P., (2017). Real Analysis, Laxmi Publication Pvt Ltd, New Delhi.
3. Gupta.S.L. and Gupta.N.R.,(2003).Principles of Real Analysis, Second edition, Pearson Education Pvt.Ltd, Singapore.
4. Royden .H.L., (2002). Real Analysis, Third edition, Prentice hall of India,New Delhi.
5. Sterling. K. Berberian., (2004).A First Course in Real Analysis, Springer Pvt Ltd, New Delhi.

Semester – I

18MMP103 **NUMERICAL ANALYSIS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- To develop the working knowledge on different numerical techniques.
- To solve algebraic and transcendental equations.
- Appropriate numerical methods to solve differential equations.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Identify the concept of numerical differentiation and integration.
2. Provide information on methods of iteration.
3. Solve ordinary differential equations by using Euler and modified Euler method.
4. Study in detail the concept of boundary value problems.
5. Attain mastery in the numerical solution of partial differential equations.

UNIT I

SOLUTIONS OF NON LINEAR EQUATIONS

Newton's method-Convergence of Newton's method- Bairstow's method for quadratic factors. Numerical Differentiation and Integration: Derivatives from difference tables – Higher order derivatives – divided difference. Trapezoidal rule
– Romberg integration – Simpson's rules.

UNIT II

SOLUTIONS OF SYSTEM OF EQUATIONS

The Elimination method: Gauss Elimination and Gauss Jordan Methods – LU decomposition method. Methods of Iteration: Gauss Jacobi and Gauss Seidal iteration-Relaxation method.

UNIT III

SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

One step method: Euler and Modified Euler methods–Rungekutta methods. Multistep methods: Adams Moulton method – Milne's method

UNIT IV

BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS

The shooting method: The linear shooting method – The shooting method for non-linear systems. Characteristic value problems –Eigen values of a matrix by Iteration-The power method.

UNIT V

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of Partial Differential Equation of the second order – Elliptic Equations. Parabolic equations: Explicit method – The Crank Nicolson difference method. Hyperbolic equations – solving wave equation by Explicit Formula.

SUGGESTED READINGS

1. Gerald, C. F., and Wheatley. P. O., (2009). Applied Numerical Analysis, Seventh edition, Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. Jain. M. K., Iyengar. S. R. K. and R. K. Jain., (2012). Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi .
3. Burden R. L., and Douglas Faires.J,(2014). Numerical Analysis, Seventh edition, P. W. S. Kent Publishing Company, Boston.
4. Sastry S.S., (2009). Introductory methods of Numerical Analysis, Fourth edition, Prentice Hall of India, New Delhi.

Semester – I

18MMP104 **ORDINARY DIFFERENTIAL EQUATIONS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The formulation and solutions of ordinary differential equations and get exposed to physical problems with applications.
- Linear homogeneous and non homogeneous equations of higher order with constant coefficients.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Model a simple physical system to obtain a first and second order differential equation.
2. Understand the basic notions of linearity, superposition, existence and uniqueness of solution to differential equations and use these concepts in solving linear differential equations.
3. Identify homogeneous equations, homogeneous equations with constant coefficients and exact linear differential equations.

UNIT I

SECOND ORDER LINEAR EQUATIONS

Second order linear equations with ordinary points – Legendre equation and Legendre polynomial – Second order equations with regular singular points – Bessel equation.

UNIT II

EXISTENCE AND UNIQUENESS SOLUTIONS

System of first order equations – existence and uniqueness theorems – fundamental matrix.

UNIT III

NON HOMOGENEOUS EQUATIONS

Non homogeneous linear system – linear systems with constant coefficient – Linear systems with periodic coefficients.

UNIT IV

SUCCESSIVE APPROXIMATION AND NON UNIQUENESS SOLUTIONS

Successive approximation – Picard's theorem – Non uniqueness of solution – continuation and dependence on initial conditions – existence of solution in the large existence and uniqueness of solution in the system.

UNIT V

OSCILLATION THEORY

Fundamental results – Sturms comparison theorem – elementary linear oscillations – comparison theorem of Hille winter – Oscillations of $x'' + a(t)x = 0$ elementary non linear oscillations.

SUGGESTED READINGS

1. Earl A. Coddington, (2004). An introduction to Ordinary differential Equations, Prentice Hall of India Private limited, New Delhi.
2. Deo. S. G, Lakshmikantham, V. and Raghavendra, V. (2005). of Ordinary differential Equations, Second edition, Tata Mc Graw Hill Publishing Company limited, New Delhi.
3. Rai. B, Choudhury, D. P. and Freedman, H. I. (2004). A course of Ordinary differential Equations, Narosa Publishing House, New Delhi.
4. George F. Simmons, (2017). Differential Equations with application and historical notes, 3rd edition by Taylor & Francis Group, LLC.

Semester – I

18MMP105A **ADVANCED DISCRETE MATHEMATICS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The concept of algebraic structures, lattices and its special categories which plays an important role in the field of computers.
- The fundamental concepts in graph theory, with a sense of some its modern applications.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Develop new algebraic structures.
2. Think critically and analytically by modeling problems form social and natural sciences with the help of theory of graphs.
3. Work effectively in groups on a project that requires an understanding of graph theory.

UNIT I

ALGEBRAIC STRUCTURES

Introduction- Algebraic Systems: Examples and General Properties: Definition and examples - Some Simple Algebraic Systems and General properties - Homomorphism and isomorphism - congruence relation - Semigroups and Monoids: Definitions and Examples - Homomorphism of Semigroups and Monoids.

UNIT II

LATTICES

Lattices as Partially Ordered Sets: Definition and Examples - Principle of duality - Some Properties of Lattices - Lattices as Algebraic Systems – Sublattices - Direct product, and Homomorphism.

UNIT III

BOOLEAN AND SOME SPECIAL LATTICES

Complete, Complemented and Distributive Lattices - Boolean Algebra: Definition and Examples - Subalgebra - Direct product and Homomorphism - join irreducible - atoms and antiatoms.

UNIT IV

GRAPH THEORY

Definition of a graph - applications, Incidence and degree - Isolated and pendant vertices - Null graph, Path and Circuits: Isomorphism - Subgraphs, Walks -Paths and circuits - Connected graphs, disconnected graphs – components - Euler graph.

UNIT V

TREES

Trees and its properties - minimally connected graph - Pendant vertices in a tree - distance and centers in a tree - rooted and binary tree. Levels in binary tree - height of a tree - Spanning trees - rank and nullity.

SUGGESTED READINGS

1. Tremblay J. P. and Manohar, R., (2017). Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co.
2. Deo N., (2007). Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India.
3. Liu C.L., (2012). Elements of Discrete Mathematics, Fourth edition McGraw-Hill Publishing Company Ltd, New Delhi.
4. Wiitala S., (2003),Discrete Mathematics- A Unified Approach, McGraw-Hill Book Co, New Delhi.
5. Seymour Lepschutz, (2007),Discrete Mathematics, Schaum Series, McGraw-Hill Publishing Company Ltd, New Delhi.

Semester – I

18MMP105B **NEURAL NETWORKS AND FUZZY LOGIC** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The introduction and different architectures of neural networks.
- The applications of neural networks.
- To cater the knowledge of Fuzzy Logic Control and use these for controlling real time systems.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Obtain the fundamentals and types of neural networks.
2. Have a broad knowledge in developing the different algorithms for neural networks.
3. Analyze neural controllers.
4. Acquire a broad knowledge in fuzzy logic principles.

UNIT I

EVOLUTION OF NEURAL NETWORKS

Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline.

UNIT II

MULTI-LAYER PERCEPTRONS

Topology of Multi-layer perceptron, Back propagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm, Kohenen's self-organizing network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

UNIT III

RECURRENT NEURAL NETWORKS

Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

UNIT IV

CLASSICAL AND FUZZY SETS

Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy arithmetic; composition and inference; Considerations of fuzzy decision-making.

UNIT V

FUZZY LOGIC CONTROL

Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

SUGGESTED READINGS

1. Fakhreddine O. Karray and Clarence De Silva., (2009). Soft Computing and Intelligent Systems Design, Theory, Tools and Applications, Pearson Education, India.
2. Timothy J. Ross, (2011). Fuzzy Logic with Engineering Applications, Third edition Wiley publishers, India.
3. Yegnanarayana B., (2006). Artificial Neural Networks, PHI, India.
4. Limin Fu, (2003). Neural Networks in Computer Intelligence, McGraw Hill, Delhi.
5. Sivanadam ,S.N, Sumathi S and Deepa,S.N, (2006) Introduction to Neural Network using MATLAB 6.0., McGraw Hill Education, New Delhi.
6. Sivanadam ,S.N, Sumathi S and Deepa,S.N, (2006) Introduction to Fuzzy logic using MATLAB, McGraw Hill Education, New Delhi.

Semester – I

18MMP105C **COMBINATORICS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- To improve mathematical proof writing skills.
- To cater mathematical verbal communication skills.
- To afford problem-solving skills.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Cognition in various combinatorial methods.
2. Solve real-life problems through computational skills.
3. Develop different combinatorial techniques.

UNIT I

COMBINATORIAL NUMBERS

Basic Combinatorial Numbers – Stirling numbers of the second kind – Recurrence formula for Pnm.

UNIT II

GENERATING FUNCTIONS

Generating functions – Recurrence relations- Bell's formula.

UNIT III

MULTINOMIAL COEFFICIENTS

Multinomial – Multinomial theorem- Inclusion and Exclusion principle.

UNIT IV

FORBIDDEN POSITIONS

Euler function –Permutations with forbidden positions –the Menage Problem.

UNIT V

SPECIAL TYPE OF COMBINATORIAL PROBLEMS

Problem of Fibonacci –Necklace problem – Burnside's lemma.

SUGGESTED READINGS

1. Krishnamurthy, V. (2002), Combinatorics: Theory and Applications, East West Press Pvt. Ltd.
2. Balakrishnan V.K., (1995). Theory and problems of Combinatorics, Schaums outline series,McGraw Hill Professional.
3. Alan tucker, (2002). Applied Combinatorics, 4th edition, John wiley & Sons, New York.

Semester – I

18MMP106 **MECHANICS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- How to use Newton's laws of motion to solve advanced problems involving the dynamic motion of classical mechanical systems.
- Applications of differential equations in advanced mathematical problems.
- To solve dynamics problems such as conservation of energy and linear and angular momentum.

Course Outcomes (COs)

On successful completion of this course students will be able to

1. Understand the concept of the D'Alembert's principle .
2. Derive the Lagrange's equation for holomonic and non holomonic constraints.
3. Classify Scleronomic and Rheonomic systems .
4. Solve the problems of Hamilton equations of motion.

UNIT I

SURVEY OF ELEMENTARY PRINCIPLES

Constraints - Generalized coordinates, Holonomic and non- holonomic systems, Scleronomic and Rheonomic systems. D'Alembert's principle and Lagrange's equations – Velocity – dependent potentials and the dissipation function – some applications of the Lagrange formulation.

UNIT II

VARIATION PRINCIPLES AND LAGRANGE'S EQUATIONS

Hamilton's principle – Some techniques of calculus of variations – Derivation of Lagrange's Equations from Hamilton's principle – Extension of Hamilton's principle to non-holonomic systems – Conservation theorems and symmetry properties.

UNIT III

HAMILTON EQUATIONS OF MOTION

Legendre Transformations and the Hamilton Equations of motion-canonical equations of Hamilton – Cyclic coordinates and conservation theorems – Routh's procedure - Derivation of Hamilton's equations from a variational principle – The principle of least action.

UNIT IV

CANONICAL TRANSFORMATIONS

The equations of canonical transformation – Examples of Canonical transformations – Poission Brackets and other Canonical invariants – integral invariants of Poincare, Lagrange brackets.

UNIT V

HAMILTON JACOBI THEORY

Hamilton Jacobi equations for Hamilton's principle function – Harmonic oscillator problem - Hamilton Jacobi equation for Hamilton's characteristic function – Separation of variables in the Hamilton-Jacobi equation.

SUGGESTED READINGS

1. Goldstein. H. (2011), Classical Mechanics Third Edition, Narosa Publishing House, New Delhi.
2. Gantmacher, F., (2013). Lectures in Analytic Mechanics, MIR Publishers, Moscow.
3. Gelfand, I. M., and Fomin, S. V., (2003), Calculus of Variations, Prentice Hall, New Delhi.
4. Loney, S. L., (2015). An elementary treatise on Statics, Kalyani Publishers, New Delhi.

Semester – I

18MMP111 **NUMERICAL ANALYSIS - PRACTICAL** **4H – 2C**

Instruction Hours / week: L: 0 T: 0 P: 2 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- In-depth understanding of functional, logic, and programming paradigms.
- How to implement several programs in languages other than the one emphasized in the core curriculum.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Know the concepts for problem solving.
2. Acquire new knowledge in computing, including the ability to learn about new ideas and advances, techniques, tools, and languages, and to use them effectively; and to be motivated to engage in life-long learning
3. Comprehend important issues related to the development of computer-based systems in a professional context using a well-defined process.

List of Practical

1. Solution of non-linear equation-Bairstow's method for quadratic factors.
2. Solution of simultaneous equations-Gauss Elimination.
3. Solution of simultaneous equations-Gauss Jordan.
4. Solution of simultaneous equations-Gauss Jacobi.
5. Solution of simultaneous equations-Gauss Seidal.
6. Solution of simultaneous equations-Triangularisation.
7. Numerical integration-Trapezoidal rule.
8. Numerical integration-Simpson's rules.
9. Solution for ordinary differential equation-Euler method.
10. Solution for ordinary differential equation- Runge Kutta Second order.
11. Solution for parabolic equation - Explicit method.
12. Solution for parabolic equation - The Crank Nicolson method.

Semester – II

18MMP201 **COMPLEX ANALYSIS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The manipulation skills in the use of Cauchy's theorem.
- Fundamental concepts of complex variable theory.
- To develop the skill of contour integration to evaluate complicated real integrals via residue calculus.
- The development of functions of one complex variable.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Explain the role of the Cauchy-Riemann equations.
2. Evaluate complex contour integrals and some of their consequences.
3. Describe the convergence properties of a power series.
4. Determine the Taylor series or the Laurent series of an analytic function in a given region.
5. Know the basic properties of singularities of analytic functions.

UNIT I

CONFORMALITY

Conformal mapping-Linear transformations- cross ratio- symmetry- Oriented circles-families of circles-level curves.

UNIT II

FUNDAMENTAL THEOREMS ON COMPLEX INTEGRATIONS

Complex integration-rectifiable Arcs- Cauchy's theorem for Rectangle and disc-Cauchy's integral formula-higher derivatives.

UNIT III

HARMONIC FUNCTIONS

Harmonic functions-mean value property-Poisson's formula-Schwarz theorem, Reflection principle-Weierstrass theorem- Taylor series and Laurent series.

UNIT IV

ENTIRE FUNCTIONS

Partial Fractions- Infinite products – Canonical products-The gamma function – Stirling's Formula – Entire functions – Jensen's formula.

UNIT V

CONFORMAL MAPPINGS

Riemann Mapping Theorem – Boundary behaviour – Use of Reflection Principle – Analytical arcs – Conformal mapping of polygons- The Schwartz - Christoffel formula.

SUGGESTED READINGS

1. Lars V .Ahlfors., (1979). Complex Analysis, Third edition, Mc-Graw Hill Book Company, New Delhi.
2. Ponnusamy, S., (2005). Foundation of Complex Analysis, Second edition, Narosa publishing house, New Delhi.
3. Choudhary, B.,(2005). The Elements of Complex Analysis ,New Age International Pvt. Ltd , New Delhi.
4. Vasishtha, A. R.,(2014). Complex Analysis, Krishna Prakashan Media Pvt. Ltd., Meerut.
5. Walter Rudin., (2017) .Real and Complex Analysis,3rd edition, Mc Graw Hill Book Company, New york.

Semester – II

18MMP202 **TOPOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- Topological properties of sets.
- The properties of compact spaces and connected spaces.

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Develop their abstract thinking skills.
2. Acquire knowledge about various types of topological spaces and their properties.
3. Admire the deep mathematical results like Urysohn's lemma.
4. Create examples and counterexamples in the fundamental concepts of topological spaces.
5. Formulate and analyze topological problems.

UNIT I

TOPOLOGY OF METRIC SPACES

Topological spaces, Basis for a topologies, the order topology, the product topology X x Y, the subspace topology.

UNIT II

TOPOLOGICAL PROPERTIES

Closed set and limit points, continuous functions, the product topologies, the metric topologies.

UNIT III

CONNECTEDNESS

Connected spaces, connected subspaces of the real line, components and local connectedness.

UNIT IV

COMPACTNESS

Compact spaces, compact subspaces of the Real line, limit point compactness, local compactness.

UNIT V

COUNTABILITY AND SEPARATION AXIOMS

The countability axioms, the separation axioms, normal spaces, The Urysohn lemma, The Urysohn metrization theorem, the Tietze Extension theorem.

SUGGESTED READINGS

1. James R.Munkres., (2008). Topology, Second edition, Pearson Prentice Hall, New Delhi.
2. Simmons, G. F., (2017). Introduction to Topology and Modern Analysis, Tata Mc Graw Hill, New Delhi.
3. Deshpande, J. V., (1990). Introduction to topology, Tata Mc Graw Hill, New Delhi.
4. James Dugundji., (2002). Topology, Universal Book Stall, New Delhi.
5. Joshi, K. D.(2017). Introduction to General Topology, New Age International Pvt Ltd, New Delhi.

Semester – II

18MMP203 **OPTIMIZATION TECHNIQUES** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The basic concepts of integer linear programming.
- How to solve quadratic programming problems, dynamic programming problems and non-linear programming problems.

Course Outcomes (COs)

After successful completion of this course the students will be able to

1. Understand the concept of linear programming and integer programming.
2. Develop optimal decision policy skill.
3. Familiarize with real life applications of inventory models.
4. Skill in decision analysis.
5. Mastery in Beale's method and simplex method.

UNIT I
INTEGER LINEAR PROGRAMMING

Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory’s All Integer Cutting Plane Method - Gomory’s mixed Integer Cutting Plane method Branch and Bound Method. - Zero-One Integer Programming – Real life application in Integer Linear Programming.

UNIT II
DYNAMIC PROGRAMMING

Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming under Certainty - DP approach to solve LPP.

UNIT III
PROBABILISTIC INVENTORY MODEL

Real life application -Continuous review models- Probabilistic Economic order quantity (EOQ) Model. Single-period models – No setup model – setup model. Multi period model.

UNIT IV

DECISION ANALYSIS

Real life application - Decision making under certainty- Analytic hierarchy process. Decisions under Risk- Decision Trees-based expected value criterion, variations of the expected value criterion. Decisions under Uncertainty Real life application in Decision Analysis

UNIT V

NON-LINEAR PROGRAMMING METHODS

Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods - Beale's Method.

SUGGESTED READINGS

1. Sharma, J. K., (2017). Operations Research Theory and Practice, Third edition, Macmillan India Ltd.
2. Handy, A. Taha.(2007). Operations Research, Eighth edition, Prentice Hall of India Pvt Ltd, New Delhi.
3. Kanti swarup., Gupta, P. K. and Manmohan., (2006). Operations Research, Twelfth edition, Sultan Chand & Sons Educational Publishers, New Delhi.
4. Panneerselvam, R., (2007). Operations Research, Second edition, Prentice Hall of India Private Ltd, New Delhi.
5. Singiresu, S. Rao., (2006). Engineering Optimization Theory and Practice, Third edition New Age International Pvt Ltd, New Delhi.
6. Sivarethina Mohan. R., (2008). Operations Research, First edition, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.

Semester – II

18MMP204 **PARTIAL DIFFERENTIAL EQUATIONS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The basic concepts of solution of PDE and its applications.
- About initial and boundary value problems for PDEs of first and second order which includes Laplace Equation, Diffusion Equation and Wave Equation.

Course Outcomes (COs)

After successful completion of this course the students will be able to

1. Classify linear and Non linear first order differential equations with constant coefficients.
2. Describe the method of separable variables and integral transforms.
3. Solve the elementary Laplace equation with symmetry.
4. Acquire the knowledge of wave equation and vibrating membranes.
5. Enrich their knowledge about diffusion equations with sources.

UNIT I

FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS

Non linear partial differential equation of first order –Compatible systems of first order equations – Special type of first order equations- Partial differential equations of second order – The origin of second order equations – Linear partial differential equations with constant coefficient equations with variable coefficients.

UNIT II

SEPARATION OF VARIABLES

Method of separation of variables –The method of integral transforms.

UNIT III

LAPLACE EQUATION

Elementary solutions of Laplace equations- Families of Equi-potential surfaces - Boundary Value problems-separation of variables-problems with axial symmetry.

UNIT IV

WAVE EQUATION

Elementary solutions of one dimensional wave equation-Vibrating membrane - Applications of calculus of variations- Green’s functions for the wave equation.

UNIT V

DIFFUSION EQUATION

The resolution of Boundary value problems for the Diffusion equation- Elementary solutions of diffusion equation - Separation of variables- use of Green's functions- Diffusion with Sources.

SUGGESTED READINGS

1. Sharma, J. N, Kehar singh, (2009), Partial Differential Equations for Engineering and Scientists, Narosa Publishing House, New Delhi.
2. Ian. N. Sneedon, (2006). Elementary Partial differential equations, Tata Mcgraw Hill Ltd.
3. Geraold. B. Folland, (2001), Introduction to Partial Differential Equations, Prentice Hall of India Private limited, New Delhi.
4. Sankara Rao. K, (2010), Introduction to Partial Differential Equations, Third edition, Prentice Hall of India Private limited, New Delhi.
5. Veerarajan, T, (2004), Partial Differential Equations and Integral Transforms, Tata McGraw- Hill Publishing Company limited, New Delhi.
6. John, F, (1991). Partial Differential equations, Third edition, Narosa publication co, New Delhi.
7. Tyn-Myint-U and Lokenath Debnath(2008), Linear Partial Differential Equations for Scientists and Engineers, Fourth Edition, Birkhauser, Berlin.

Semester – II

18MMP205 A **GRAPH THEORY AND ITS APPLICATIONS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The fundamental concepts in Graph Theory and some of its modern applications.
- The use of these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

Course Outcomes (COs)

1. Understanding the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.
2. Overview of properties of trees and a minimal spanning tree for a given weighted graph.
3. Understand Eulerian and Hamiltonian graphs.
4. Applied the knowledge of graphs to solve the real-life problem.

UNIT I

GRAPHS

Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits – Connectedness – Components – Euler Graphs – Hamiltonian Paths and Circuits – Trees – Properties of trees – Distance and Centers in Tree – Rooted and Binary Trees - Spanning trees – Fundamental Circuits.

UNIT II

SPANNING TREES

Spanning Trees in a Weighted Graph – Cut Sets – Properties of Cut Set – All Cut Sets – Fundamental Circuits and Cut Sets – Connectivity and separability – Network flows – 1-Isomorphism – 2-Isomorphism – Combinational versus Geometric Graphs – Planer Graphs – Different Representation of a Planer Graph.

UNIT III

MATRIX REPRESENTATION OF A GRAPH

Incidence matrix – Sub matrices – Circuit Matrix – Path Matrix – Adjacency Matrix – Chromatic Number – Chromatic partitioning – Chromatic polynomial - Matching - Covering – Four Color Problem.

UNIT IV

COUNTING TREE

Directed Graphs – Types of Directed Graphs - Types of enumeration, counting labeled trees, counting unlabelled trees, Polya's counting theorem, graph enumeration with Polya's theorem.

UNIT V

DOMINATION IN GRAPHS

Introduction – Terminology and concepts – Applications – Dominating set and domination number – Independent set and independence number – History of domination in graphs.

SUGGESTED READINGS

1. Deo N, (2007). Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India Pvt Ltd, New Delhi.
2. Teresa W. Haynes, Stephen T. Hedetniemi and Peter J.Slater, (1998), Fundamentals of Domination in Graphs, Marcel Dekker, New York.
3. Jonathan L Gross, Jay Yellen, (2014). Handbook of Graph Theory, CRC Press LLC. Taylor &Francis Group,Boca Rotan.
4. Diestel. R Springer-Verlag, (2012). Graph Theory. Springer-Verleg,New York.
5. Jensen.TR and Toft.B., (1995). Graph Coloring Problems. Wiley-Interscience , , New York.
6. Fred Buckley and Frank Harary, (1990). Distance in Graphs, Addison - Wesley Publications. Redwood City, California.
7. Flouds C. R., (2009). Graph Theory Applications, Narosa Publishing House. New Delhi,India.
8. Arumugam. S, Ramachandran. S ,(2006). Invitation to graph theory, Scitech publications, Chennai.
9. Harary F, (2001).Graph Theory, Addison- Wesley Publishing Company Inc USA

Semester – II

18MMP205 B **THEORY OF ELASTICITY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The theoretical fundamentals of theory of elasticity.
- The ability to use the principles of theory of elasticity in engineering problems.
- To solve advanced solid mechanics problems using classical methods and to characterize materials with elastics constitutive relations.

Course Outcomes (COs)

On successful completion of this course the student will be able

1. To understand the theory of elasticity including strain/displacement and Hooke's law relationships.
2. To analyze solid mechanics problems using classical methods and energy methods.
3. To apply various failure criteria for general stress states at points.
4. To get advanced knowledge about stresses, strains.

UNIT I

TENSOR ANALYSIS

Co-ordinate transformations-contravarient and covariant vectors and tensors-symmetric and anti-symmetric tensors- metric tensor – conjugate tensor-associated tensors –Christoffel's symbols and transformations laws – covariant derivative – permutation symbols and tensors – relative and absolute tensors.

UNIT II

ANALYSIS OF STRAIN

Deformation –Affine transformation – infinitesimal affine deformations – A geometrical interpretation of components of strain – strain quadric of Cauchy – Principal strains and invariants general infinitesimal deformation – examples of strain – saint-Venant's equations of compatibility – finite –deformations.

UNIT III

ANALYSIS OF STRESS

Body and surface forces – stress tensor – equations of equilibrium in Cartesian co-ordinates – transformation of co-ordinates –stress quadric of Cauchy principal stresses – invariants of stress tension – maximum normal and shear stresses- Mohr's diagram – examples of stress.

UNIT IV

EQUATION OF ELASTICITY

Generalized Hooke's law- homogeneous isotropic medium – elastic module for isotropic media – simple tension – pure shear – hydrostatic pressure – equilibrium equations for an isotropic elastic solid – Beltrami- Michell compatibility equations.

UNIT V

DYNAMICAL EQUATIONS

Dynamical equations of isotropic elastic solid – strain energy function – uniqueness of solution – statement of saint – Senant's principle.

SUGGESTED READINGS

1. Dipak Chatterjee,(2003). Vector Analysis, Prentice Hall Of India, New Delhi.
2. Timoshenko S.P., Goodier J.N. , Theory of Elasticity. McGraw Hill book coompany, New York.
3. Verma P. D. S., Theory of Elasticity. S.Chand (G/L) & Company Ltd, India.
4. Murray Rspiegel,(2010). Vector Analysis, Schaum's Series, Mcgraw-Hill Companies, New York
5. Sokolnikoff, I. S.,(1956) Mathematical Theory of Elasticity. Second Edition, Tata McGraw Hill Publishing Company Ltd. New Delhi.

Semester – II

18MMP205C FUNDAMENTALS OF ACTUARIAL MATHEMATICS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The fundamental theories of actuarial science as they apply in life insurance, general insurance and superannuation.
- How to assess the suitability of actuarial, financial and economic models in solving actuarial problems
- Interpretation and critically evaluating the articles in the actuarial research literature.

Course Outcomes (COs)

On successful completion of this course the student will be able

1. Explain the basic concepts of accounts and calculations of interest rates in banking / financial institution system.
2. Define Annuity and Summarize / calculate different values Annuities.
3. Leant about how to read Mortality Table and from that how to calculate the Probability of Survival and Death.
4. Describe about Premiums of Life Insurance and Endowment Assurance (Pure, Double and Marriage) and Educational Annuity plan.
5. Find the Annuity values for various Annuities.
6. Calculation of Net Premiums for Assurance Plans.
7. Understand the Premium Conversion tables for calculation of Policy values.

UNIT I

BASIC CONCEPTS OF ACTUARIAL MATHEMATICS

Accumulated Value – Present Value – Formula for present value- Annuities Certain- present Values-Amounts - Deferred Annuities –Perpetuities - Present Value of an Immediate Annuity Certain – Accumulated Value of Annuity – Relation between Sn and a_n – Present Value of Deferred Annuity Certain – Accumulated Value of a term of n years – Perpetuity – Present Value of an Immediate Perpetuity of 1p.a. – Present Value of a Perpetuity due of 1 p.a. – Deferred Perpetuity with Deferment Period of m years – Mortality Table – The Probabilities of Survival and Death.

UNIT II

CALCULATION OF DIFFERENT INSURANCE PREMIUMS

Life Insurance Premiums – General considerations - Assurance Benefits – Pure Endowment Assurance – Endowment Assurance – Temporary Assurance or Term Assurance - Whole Life Assurance – Pure Endowment Assurance – Endowment Assurance – Double Endowment

Assurance Increasing Temporary Assurance – Increasing Whole Life Assurance – Fixed Term (Marriage) Endowment – Educational Annuity Plan.

UNIT III

VARIOUS VALUES OF ANNUITIES

Life Annuities and Temporary Annuities – Commutation Functions Nx – To Find the Present Value of an Annuity Due of Re.1 p.a. for Life – Temporary Immediate Life Annuity – Expression for ax : n – Deferred Temporary Life Annuity – Variable Life Annuity – Increasing Life Annuity – Variations in the Present Values of Annuities – Life Annuities Payable at Frequent Intervals.

UNIT IV

ANNUAL PREMIUMS AND ANNUITY PLANS

Net Premiums for Assurance Plans – Natural Premiums – Level Annual Premium – Symbols for Level Annual Premium under Various Assurance Plans – Mathematical Expressions for level Annual Premium under Level Annual Premium under Various Plans for Sum Assure of Re. 1 – Net Premiums – Consequences of charging level Premium – Consequences of withdrawals – Net Premiums for Annuity Plans – Immediate Annuities – Deferred Annuities.

UNIT V

POLICY VALUE AND ITS CALCULATION

Premium Conversion tables – Single Premium Conversion tables – Annual Premium Conversion Tables – Policy Values – Two kinds of Policy values – Policy value in symbols – Calculation of Policy Value for Unit Sum Assure – Other Expressions for Policy Value – Surrender Values – Paid up Policies – Alteration of Policy Contracts.

SUGGESTED READING

1. Mathematical Basis of Life Insurance - Insurance Institute of India

Semester – II

18MMP206 **FLUID DYNAMICS** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

This course enables the students to learn

- The concepts of fluid, its properties and behavior under various conditions of internal and external flows.
- The fundamentals of Fluid Dynamics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
- To imbibe basic laws and equations used for analysis of static and dynamic fluids

Course Outcomes (COs)

On successful completion of this course, students will be able to

1. Classify and exploit fluids based on the physical properties of a fluid.
2. Compute correctly the kinematical properties of a fluid element.
3. Apply correctly the conservation principles of mass, linear momentum, and energy to fluid flow systems.
4. Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution.
5. Provide the student with the basic mathematical background and tools to model fluid motion.
6. Calculate the flow of an ideal fluid in a variety of situations.
7. Develop a physical understanding of the important aspects that govern fluid flows that can be observed in a variety of situations in everyday life.

UNIT I

INTRODUCTORY NOTIONS

Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation following the Fluid – Equation of continuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an in viscid fluid.

UNIT II

EQUATION OF MOTION OF A FLUID

Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady motion – energy equation for in viscid fluid – circulation – Kelvin's theorem – vortex motion – Helmholtz equation.

UNIT III

TWO DIMENSIONAL FLOW

Two Dimensional Motion – Two Dimensional Functions – Complex Potential – basic singularities – source – sink – Vortex – doublet – Circle theorem. Flow past a circular cylinder with circulation – Blasius Theorem – Lift force. (Magnus effect)

UNIT IV

VISCOUS FLOWS

Viscous flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – Steady Couettc flow between cylinders in relative motion – Steady flow between parallel planes.

UNIT V

LAMINAR BOUNDARY LAYER IN INCOMPRESSIBLE FLOW

Boundary Layer concept – Boundary Layer equations – Displacement thickness, Momentum thickness – Kinetic energy thickness – integral equation of boundary layer – flow parallel to semi infinite flat plate – Blasius equation and its solution in series.

SUGGESTED READINGS

1. Milne Thomson .L.M., (1968). Theoretical Hydrodynamics, Fifth edition, Dover Publications INC, NewYork.
2. Curle.N., and Davies H.J., (1971), Modern Fluid Dynamics Volume-I , D Van Nostrand Company Ltd., London.
3. Yuan, S.W, (1976). Foundations of Fluid Mechanics, Prentice- Hall, India.
4. Shanthi swarup, (2003), Fluid dynamics, Krishna Prakasan media Pvt Ltd, Meerut.

Semester – II

18MMP211 **OPTIMIZATION TECHNIQUES - PRACTICAL** **4H – 2C**

Instruction Hours / week: L: 0 T: 0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

- To provide the students an exposure to develop well-structured optimization techniques knowledge arising process in various level of science.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Use the object oriented concepts for implementation of Optimization Techniques.
2. Implement the data structure concepts for Optimization Techniques problems.
3. Acquire skills to solve various multivariable optimization problems
4. Solve of different optimization problems.

List of Practical

1. Solution for a system of equations- Simplex method.
2. Decision making with minimax criteria.
3. Decision making under risk.
4. Travelling salesman problem to find the shortest path.
5. Write a C program to calculate the minimum cost using North West Corner Rule.
6. To calculate the EOQ for purchasing model without shortage using C program.
7. To calculate the EOQ for manufacturing model without shortage using C program.
8. To calculate the EOQ for manufacturing model with shortage using C program.
9. To calculate the EOQ for purchasing model with shortage using C program.
10. Probabilistic Model-EOQ.