Master of Science (Mathematics)

(M.Sc. Maths)

Syllabus

MATS Centre for Distance and Online Education (MCDOE)

MATS University, Raipur, Chhattisgarah

First Semester

Algebra Theory

Course Outcome(s): After completing this course, the student will be able to:

CO-1 Explain the fundamental concepts of advanced abstract algebra and their role in modern mathematics and applied contexts.

CO-2 Able to utilize application of rings.

CO-3 Knowledge of extension fields and its applications.

CO-4 Understand the concepts Galois Theory and concept of polynomial of radicals.

CO-5 Understand the connection and transition between previously studied mathematics and more advanced mathematics.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
ALGEBRA Subject code - MSCMODL101	**CO 1** - Explain the fundamental concepts of advanced abstract algebra and their role in modern mathematics and applied contexts.	**1,2**	**1**
	CO 2 - Able to utilize application of rings.	**3,4,5**	**1,2**
	CO 3 – Knowledge of extension fields and its applications.	**1,3**	**2,3**
	CO 4 – Understand the concepts Galois Theory and concept of polynomial of radicals.	**2,3**	**2**
	CO 5 - Understand the connection and transition between previously studied mathematics and more advanced mathematics.	**6,7,8,9**	**1,3**

CO-PO and CO-PSO Mapping

Subject	ALGEBRA												
Code	MSCMODL 101												
Course outcomes CO MSCMODL101	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO101. 1	2	1	-	-	-	-	-	-	-	-	1	-	-

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CO101. 2	-	-	3	2	2	-	-	-	-	-	2	3	
CO101. 3	2	-	2	-	-	-	-	-	-	-		2	2
CO101.4	-	2	1	-	-	-	-	-	-	-	-	2	-
CO101.5	-	-	-	-	-	2	3	3	2	-	1	-	2
Average CO MSCMOD L101	0.8	0.6	1.2	0.4	0.4	0.4	0.6	0.6	0.4	-	0.8	1.4	0.8

Note: 1- Low relation
2- Average relation
3- Good relation

Unit-I:

Group theory: Direct products- Group action on a set: Isotropy subgroups- Orbits- Application of G-Sets to Counting: Counting theorems- p-Groups- The Sylow theorems.

Unit-II:

Applications of the Sylow theory: Applications to p-groups and the class equation- Further applications. Ring theory: Rings of polynomials: Polynomials in an indeterminate - The evaluation homomorphism - Factorization of polynomials over a field.

Unit-III:

Field theory: Extension fields-algebraic and transcendental elements-Irreducible polynomial over F - Simple extensions- Algebraic extensions: Finite extensions- Structure of a finite fields.

Unit - IV:

Automorphisms of fields- Conjugation isomorphisms- Automorphisms and fixed fields- The Frobenius automorphism- Splitting fields.

Unit-V:

Separable extensions- Galois theory: Normal extensions- The main theorem- Illustrations of Galois theory: Symmetric functions

Books Recommended:

1.A First Course in Abstract Algebra by **J.B. Fraleigh**, Fifth Edition, Addison-Wesly Longman, Inc, Reading Massachusetts, 1999.

2.Topics in Algebra by **I.N. Herstein**, Blaisdell, New York, 1964.

3. Algebra by **M. Artin**, Prentice-Hall of India, New Delhi, 1991.

REAL ANALYSIS
THEORY

Total Marks: 100 (70+30)

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Course Objective(s): To learn the concepts of basic topological objects such as open sets, closed sets, compact sets and the concept of uniform convergence and also to work comfortably with continuous, differentiable and Riemann integrable functions, Sequences And Series Of Functions, Functions Of Several Variables, : Lebesgue Measure And The Lebesgue Integral.

Course Outcome(s): After completing this course, the student will be able to:

CO1: Attain mastery in Riemann integrable functions, Countable and Uncountable set.

CO2: Locate Sequence and Series, point wise and uniform convergent sequences.

CO3: Enumerate the concept of differentiation and Functions of Several Variables.

CO4: Study Briefly the Measurable sets and integration of series.

CO5: Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty like Lebesgue Measure And The Lebesgue Integral.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
REAL ANALYSIS Subject code - MSCMODL102	**CO 1** - Attain mastery in Riemann integrable functions, Countable and Uncountable set.	**4, 5, 7, 9**	**1, 3**
	CO 2 - Locate Sequence and Series, point wise and uniform convergent sequences.	**3, 5 ,7, 8**	**2, 3**

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	CO 3 – Enumerate the concept of differentiation and Functions of Several Variables.	**1 ,2, 4, 6, 8, 10**	**1, 3**
	CO 4 – Study Briefly the Measurable sets and integration of series.	**3, 4, 6, 8, 9**	**1, 3**
	CO 5 - Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty like Lebesgue Measure And The Lebesgue Integral.	**3, 7, 9, 10**	**1, 2**

CO-PO and CO-PSO Mapping

Subject	REAL ANALYSIS												
Code	MSCMODL102												
Course outcomes CO MSCMODL102	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO102. 1	-	-	-	2	3	-	2	-	1	-	1	-	2
CO102. 2	-	-	2	-	2	-	1	3	-	-	-	2	1
CO102. 3	2	2	-	3	-	2	-	1	-	3	1	-	2
CO102.4	-	-	1	2	-	2	-	3	2	-	1	-	2
CO102.5	-	-	2	-	-	-	2	-	2	3	2	3	-
Average CO MSCMODL102													

Note: 1- Low relation
2- Average relation
3- Good relation

Unit-I:

RIEMANN STIELTJES INTEGRAL: Definition and existence of the integral – Properties of the integral – Integration and differentiation – Integration of vector-valued functions – Rectifiable curves.

Unit-II:

SEQUENCES AND SERIES OF FUNCTIONS: Uniform convergence-Uniform convergence and continuity – Uniform convergence and integration – Uniform convergence and differentiation – Equicontinuous families of functions – The Stone-Weierstrass theorem.

Unit-III:

FUNCTIONS OF SEVERAL VARIABLES Linear transformations –Differentiation - The contraction principle – The inverse function theorem – The implicit function theorem – Determinants – Derivatives of higher order – Differentiation of integrals.

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Unit-IV:

LEBESGUE MEASURE Outer measure – Measurable sets and Lebesgue measure – Nonmeasurable set- Measurable functions – Littlewood's three principles.

Unit-V:

THE LEBESGUE INTEGRAL The Lebesgue integral of a bounded function over a set of finite measure –The integral of a nonnegative function – The general Lebesgue integral – Convergence in measure.

Books Recommended:

1.Principles of Mathematical Analysis by **W. Rudin**, McGraw-Hill, New York, 1976

2.Real Analysis by **H.L. Royden**, Third Edition, Macmillan, New York, 1988

DIFFERENTIAL EQUATIONS

THEORY

Total Marks: 100 (70+30)

Course Objective(s): To study Linear Equations with Linear Equations with constant coefficient and Variable Co-efficient, Homogeneous and non–homogeneous equations of order n ,Linear equation with regular singular points, and Exact equations.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Students will have a working knowledge of important mathematical concepts in Ordinary and Differential Equations.

CO2 Comprehend the Homogeneous and non–homogeneous equations of order n.

CO3 Study Linear equation with regular singular points.

CO4 Analyze the Exact equations and solving them .

CO5 Identify the equation with regular singular points and solve them.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
DIFFERENTIAL EQUATIONS Subject code - MSCMODL103	**CO 1** - Students will have a working knowledge of important mathematical concepts in Ordinary and Differential Equations	1,4,6,8	1,2
	CO 2 - Comprehend the Homogeneous and non–homogeneous equations of order n	2,4,5,7,10	2,3
	CO 3 – Study Linear equation with regular singular points	3,5,6,8,9	1,3
	CO 4 – Analyze the Exact equations and solving them	4,6,7,8,10	1,2,3

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	CO 5 - Identify the equation with regular singular points and solve them	3,5,7,9,10	2,3

CO-PO and CO-PSO Mapping

Subject	DIFFERENTIAL EQUATIONS												
Code	MSCMODL103												
Course outcomes CO MSCMODL103	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO103. 1	2	-	-	2	-	1	-	3	-	-	1	3	-
CO103. 2	-	2	-	2	3	-	1	3	-	3	-	2	1
CO103. 3	-	-	2	-	3	2	-	1	2	-	2	-	2
CO103.4	-	-	-	2	-	3	2	1	-	2	2	3	2
CO103.5	-	-	2	-	3	-	2	-	2	3	-	2	2
Average CO MSCMODL103													

Note: **1- Low relation**
2- Average relation
3- Good relation

Unit-I:

Linear equations with constant coefficients: The second order homogeneous equations – Initial value problems – Linear dependence and independence - A formula for the Wronskian – The non- homogeneous equation of order two.

Unit-II:

Homogeneous and non–homogeneous equations of order n – Initial value problems – Annihilator method to solve a non–homogeneous equation – Algebra of constant coefficient operators.

Unit-III:

Linear equations with variable coefficients: initial value problems for the homogeneous equation- Solutions of the homogeneous equation – The Wronskian and linear independence –Reduction of the order of a homogeneous equation - Homogeneous equation with analytic coefficients – The Legendre equation.

Unit-IV:

Linear equation with regular singular points: Euler equation - Second order equations with regular singular points – Exceptional cases – Bessel equation.

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Unit-V:

Existence and uniqueness of solutions to first order equations: Equation with variables separated– Exact equations – The method of successive approximations – The Lipschitz condition –Convergence of the successive approximations.

Books Recommended:

1.An Introduction to Ordinary Differential Equations by **E.A. Coddington**, Prentice Hall of India Ltd., New Delhi, 1957

DISCRETE MATHEMATICS

THEORY

Total Marks: 100 (70+30)

Course Objective(s): To study Relation, Lattices, Grammar, Boolean algebra and graph theory with the various applications.

Course Outcome(s): After completing this course, the student will be able to:

CO 1 - Study Congruence relation and quotient semigroups, Lattices.

CO 2 - Understand the finite automata, Moore and mealy machines.

CO 3 – Express the Boolean algebra as lattices and its applications.

CO 4 – Understand the Graph and its types.

CO 5 - Discuss the various algorithms for shortest route.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
DISCRETE MATHEMATICS Subject code - MSCMODL104	**CO 1** - Study Congruence relation and quotient semigroups, Lattices.	**2,4,5,7,9**	**1,3**
	CO 2 - Understand the finite automata, Moore and mealy machines.	**3,5,7,8,10**	**2,3**
	CO 3 – Express the Boolean algebra as lattices and its applications.	**1,4,5,6,8,10**	**1,3**
	CO 4 – Understand the Graph and its types.	**2,4,5,6,8,9**	**2,3**
	CO 5 - Discuss the various algorithms for shortest route.	**1,2,4,6,7,8**	**1,3**

CO-PO and CO-PSO Mapping

Subject	DISCRETE MATHEMATICS									
Code	MSCMODL1									

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	04												
Course	PO 1	PO 2	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
outcomes CO **MSCMOD L104**			3	4	5	6	7	8	9	10	1	2	3
CO104. 1	-	2	-	3	2	-	1	-	2	-	1	-	3
CO104. 2	-	-	2	-	2	-	3	1	-	1	-	2	2
CO104. 3	2	-	-	2	1	3	-	2	-	2	2	-	3
CO104.4	-	2	-	3	2	2	-	3	2	-	-	2	2
CO104.5	2	2	-	1	-	2	1	3	-	-	3	-	1
Average CO MSCMODL 104													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit I

Recurrence Relations and Generating Functions, Some number sequences, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Generating functions, Recurrences and generating functions, Exponential generating functions.

Unit II

Statements Symbolic Representation and Tautologies, Quantifiers, Predicates and validity, Prepositional Logic. Lattices as partially ordered sets, their properties, Lattices as Algebraic systems. Sub lattices, Direct products and Homomorphism, Some special lattices e.g. complete, Complemented and Distributive Lattices.

Unit III

Boolean Algebras as Lattices, Various Boolean Identities, The switching Algebra. Example, Subalgebras, Direct Products and Homomorphism, Joint-irreducible elements, Atoms and Minterms, Boolean forms and their equivalence, Minterm Boolean forms, Sum of Products, Cononical forms, Minimization of Boolean functions, Applications of Boolean Algebra to Switching Theory (using AND, OR and NOT gates.) The Karnaugh method.

Unit IV

Finite state Machines and their Transition table diagrams, Equivalence of Finite State, Machines, Reduced Machines, Homomorphism. Finite automata, Acceptors, Nondeterministic, Finite Automata and equivalence of its power to that of deterministic Finite automata, Moore and Mealy Machines.

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Unit V : Grammars and Language: Phrase-Structure Grammars, Requiting rules, Derivation, Sentential forms, Language generated by a Grammar, Regular, Context -Free and context sensitive grammars and Languages, Regular sets, Regular Expressions and the pumping Lemma. Kleene's Theorem. Notions of Syntax Analysis, Polish Notations. Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

Books Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill, Fourth Edition.
2. Seymour Lipschutz and Marc Lipson, Theory and Problems of Discrete Mathematics, Schaum Outline Series, McGraw-Hill Book Co, New York.
3. John A. Dossey, Otto, Spence and Vanden K. Eynden, Discrete Mathematics, Pearson, Fifth Edition.
4. J.P. Tremblay, R. Manohar, "Discrete mathematical structures with applications to computer science", Tata-McGraw Hill Education Pvt.Ltd.
5. J.E. Hopcraft and J.D.Ullman, Introduction to Automata Theory, Langauages and Computation, Narosa Publishing House.
6. M. K. Das, Discrete Mathematical Structures for Computer Scientists and Engineers, Narosa Publishing House.
7. C. L. Liu and D.P.Mohapatra, Elements of Discrete Mathematics- A Computer Oriented Approach, Tata McGraw-Hill, Fourth Edition.

ELECTIVE 1

THEORY

Total Marks: 100 (70+30)

NUMERICAL METHODS

Course Objective(s): Numerical Analysis deals with numerical solutions of certain problems of Mathematics. In this course we study an application of Numerical Integration, Types of partial differential equations and their solutions.

Course Outcome(s): After completing this course, the student will be able to:

CO1: Obtain the solutions of Higher Order Derivatives numerically.

CO2: Express the System of equations and higher Order Equation.

CO3: Apply the Shooting Method, the alternating direction Implicit Method.

CO4: State Types of partial differential equations.

CO5: Express the elements of ordinary differential equations.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
NUMERICAL METHODS Subject code - MSCMODL 105	**CO 1** - Obtain the solutions of Higher Order Derivatives numerically.	**2,3,5,7,9**	**1,3**
	CO 2 - Express the System of equations and higher Order Equation.	**3,4,6,8,9**	**2,3**
	CO 3 – Apply the Shooting Method, the alternating direction Implicit Method.	**1,3,4,6,7,10**	**1,3**
	CO 4 – State Types of partial differential equations.	**1,3,5,6,8,9,10**	**1,2,3**
	CO 5 - Express the elements of ordinary differential equations.	**2,3,5,6**	**2,3**

CO-PO and CO-PSO Mapping

Subject	NUMERICAL METHODS												
Code	MSCMODL105												
Course outcomes CO MSCMODL 105	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO105. 1	-	2	1	-	2	-	2	-	3	-	1	-	2
CO105. 2	-	-	2	3	-	2	-	1	2	-	-	2	1
CO105. 3	2	-	1	2	-	3	2	-	-	3	2	-	3
CO105.4	2	-	2	3	1	-	-	3	2	3	2	1	2
CO105.5	-	2	3	-	2	3	-	-	-	-	-	2	3
Average CO MSCMODL 105													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit-I

Introduction, difference calculus, difference operator, linear difference equations, first order equations, general results for linear equations, equations with constant coefficients, equations with variable coefficients.

Unit-II

Classification of partial differential equations, Dirichlet's problem, Cauchy's problem, Finite difference

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approximations to partial derivatives, Elliptic equation, Numerical solutions of Laplace and Poisson equations, Solution to elliptic equations by relaxation method, solution by Laplace equation by Alternating Direction Implicit (ADI) method.

Unit-III

Parabolic equations, Numerical solution of one dimensional diffusion & heat equations, Schmidt method, Crank-Nicholson method, Iterative methods-Dufort and Frankel method.

Unit-IV

Hyperbolic equations, the one dimensional wave equation, Numerical solutions of one-dimensional wave equation, Numerical solution of one dimensional wave equation by difference schemes, central-difference schemes, D'Alembert solution.

Unit-V

Variational finite element method with application to one-dimensional problem, solution of time dependent problems in one dimension and two dimension & steady state problems using Ritz's method.

Books Recommended:

1. Difference Equation-An Introduction with Applications by Walter G. Kelley and Allan C. Peterson, Academic Press Inc., Harcourt Brace Joranovich Publishers, 1991.
2. Numerical Solution of Differential Equations by M.K.Jain, New Age International (P) Limited, Publishers.
3. Applied Numerical Analysis by Gerald & Wheatley, Pearson Education.

MATHEMATICAL STATISTICS

Course Objective(s): To study probability density function, Mathematical Expectation, Marginal and Conditional distributions, Some Special Distributions.

Course Outcome(s): After completing this course, the student will be able to:

CO1: Understand Descriptive statistics and discrete probability.

CO2: Study Random variables and distribution function and applications.

CO3: Apply the standard discrete and continuous univariate distribution.

CO4: Study the Tests of hypothesis, Analysis of discrete data and chi-square test.

CO5: Understand Multivariate normal distribution, partial and multiple correlation coefficients and related tests

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
MATHEMATICAL STATISTICS Subject code - MSCMODL 105	**CO 1** - Understand Descriptive statistics and discrete probability.	**1,3,4,5**	**1,2**
	CO 2 - Study Random variables and distribution function and applications.	**2,3,5,6**	**2,3**
	CO 3 – Apply the standard discrete and continuous univariate distribution.	**2,4,5,7**	**1,3**
	CO 4 – Study the Tests of hypothesis, Analysis of discrete data and chi-square test.	**3,4,6,8,9**	**2,3**
	CO 5 - Understand Multivariate normal distribution, partial and multiple correlation coefficients and related tests	**5,7,8,9**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	MATHEMATICAL STATISTICS												
Code	MSCMODL105												
Course outcomes CO MSCMODL 105	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO105. 1	2	-	3	2	1	-	-	-	-	-	2	3	-
CO105. 2	-	2	3	-	2	1	-	-	-	-	-	2	3
CO105. 3	-	2	-	3	2	-	3	-	-	-	1	2	-
CO105.4	-	-	2	2	-	3	-	2	1	-	-	2	1
CO105.5	-	-	-	-	2	-	2	1	2	-	2	1	2
Average CO MSCMODL 105													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit - I

Probability: Definition and various approaches of probability, Addition theorem, Boole inequality, Conditional probability and multiplication theorem, Independent events, Mutual and pairwise independence of events, Bayes theorem and its applications.

Unit - II

Random variable and probability functions: Definition and properties of random variables,

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Discrete and continuous random variables, Probability mass and density functions, Distribution function. Concepts of bivariate random variable: joint, marginal and conditional distributions. Mathematical expectation: Definition and its properties. Variance, Covariance, Moment generating function- Definitions and their properties.

Unit - III

Discrete distributions: Uniform, Bernoulli, Binomial, Poisson and Geometric distributions with their properties. Continuous distributions: Uniform, Exponential and Normal distributions with their properties.

Unit - IV

Testing of hypothesis: Parameter and statistic, Sampling distribution and standard error of estimate, Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Two types of errors. Tests of significance: Large sample tests for single mean, Single proportion, Difference between two means and two proportions.

Books recommended :

1. V. Hogg and T. Craig, Introduction to Mathematical Statistics , 7th addition, Pearson Education Limited-2014
2. A.M. Mood, F.A. Graybill, and D.C. Boes, Introduction to the Theory of Statistics, Mc Graw Hill Book Company.
3. J.E. Freund, Mathematical Statistics, Prentice Hall of India.
4. M. Speigel, Probability and Statistics, Schaum Outline Series.
5. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.

SECOND SEMESTER

COMPLEX ANALYSIS
THEORY

Total Marks: 100 (70+30)

Course Objective(s): To study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and evaluation of definite integrals and harmonic functions, Jacobian of a transformation, conformal mapping.

Course Outcome(s): After completing this course, the student will be able to:

CO1: Analyze Analytic functions and harmonic functions.

CO2: Apply Cauchy's theorem for disk and the Integral formula.

CO3: Understand Local properties of Analytic functions.

CO4: Study Power series Expansions and the The Riemann mapping theorem.

CO5: Differentiate the Taylor's series and Laurent series.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
COMPLEX ANALYSIS Subject code – MSCMODL 201	**CO 1** - Analyze Analytic functions and harmonic functions.	**3,5,6,7,9**	**2,3**
	CO 2 - Apply Cauchy's theorem for disk and the Integral formula.	**1,3,5,6,8,9,10**	**1,3**
	CO 3 – Understand Local properties of Analytic functions	**4,6,7,8,10**	**1,2,3**
	CO 4 – Study Power series Expansions and the Riemann mapping theorem.	**2,3,4,6,7,8**	**2,3**
	CO 5 - Differentiate the Taylor's series and Laurent series.	**3,5,8,9,10**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	COMPLEX ANALYSIS												
Code	MSCMODL201												
Course outcomes CO MSCMODL201	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO201. 1	-	-	2	-	1	2	3	-	2	-	-	2	2
CO201. 2	2	-	2	-	1	3	-	2	3	1	1	-	2
CO201. 3	-	-	-	2	-	3	3	2	-	1	1	2	1
CO201.4	-	2	1	2	-	3	2	2	-	-	-	2	2
CO201.5	-	-	2	-	2	-	-	3	1	1	2	2	1
Average CO MSCMODL201													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit–I:

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Introduction to the concept of analytic function: Limits and continuity – Analytic functions – Polynomials – Rational functions – Conformality: Arcs and closed curves – Analytic functions in regions – Conformal mapping – Length and area – Linear transformations: The linear group –The cross ratio –Elementary conformal mappings: Elementary Riemann surfaces.

Unit-II:

Fundamental theorems: Line integrals rectifiable arcs – Line integrals as functions of arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk, Cauchy's integral formula: The index of a point with respect to a closed curve – The integral formula – Higher derivatives -Local properties of analytical functions: Removable singularities, Taylor's theorem – Zeros and poles – The local mapping – The maximum principle –The general form of Cauchy's theorem: Chains and cycles.

Unit-III:

The calculus of residues: The residue theorem – The argument principle – Evaluation of definite integrals-Harmonic functions: Definition and basic properties – The mean-value property –Poisson's formula.

Unit-IV:

Power series Expansions : Weierstrass theorem – The Taylor series – The Laurent series–Partial fractions and factorization: Partial fractions – Infinite products – Canonical products.

Unit-V:

The Riemann mapping theorem: Statement and proof – Boundary behavior – Use of the reflection principle – Analytic arcs – Conformal mapping of polygons: The behavior at an angle– The Schwarz – Christoffel formula – Mapping on a rectangle.

Books Recommended:

1.Complex Analysis by **L.V. Ahlfors**, Third Edition, McGraw-Hill, New York, 1979.

PARTIAL DIFFERENTIAL EQUATIONS
THEORY

Total Marks: 100 (70+30)

Course Objective(s): To study Nonlinear partial differential equations of the first order, Linear Equations with constant and Variable Co-efficient, The solution of linear hyperbolic equations, Partial Differential Equations of the First order, Partial Differential Equations of the second order.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Obtain solutions of the nonlinear partial differential equations of the first order.

CO2 Comprehend the Partial differential equations of second order.

CO3 Study the solution of linear hyperbolic equations.

CO4 Analyze the Laplace's equation.

CO5 Identify and Gain the knowledge of the wave equation.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
PARTIAL DIFFERENTIAL EQUATIONS Subject code – MSCMODL202	**CO 1** - Obtain solutions of the nonlinear partial differential equations of the first order.	**2,4,5,6,8,9**	**2,3**
	CO 2 - Comprehend the Partial differential equations of second order.	**3,5,6,8,9,10**	**1,3**
	CO 3 – Study the solution of linear hyperbolic equations.	**1,3,5,6,7,9,10**	**1,2,3**
	CO 4 – Analyze the Laplace's equation.	**4,6,8,9**	**2,3**
	CO 5 - Identify and Gain the knowledge of the wave equation.	**2,3,5,6,8,9**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	**PARTIAL DIFFERENTIAL EQUATIONS**												
Code	**MSCMODL202**												
Course outcomes CO **MSCMODL202**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO202. 1	-	2	-	3	2	3	-	1	2	-	-	1	2
CO202. 2	-	-	2	-	1	2	-	2	3	2	1	-	2
CO202. 3	2	-	2	-	1	3	3	-	2	3	2	1	2
CO202.4	-	-	-	2	-	3	-	2	2	-	-	2	1
CO202.5	-	2	1	-	2	3	-	2	1	-	2	1	3
Average CO MSCMODL202													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit I: Nonlinear partial differential equations of the first order: Cauchy's method of characteristics –Compatible systems of first order equations – Charpit's method- Special types of first order equations – Jacobi's method.

Unit II: Partial differential equations of second order: The origin of second-order equations – Linear partial differential equations with constant coefficients – Equations with variable coefficients –Characteristic curves of second–order equations- Characteristics of equations in three variables.

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Unit III: The solution of linear hyperbolic equations – Separation of variables – The method of integral transforms – Nonlinear equations of the second order.

Unit IV: Laplace's equation : The occurrence of Laplace's equation in physics- elementary solution of Laplace's equation – Families of equipotential surfaces - boundary value problems – Separation of variables- Problems with axial symmetry.

Unit V: The wave equation: The occurrence of wave equation in physics – Elementary solutions of the one-dimensional wave equation – vibrating membranes: Applications of the calculus of variations – Three dimensional problems. The diffusion equations: Elementary solutions of the diffusion equation – Separation of variables- The use of integral transforms.

Books Recommended:

1.Elements of Partial Differential Equations by **I. N. Sneddon**, McGraw-Hill Book Company, Singapore, 1957.

LINEAR ALGEBRA
THEORY

Total Marks: 100 (70+30)

Course Objective(s): This course objective is the basic concepts of linear algebra such as Vector Spaces And Linear Maps, Diagonalization And The Primary Decomposition Theorem, Unitary Transformations, The Jordan Canonical Form and brief introduction to their possible application.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Understand the vector s paces and Linear Maps also, Express the concept of Basis.

CO2 Give the knowledge of The Primary Decomposition Theorem and its applications.

CO3 Understand Unitary Transformations and its concept.

CO4 Understand The Jordan Canonical Form.

CO5 Abel about the brief introduction to their possible application.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
LINEAR ALGEBRA **Subject code – MSCMODL203**	**CO 1** - Understand the vector s paces and Linear Maps also, Express the concept of Basis.	**2,4,5,6,8,10**	**2,3**
	CO 2 - Give the knowledge of The Primary Decomposition Theorem and its applications	**1,3,5,6,8,**	**1,3**

	CO 3 – Understand Unitary Transformations and its concept	**4,5,6,8,9,10**	**1,2,3**
	CO 4 – Understand The Jordan Canonical Form.	**2,3,5,6,8,**	**2,3**
	CO 5 - Abel about the brief introduction to their possible application	**1,3,5,6,8,9**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	LINEAR ALGEBRA												
Code	MSCMODL203												
Course outcomes CO MSCMODL203	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO203. 1	-	2	-	3	1	2	-	2	-	3	-	2	1
CO203. 2	2	-	2	1	3	-	-	1	-	-	2	-	3
CO203. 3	-	-	-	2	3	2	-	2	3	3	2	2	1
CO203.4	-	2	3	-	2	3	-	1	-	-	-	1	3
CO203.5	2	-	2	-	1	1	-	2	3	-	2	3	1
Average CO MSCMODL203													

Note: 1- Low relation
2- Average relation
3- Good relation

UNIT I

Vector Spaces And Linear Maps: Vector spaces – Bases and dimension – Subspaces – Matrices and linear maps –rank nullity theorem - Inner product spaces-orthonormal basis – Gram-Schmidt Orthonormalization process.

UNIT II

Diagonalization And The Primary Decomposition Theorem: Eigen spaces-Algebraic and Geometric multiplicities – Cayley-Hamilton theorem Diagonalization – Direct sum decomposition – Invariant direct sums – Primary decomposition theorem.

UNIT III

Unitary Transformations:Unitary matrices and their properties-rotation matrices-Schur, Diagonal and Hessenberg forms and Schur Decomposition.

UNIT IV

The Jordan Canonical Form: Similarity Transformations and change of basis-Generalised eigen vectors-

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Canonical basis-Jordan canonical form – Applications to linear differential equations – Diagonal and the general cases.

UNIT V

Applications; An error–correcting code – The method of least squares – Particular solutions of nonhomogeneous differential equations with constant coefficients – The Scrambler transformation.

Books Recommended:

1. Hoffmann K. and Kunze R., "Linear Algebra", Prentice Hall of India, 2nd Edition, 2000. (Sections: 2.1, 2.2, 2.3, 2.4, 3.1, 3.3, 3.4, 6.2, 6.4, 6.6, 6.7, 6.8, 8.2)

2. Ben Noble and James W. Daniel, "Applied Linear Algebra", Prentice Hall International Inc, 3rd Edition, 1988. (Sections: 7.3 - 7.5, 8.2)

3. Agnew J. and Knapp R.C., "Linear Algebra with Applications", Brooks/Cole Publishing Co., 1983. (Sections: 4.6, 5.4)

4. Gilbert Strang, "Linear Algebra and its applications", Thomson, 3rd Edition, 1998.

5. S. Kumaresan, "Linear Algebra: A Geometric Approach", Prentice Hall of India, 2006.

MATLAB

THEORY

Total Marks: 100 (70+30)

Course Objective(s): In this course we will study the basics of the Starting with Matlab, Script files, Two-dimensional plots - Three-dimensional plots, Programming in MATLAB and its applications

Course Outcome(s): After completing this course, the student will be able to:

CO 1 - Identify the basic concept of MAT LAB
CO 2 - Gain knowledge of Analyze Classes and Objects.
CO 3 – Understand Two-dimensional plots and Three-dimensional plots
CO 4 – Apply the concept of Extending Classes.
CO 5 - Understand how to build Elementary MATH Built.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
MATLAB Subject code – MSCMODL204	**CO 1** - Identify the basic concept of MAT LAB	**2,3,5,6,8,10**	**2,3**
	CO 2 - Gain knowledge of Analyze Classes and Objects.	**1,3,5,6,9**	**1,2,3**

	CO 3 – Understand Two-dimensional plots and Three-dimensional plots	**2,3,5,6,9,10**	**1,3**
	CO 4 – Apply the concept of Extending Classes.	**3,5,6,8,9,10**	**2,3**
	CO 5 - Understand how to build Elementary MATH Built.	**1,2,5,8,9**	**2,3**

CO-PO and CO-PSO Mapping

Subject	MATLAB												
Code	MSCMODL204												
Course outcomes CO MSCMODL204	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO204. 1		2	3		1	2		2		2		2	2
CO204. 2	2		2		1	3			3		2	3	1
CO204. 3		2	3		2	2			1	3		3	2
CO204.4			3		2	2		2	2	1		2	2
CO204.5	2	2			1			1	2			2	3
Average CO MSCMODL204													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit – I:

Starting with Matlab - Creating arrays - Mathematical operations with arrays.

Unit – II:

Script files - Functions and function files.

Unit – III:

Two-dimensional plots - Three-dimensional plots.

Unit – IV:

Programming in MATLAB.

Unit – V:

Polynomials, Curve fitting and interpolation - Applications in numerical analysis.

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Books Recommended:

1. MATLAB An Introduction with Application" by **A. Gilat,** John Wiley & Sons, Singapore, 2004.

2. Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers" by **R. Prata p**, Oxford University Press, New Delhi, 2006.

3. "Introduction to Matlab 7 for Engineers" by **W.J. Palm,** McGraw-Hill Education, New York, 2005.

4. "Introduction to MATLAB 7" by **D. M. Etter, D. C. Kuncicky and H.Moore**, Prentice Hall, New Jersy, 2004.

MATLAB

PRACTICAL

Total Marks: 50 (35+15)

ELECTIVE II

THEORY

Total Marks: 100 (70+30)

DISTRIBUTION THEORY

Course Objective(s): This course objective is the basic and advanced concepts of distribution theory such as Test Functions And Distributions, Derivatives And Integrals, study of Convolutions And Fundamental Solutions, Green's Functions, and brief introduction to their possible application.

Course Outcome(s): After completing this course, the student will be able to:

CO-1 Explain the fundamental concepts of advanced distribution theory and their role in modern mathematics and applied contexts.

CO-2 Able to known Derivatives And Integrals.

CO-3 Knowledge of Convolutions And Fundamental Solutions and its applications.

CO-4 Understand the concepts Green's Functions.

CO-5 Understand the connection and transition between previously studied mathematics and more advanced mathematics.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
DISTRIBUTION THEORY Subject code – MSCMODL206	**CO 1 -** Explain the fundamental concepts of advanced distribution theory and their role in modern mathematics and applied contexts	**2,3,5,6,8,9**	**1,3**
	CO 2 - Able to known Derivatives And Integrals.	**4,6,8,9,10**	**2,3**
	CO 3 – Knowledge of Convolutions And Fundamental Solutions and its applications.	**1,3,5,6,8,10**	**1,2,3**

	CO 4 – Understand the concepts Green's Functions.	**2,4,6,8,9**	**1,2**
	CO 5 - Understand the connection and transition between previously studied mathematics and more advanced mathematics.	**2,5,6,8,9**	**1,2**

CO-PO and CO-PSO Mapping

Subject	**DISTRIBUTION THEORY**												
Code	**MSCMODL206**												
Course outcomes CO **MSCMODL 206**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO206. 1	-	2	3	-	2	1	-	1	2	-	2	-	2
CO206. 2	-	-	-	2	-	3	-	2	2	1	-	1	3
CO206. 3	2	-	2	-	1	3	-	3	-	2	2	3	1
CO206.4	-	2	-	3	-	2	-	2	1	1	1	-	-
CO206.5	-	2	-	-	3	3	-	2	1	2	2	-	-
Average CO **MSCMODL 206**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit - I:

Test Functions And Distributions: Test functions - Distributions - Localization and regularization - Convergence of distributions -Tempered distributions.

Unit - II:

Derivatives And Integrals: Basic Definitions - Examples - Primitives and ordinary differential equations.

Unit - III:

CONVOLUTIONS AND FUNDAMENTAL SOLUTIONS The direct product of distributions - Convolution of distributions – Fundamental solutions.

Unit - IV:

THE FOURIER TRANSFORM Fourier transforms of test functions - Fourier transforms of tempered distributions- The fundamental solution for the wave equation-Fourier transform of convolutions-Laplace transforms.

Unit - V:

GREEN'S FUNCTIONS Boundary-Value problems and their adjoints - Green's functions for boundary-Value

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problems- Boundary integral methods.

Books Recommended:

1. An Introduction to Partial Differential Equations by **M. Renardy and R.C. Rogers**, Second Edition, Springer Verlag, New York, 2008.

2. "The Analysis of Linear Partial Differential Operators I – Distribution Theory and Fourier Analysis" by **L. HÖrmander**, Second Edition, Springer Verlag, Berlin, 2003.

3. "Introduction to the Theory of Distributions" by **F.G. Friedlander and M. Joshi,** Cambridge University Press,UK, 1998.

4. "Generalized Functions - Theory and Technique" by **R.P. Kanwal**, Academic Press, New York, 1983.

INFORMATION THEORY

Course Objectives

To provide an insight into the Basic concepts of probability and its significance in the information theory..

To explore in detail, the calculations of channel capacity to support error-free transmission and also, the most commonly used source coding and channel coding algorithms.

To encourage and train to design coding schemes for data compression and error correction, and they will also get an overall perspective of how this impacts the design of an optimum communication receiver.

Course Outcomes

CO1: Overview of Probability Theory, significance of "Information" with respect to Information Theory.

CO2: Derive equations for entropy, mutual information and channel capacity for all kinds of channels.

CO3: Implement the various types of source coding algorithms and analyse their performance.

CO4: Explain various methods of generating and detecting different types of error correcting codes.

CO5: Understand the fundamentals of Field Theory and polynomial arithmetic.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
INFORMATION THEORY Subject code – MSCMODL206	**CO 1** - Overview of Probability Theory, significance of "Information" with respect to Information Theory.	**2,3,5,6,9**	**1,3**
	CO 2 - Derive equations for entropy, mutual information and channel capacity for all kinds of channels.	**3,5,8,10**	**1,2,3**

	CO 3 – Implement the various types of source coding algorithms and analyse their performance.	**1,3,5,6,9**	**2,3**
	CO 4 – Explain various methods of generating and detecting different types of error correcting codes.	**2,3,5,8,10**	**1,2**
	CO 5 - Understand the fundamentals of Field Theory and polynomial arithmetic.	**1,3,5,6,9,10**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	**INFORMATION THEORY**												
Code	**MSCMODL1 206**												
Course outcomes CO **MSCMODL 206**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO206. 1	-	2	1	-	2	3	-	-	1	-	1	-	2
CO206. 2	-	-	2	-	3	-	-	2	-	1	2	2	3
CO206. 3	2	-	1	-	2	3	-	-	2	-	-	3	2
CO206.4	-	2	2	-	1	-	-	1	-	3	3	2	-
CO206.5	2	-	3	-	1	2	-	-	2	3	3	2	2
Average CO **MSCMODL 206**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit - I

Basic concepts of probability, Sample spaces, Probability measure, Theorems of addition and multiplication, Conditional probability, Bayes Theorem Random, Variable, Discrete and continous probability distributions Communication processes.

Unit - II

Entropy as a measure of uncertainty and information, Shannon's entropy and entropies of order, Algebraic properties and possible interpretations, Analytical properties and inqualities, Joint and conditional entropies, Mutual information. Noiseless codding, Unique decipherability, Conditions of existence of instantaneous codes, Its extention to uniquely decipherable codes, Noiseless coding theorem.

Unit - III

Construction of optional codes, Discrete memory less channels, Models for communication channel capacity, Clasification of channels, Calculation of channel capacity, Decoding scheme. fundamental theorems, Expontial

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error bound weak converse of Fundamental theorem.

Unit - IV

Extension of definition of entropies to continous memory less channels and properties. Characterization theorem for entropies due to Shannon, Tevberg, Chaundy and Mechleod, Kandall, Daroczy, Campbell and Hayarda-Charvat.

Unit - V

Error correcting codes- maximum distance, Principal and error correcting properties, Gamming bounds, Pairy coding, Upper and Lower bounds of parity cheek codes.

Books Recommended:

1. R. Ash, Information Theory, Interscience Publishers, New York, 1965.

2. F.M. Reza, An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.

3. J. Aczela dn Z. Daroczy, On Measures of Information and their Characterizations, Academic Press, New York.

4. Mathai A.M. and Rathi P.N. : Axomatic Foundations of some concepts of Information Theory.

THIRD SEMESTER

TOPOLOGY
THEORY

Total Marks: 100 (70+30)

Course Objectives:

The prerequisite for the course is a first course in Analysis, at the level of Rudin's "Principles of Mathematical Analysis". In this course the students will be introduced the basic concepts of Topology. Definitions and examples of Topological Spaces, Open Bases, Open covering, Compact spaces, Hausdorff spaces, Separable spaces and totally disconnected spaces will be discussed. Proofs of important theorems such as Lindelof's Theorem, Tychnoff's Theorem, will be discussed.

Course Outcomes:

CO-1 In mathematics, topology is concerned with the properties of space that are preserved under continuous deformations, such as stretching, crumpling and bending, but not tearing or gluing, hence Topology is also known as rubber sheet geometry.

CO-2 On completion of the course students will understand that many concepts such as continuity, connectedness, compactness etc. are invariant under deformation of stretching and shearing.

CO-3 This course will give an insight into the beauty of mathematical argument and into qualitative approach to

problem solving.

CO4: Discuss the components of a space and totally disconnected spaces.

CO5: Study Stone-Weierstrass theorems and its applications.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
TOPOLOGY Subject code – MSCMODL301	**CO 1** - In mathematics, topology is concerned with the properties of space that are preserved under continuous deformations, such as stretching, crumpling and bending, but not tearing or gluing, hence Topology is also known as rubber sheet geometry.	**2,4,5,6,8**	**2,3**
	CO 2 - On completion of the course students will understand that many concepts such as continuity, connectedness, compactness etc. are invariant under deformation of stretching and shearing.	**1,4,6,8,10**	**1,2,3**
	CO 3 – This course will give an insight into the beauty of mathematical argument and into qualitative approach to problem solving.	**2,5,6,8,9,10**	**2,3**
	CO 4 – Discuss the components of a space and totally disconnected spaces.	**1,3,5,7,8,9**	**1,2**
	CO 5 - Study Stone-Weierstrass theorems and its applications	**2,3,4,5,6,8,9**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	TOPOLOGY												
Code	MSCMODL 301												
Course outcomes CO MSCMODL301	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO301. 1	-	2	-	2	3	1	-	3	-	-	-	1	3
CO301. 2	2	-	-	2	-	3	-	1	-	3	2	1	2
CO301. 3	-	2	-	-	1	2	-	3	3	1	-	2	1
CO301.4	2	-	3	-	2	-	2	1	2	-	2	2	-
CO301.5	-	2	3	2	1	2	-	-	2	3	1	2	2
Average CO MSCMODL301													

Note: 1- Low relation

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2- Average relation

3- Good relation

Unit-I:

Spaces and maps: Topological spaces-Sets in a space-Maps-Subspaces-Sum and product of spaces.

Unit-II:

Identification and quotient spaces-Homotopy and isotopy.

Unit-III:

Properties of spaces and maps: Separation axioms and compactness.

Unit-IV

Connectedness – Pathwise connectedness – Imbedding theorems.

Unit-V

Extension theorems-Compactification-Hereditary properties.

Books Recommended:

1. Introduction to Topology by **S.T. Hu**, **Tata** – McGraw-Hill, New Delhi, 1979.
2. Topology by **J. Dugunj**i, Allyn and Bagon, Boston, 1966.
3. Topology by **K. Kuratowski,** Academic Press, New york, 1966
4. Topology, A First Course " by **J.R. Munkres,** Prentice Hall , Englewood Cliffs, 1975.
5. General Topology by **S. Willard,** Addison-Wesley, Reading, 1970 .

MATHEMATICAL METHOD

THEORY

Total Marks: 100 (70+30)

Course Objective(s): This course gives the basic concept of Mathematical modelling, so that students from various fields like Engineering, Economics, Biology, Epidemiology etc. can apply its concept.

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

CO 1 - Discuss the basic features of mathematical modelling.
CO 2 - Apply the mathematical modeling using ODE of first order.
CO 3 – Explain the discrete model and its applications.
CO 4 – Get the application of The Method Of Variations In Problems With Fixed Boundaries.

CO 5 - Discussed Sufficient Conditions For An Extremum.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
MATHEMATICAL METHOD Subject code – MSCMODL302	**CO 1** - Discuss the basic features of mathematical modelling.	**1,3,4,5,6,8,9**	**2,3**
	CO 2 - Apply the mathematical modeling using ODE of first order.	**2,3,5,6,8,9**	**1,2**
	CO 3 – Explain the discrete model and its applications.	**1,2,3,7,8,9,10**	**1,2,3**
	CO 4 – Get the application of The Method Of Variations In Problems With Fixed Boundaries.	**2,4,6,8**	**2,3**
	CO 5 - Discussed Sufficient Conditions For An Extremum.	**1,4,5,8**	**2,3**

CO-PO and CO-PSO Mapping

Subject	**MATHEMATICAL METHOD**												
Code	**MSCMODL 302**												
Course outcomes CO **MSCMODL302**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO302. 1	2	-	2	3	3	2	-	2	1	-	-	2	2
CO302. 2	-	2	3	-	2	2	-	2	3	-	2	2	-
CO302. 3	2	3	1	-	-	-	2	2	3	1	2	1	2
CO302.4	-	2	-	4	-	2	-	2	-	-	-	2	2
CO302.5	2	-	-	2	1	-	-	3	-	-	-	2	2
Average CO **MSCMODL302**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit-I:

Integral Equations: Introduction: Integral equations with separable kernels - Reduction to a system of algebraic equations, Fredholm alternative, an approximate method, Fredholm integral equations of the first kind, method of successive approximations - Iterative scheme, Volterra integral equation, some results about the resolvent

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kernel, classical Fredholm theory - Fredholm's method of solution - Fredholm's first, second, third theorems.

Unit-II:

Applications Of Integral Equations : Application to ordinary differential equation - Initial value problems, boundary value problems - Singular integral equations - Abel integral equation.

CALCULUS OF VARIATIONS

Unit-III:

The Method Of Variations In Problems With Fixed Boundaries: Variation and its properties - Euler's equation - Functionals of the form $\int F(x,y1,y2,\ldots yn,y1',y2',\ldots yn')dx$, Functionals dependent on higher order derivatives - Functionals dependent on the functions of several independent variables - Variational problems in parametric form - Some applications. **Unit-IV:** Sufficient Conditions For An Extremum: Field of extremals - The function E(x,y,p,y') - Transforming the Euler equations to the canonical form.

Unit-V:

Direct Methods In Variational Problems: Direct methods - Euler's finite difference method - The Ritz method - Kantorovich's method.

Books Recommended:

1. Linear Integral Equations - Theory and Technique by **R. P. Kanwal**, Second Edition, Birkhauser, Boston, 1997.

2. Differential Equations and the Calculus of Variations by **L. Elsgolts**, MIR Publishers, Moscow, 1970.

3. Integral Equations and Applications by **C. Corduneanu**, Cambridge University Press, Cambridge, 1991.

4.Calculus of Variations, with Applications to Physics and Engineering by **R. Weinstock**, McGraw-Hill Book Co., Inc., New York, 1952.

FUNCTIONAL ANALYSIS

THEORY

Total Marks: 100 (70+30)

Course Objectives:

The objectives of the course are to develop the theory needed to treat linear integral and differential equations, within the framework of infinite-dimensional linear algebra. Concepts of Normed spaces, Banach spaces, Hilbert spaces with examples are explained. Uniform boundedness principle and the open mapping theorem Banach Contraction Fixed point theorem and its generalization, Schauder's Fixed Point Theorem and applications of fixed point theorems are dealt with in detail.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Study Continuous linear transformations and the Hahn-Banach theorem.

CO2 Understand the, normed linearspaces of bounded linear transformations.

CO3 Obtain Orthogonal complements, Orthonormal sets and conjugate space.

CO4 Understand the Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces.

CO5 Discuss Measurable functions.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
FUNCTIONAL ANALYSIS Subject code – MSCMODL303	**CO 1** - Study Continuous linear transformations and the Hahn-Banach theorem.	**2,3,4,5,8,9**	**2,3**
	CO 2 - Understand the, normed linearspaces of bounded linear transformations.	**1,3,5,6,8,10**	**1,3**
	CO 3 – Obtain Orthogonal complements, Orthonormal sets and conjugate space	**1,2,3,7,8,9**	**1,2,3**
	CO 4 – Understand the Complete Orthonormal sets and Parseval's identity, Structure of Hilbert spaces	**2,5,8,10**	**1,2**
	CO 5 - Discuss Measurable functions	**1,5,8**	**1,3**

CO-PO and CO-PSO Mapping

Subject	FUNCTIONAL ANALYSIS												
Code	MSCMODL303												
Course outcomes CO MSCMODL303	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO303. 1	-	2	1	2	2	-	-	3	2	-	-	2	3
CO303. 2	2	-	3	-	1	2	-	2	3	-	2	-	3
CO303. 3	2	3	3	-	-	-	2	1	2	-	2	2	1
CO303.4	-	2	-	-	3	-	-	2	-	2	2	3	-
CO303.5	1	-	-	-	2	-	-	3	-	-	1	-	3
Average CO MSCMODL303													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit-I:

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Banach spaces: Definition and examples – Continuous linear transformations – The Hahn Banach theorem .

Unit-II

The natural imbedding – Open mapping theorem – The conjugate of an operator.

Unit-III

Hilbert spaces: Definition and simple properties – Orthogonal complements – Orthonormal sets– Conjugate space.

Unit-IV

The adjoint of an operator-Self –adjoint operators-Normal and unitary operators-Projections. Algebras of operators.

Unit-V General Preliminaries on Banach Algebras: The definitions and some examples-Regular and singular elements-Topological divisors of zero-The spectrum-The formula for the spectral radius.

Books Recommended:

1.Introduction to Topology and Modern Analysis by **G.F.Simmons**, McGraw-Hill, New York, 1963.

2.A Course in Functional Analysis by **J. B. Conway**, Springer, New York, 1990.

3. First Course in Functional Analysis by **C. Goffman & G. Pedrick**, Prentice-Hall of India, New Delhi, 2002.

4. Elements of Functional Analysis by **L. A. Lusternik & V. J. Sobolev**, Hindustan Publishing Co, New Delhi, 1985.

5. Introduction to Functional Analysis by **A. E. Taylor**, John Wiley, New York, 1958.

LATEX & MATHEMATICA

THEORY

Total Marks: 100 (70+30)

Course Objective:- The main motive is to impart the knowledge and understanding about LaTeX and Mathematica system, explain the procedure of LaTeX typesetting and familiarize the participants with various document formats of LaTeX and enable them to prepare research articles, thesis, books, and presentations with confidence.

Students will be able to learn:

Course Outcomes:-

CO-1 Typesetting of complex mathematical formulae using LaTeX.

CO-2 Use tabular and array environments within LaTeX.

CO-3 Use various methods to Mathematica.

CO-4 On completion of the course the students will get familiar Advanced Mathematics In Mathematica.

CO-5 On completion of the course the students will get familiar Linear algebra.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
LATEX & MATHEMATICA Subject code – MSCMODL304	**CO 1** - Typesetting of complex mathematical formulae using LaTeX.	**1,3,5,6,8**	**2,3**
	CO 2 - Use tabular and array environments within LaTeX.	**2,3,5,7**	**1,3**
	CO 3 – Use various methods to Mathematica.	**2,5,8,10**	**1,2,3**
	CO 4 – On completion of the course the students will get familiar Advanced Mathematics In Mathematica	**2,4,5,6,8,9**	**2,3**
	CO 5 - On completion of the course the students will get familiar Linear algebra.	**2,4,5,7,8**	**1,3**

CO-PO and CO-PSO Mapping

Subject	**LATEX & MATHEMATICA**												
Code	**MSCMODL304**												
Course outcomes CO **MSCMODL101**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO304. 1	2	-	3	-	1	2	-	2	-	-	-	2	2
CO304. 2	-	2	2	-	3	-	2	-	-	-	2	-	2
CO304. 3	-	2	-	-	1	-	-	1	-	2	2	1	3
CO304.4	-	3	-	2	1	2	-	2	2	-	-	3	2
CO304.5	-	2	-	3	1	-	2	1	-	-	1	-	1
Average CO **MSCMODL304**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit – I:

Special Characters, Document layout and organization – Document class, Page style, Parts of the document, Centering and indenting, Lists, Theorem–like declarations, Boxes, Tables.

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Unit – II:

Footnotes and marginal notes, Mathematical formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine–tuning mathematics, Drawing pictures with LATEX.

Unit – III:

Introduction To Mathematica: Running Mathematica - Numerical calculations – Building up calculations – Using the Mathematica system – Algebraic calculations - Symbolic mathematics - Numerical mathematics.

Unit – IV:

Advanced Mathematics In Mathematica: Numbers - Mathematical functions – Algebraic manipulation – Manipulating equations - Calculus.

Unit – V:

Series, limits and residues - Linear algebra.

Books Recommended:

1. A Guide to LATEX by **H. Kopka** and **P.W. Daly**, Third Edition, Addison – Wesley, London, 1999.

2.The Mathematica Book by **S. Wolfram,** Fourth Edition, Cambridge University Press, Cambridge, 1999.

LATEX & MATHEMATICA PRACTICAL

Total Marks: 50 (35+15)

ELECTIVE III THEORY

Total Marks: 100 (70+30)

GRAPH THEORY

Course Objectives:

The objectives of this course are to provide an introduction to the language, methods and terminology of the subject and to emphasise on algorithmic and probabilistic approaches that have proved fruitful in modern graph theory.

Course Outcomes:

CO-1 On completion of the course the students will get familiar with graphs; trees; paths; cycles;

CO-2 On completion of the course the students will get familiar with vertex degree;

CO-3 On completion of the course the students will get familiar with connectedness; bipartite graphs; complete graphs

CO-4 On completion of the course the students will get familiar with subgraphs and

CO-5 The techniques learnt in this course to be useful in other areas of mathematics.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
GRAPH THEORY **Subject code – MSCMODL 306**	**CO 1** - On completion of the course the students will get familiar with graphs; trees; paths; cycles;	**2,3,5,6,8,9**	**1,3**
	CO 2 - On completion of the course the students will get familiar with vertex degree;	**1,3,5,8,9,10**	**1,2,3**
	CO 3 – On completion of the course the students will get familiar with connectedness; bipartite graphs; complete graphs.	**2,4,6,8,9**	**2,3**
	CO 4 – On completion of the course the students will get familiar with sub graphs.	**1,3,4,5,8,9**	**1,2**
	CO 5 - The techniques learnt in this course to be useful in other areas of mathematics.	**1,5,8,9**	**2,3**

CO-PO and CO-PSO Mapping

Subject	GRAPH THEORY												
Code	MSCMODL306												
Course outcomes CO MSCMODL 306	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO306. 1	-	2	1	-	2	3	-	3	2	-	2	-	2
CO306. 2	2	-	2	-	3	-	-	3	2	2	2	3	3
CO306. 3	-	2	-	3	-	2	-	3	2	-	-	2	2
CO306.4	2	-	2	2	3	-	-	-	2	2	-	2	2
CO306.5	2	-	-	-	2	-	-	3	2	-	-	2	3
Average CO MSCMODL 306													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit - I

Definition and types of graphs, Walks, Paths and Circuits, Connected and Disconnected graphs, Applications of graphs, operations on Graphs, Graph Representation, Isomorphism of Graphs.

Unit - II

Eulerian and Hamiltonian paths, Shortest Path in a Weighted Graph, The Travelling Sales person Problem, Planar

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Graphs, Detection of Planarity and Kuratowski Theorem, Graph Colouring.

Unit - III

Directed Graphs, Trees, Tree Terminology, Rooted Labeled Trees, Prefix Code, Binary Search Tree, Tree Traversal.

Unit - IV

Spanning Trees and Cut Sets, Minimum Spanning Trees, Kruskal Algorithm, Prim Algorithm, Decision Trees, Sorting Methods.

Unit - V

Coloring and covering of graphs, Chromatic. Polynomial, chromatic partitioning, Dimmer problem, Dominating sets, Independent sets, Four colour conjecture.

Books Recommended:

1. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice –Hall of India Pvt. Ltd, 2004.
2. F. Harary: Graph Theory, Addition Wesley, 1969.
3. G. Chartrand and P. Zhang. Introduction to Graph Theory, Tata McGraw-Hill, 2006.
4. Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill, Fourth Edition, 1999.
5. Seymour Lipschutz and Marc Lipson, Theory and Problems of Discrete Mathematics, Schaum Outline Series, McGraw-Hill Book Co, New York, 2007.
6. John A. Dossey, Otto, Spence and Vanden K. Eynden, Discrete Mathematics, Pearson, Fifth Edition, 2005.
7. C. L. Liu and D.P.Mohapatra, Elements of Discrete Mathematics- A Computer Oriented Approach, Tata McGraw-Hill, Fourth Edition.

NUMBER THEORY & CRYPTOGRAPHY

Course Objective(s): Number theory is one of the oldest branches of Mathematics. In this course we introduce the basic concepts of Number theory such as Divisibility, Congruences with Prime Modulus, Quadratic reciprocity and some functions of Number Theory.

Course Outcome(s): After completing this course, the student will be able to:

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.

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NUMBER THEORY & CRYPTOGRAPHY Subject code – MSCMODL306	**CO 1** - Understand the concepts of divisibility and Primes.	**1,3,4,6,8**	**1,3**
	CO 2 - Solve congruences.	**3,6,8,9,10**	**2,3**
	CO 3 – Describe Gauss's Lemma, Quadratic reciprocity law.	**4,6,8,9**	**1,3**
	CO 4 – Discuss Cryptography and its applications.	**2,4,5,6,8,9**	**1,2,3**
	CO 5 - Study the various cryptanalysis.	**3,5,6,7,8,9,10**	**2,3**

CO-PO and CO-PSO Mapping

Subject	NUMBER THEORY & CRYPTOGRAPHY												
Code	MSCMODL 306												
Course outcomes CO MSCMODL306	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO306. 1	2	-	1	2	-	3	-	2	-	-	2	-	3
CO306. 2	-	-	2	-	-	3	-	1	1	2	-	2	1
CO306. 3	-	-	-	2	-	3	-	3	2	-	2	-	1
CO306.4	-	2	-	2	1	2	-	3	2	-	2	3	2
CO306.5	-	-	2	-	2	3	1	2	3	2	-	2	2
Average CO MSCMODL 306													

Note: 1- Low relation

2- Average relation

3- Good relation

UNIT I

Introduction To Number Theory:

Time estimates for doing arithmetic - Divisibility and the Euclidean algorithm – Congruences - Modular exponentiation - Some applications to factoring.

UNIT II

Quadratics Residues And Reciprocity Finite Fields - Multiplicative generators – Uniqueness of fields with prime power elements - Quadratic residues and reciprocity.

UNIT III

Cryptosystems: Some simple crypto systems - Digraph transformations - Enciphering Matrices -

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Affine enchipering transformationsRSA - Discrete Log - Diffie-Hellman key exchange - The Massey – Omura cryptosystem - Digital Signature standard -Computation of discrete log

UNIT IV

Primality And Factoring – I, Pseudoprimes - Strong pseudo primes - Solovay-Strassen Primality test – Miller - Rabin test - Rho method - Fermat factoring and factor bases - Quadratic sieve
Method.

UNIT V

Primality And Factoring – II Elliptic Curves - Elliptic curve primality test - Elliptic Curve factoring - Pollard's p - 1method -Elliptic curve reduction modulo n - Lenstras Method.

Books Recommended:

1. Neal Koblitz, "A course in Number Theory and Cryptography", 2nd Edition, Springer-Verlag, 1994.
2. Menezes A, "Van Oorschot and Vanstone S.A, Hand book of Applied Cryptography", CRC Press, 1996.

FOURTH SEMESTER

NONLINEAR DIFFERENTIAL EQUATION
THEORY

Total Marks: 100 (70+30)

Course Objectives: It is often seen that mathematical models are formulated in terms of equations involving functions as well as their derivatives. Such equations are called differential equations. The course covers the understanding of non linear differential equations and their solutions with the initial and boundary conditions. The course also covers the Perturbation Methods, Linear systems and Stability.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Obtain solutions of the First order systems in two variables and linearization.
CO2 Comprehend the Averaging Methods
CO3 Understand the concepts of Perturbation Methods: Outline of the direct method..
CO4 Analyze the Linear systems: Structure of solutions of the general linear system
CO5 Identify the Comparison theorem for the zero solutions of nearly-linear systems.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.

NONLINEAR DIFFERENTIAL EQUATION Subject code – MSCMODL401	**CO 1** - Obtain solutions of the First order systems in two variables and linearization	**2,3,5,6,8**	**1,2,3**
	CO 2 - Comprehend the Averaging Methods	**1,4,5,6,9,10**	**2,3**
	CO 3 – Understand the concepts of Perturbation Methods: Outline of the direct method.	**2,3,5,7,9**	**1,3**
	CO 4 – Analyze the Linear systems: Structure of solutions of the general linear sy	**3,5,6,7,8**	**2,3**
	CO 5 - Identify the Comparison theorem for the zero solutions of nearly-linear systems	**2,4,6,8,9**	**2,3**

CO-PO and CO-PSO Mapping

Subject	NONLINEAR DIFFERENTIAL EQUATION												
Code	MSCMODL401												
Course outcomes CO MSCMODL401	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO401. 1	-	2	1	-	2	2	-	3	-	-	2	2	3
CO401. 2	2	-	-	2	1	2	-	-	2	2	-	2	1
CO401. 3	-	2	3	-	2	-	2	-	3	-	2	-	3
CO401.4	-	-	2	-	2	3	1	2	-	-	-	2	2
CO401.5	-	2	-	2	-	1	-	1	2	-	-	2	2
Average CO MSCMODL 401													

Note: 1- Low relation
2- Average relation
3- Good relation

Unit-I:

First order systems in two variables and linearization: The general phase plane - Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Unit-II:

Averaging Methods: An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Unit-III:

Perturbation Methods: Outline of the direct method – Forced oscillations far from resonance- Forced oscillations

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near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt's method – Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.

Unit-IV:

Linear systems: Structure of solutions of the general linear system – Constant coefficient system – Periodic coefficients –Floquet theory – Wronskian.

Unit-V:

Stability: Poincare stability – Solutions, paths and norms – Liapunov stability- Stability of linearsystems – Comparison theorem for the zero solutions of nearly-linear systems.

Books Recommended:

1. *"Nonlinear Ordinary Differential Equations"* by **D.W.Jordan and P.Smith**, Clarendon Press, Oxford, 1977.
2. *"Differential Equations"* by **G.F. Simmons**, Tata McGraw-Hill, New Delhi, 1979.
3. *"Ordinary Differential Equations and Stability Theory"* by **D.A. Sanchez**, Dover, New York, 1968.
4. *"Notes on Nonlinear Systems"* by **J.K. Aggarwal**, Van Nostrand, 1972.

OPERATION RESEARCH
THEORY

Total Marks: 100 (70+30)

Course Objective(s): In this course basic concepts of Operations Research such as Linear Programming Problem, Duality in Linear Programming, Transportation Problem, Assignment Problem and Queuing Theory are introduced.

Course Outcome(s): After completing this course, the student will be able to:

CO1 Apply and solve the problems - Games Theory and Queuing Theory: Poison queuing system.

CO2 Understand the concept of LPP by Simplex method, dual simplex method, Big M method and its different applications.

CO3 Analyze Transportation problem and Assignment Problems: Hungarian Method for solution. Traveling-Salesman problems and different application in real life.

CO4 Understand Integer Programming, Goal Programming, Dynamic Programming and its importance in optimization process.

CO5 Discuss the Non-Linear Programming and its applications.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
OPERATION RESEARCH Subject code – MSCMODL 402	**CO 1** - Apply and solve the problems - Games Theory and Queuing Theory: Poison queuing system.	**1,3,5,8,9**	**1,3**
	CO 2 - Understand the concept of LPP by Simplex method, dual simplex method, Big M method and its different applications	**2,3,5,6,7,8**	**1,2,3**
	CO 3 – Analyze Transportation problem and Assignment Problems: Hungarian Method for solution. Traveling- Salesman problems and different application in real life.	**2,3,5,6,8,9,10**	**1,2**
	CO 4 – Understand Integer Programming, Goal Programming, Dynamic Programming and its importance in optimization process.	**2,3,5,8,9**	**2,3**
	CO 5 - Discuss the Non-Linear Programming and its applications	**1,4,6,7,9,10**	**2,3**

CO-PO and CO-PSO Mapping

Subject	**OPERATION RESEARCH**												
Code	**MSCMODL 402**												
Course outcomes CO **MSCMODL402**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO402. 1	2	-	3	-	1	-	-	1	2	-	1	-	2
CO402. 2	-	1	2	-	1	2	3	1	-	-	2	2	1
CO402. 3	-	2	3	-	2	2	-	2	1	3	2	2	-
CO402.4	-	2	2	-	2	1	-	2	3	-	-	2	2
CO402.5	2	-	-	2	-	1	2	-	2	3	-	2	2
Average CO **MSCMODL402**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit-I

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Introduction, Nature and Meaning of O.R. Modelling in operations Research, Features of Operation research, scope of operations research Linear Programming Problem: formulation of L.P.P. solution of L.P.P. Graphical Method, Simplex Methods in Duality, Integer Programming.

Unit-II

Assignment problems: Mathematical formulation, reduction theorem, unbalanced assignment problem, Transportation problem formulation, basic feasible solution – North-West-corner method, Least cost method, Vogel's Approximation method, Optimum solution: MODI method.

Unit-III

Job sequencing: Processing n jobs through 2 machines, Processing n jobs through 3 machines, Processing 2 Jobs through m machines, Replacement problems: Replacement policy for items whose maintenance cost increase with time and money value is constant, Money value changes with constant rate.

Unit-IV

Project management: Introduction, network diagram representation, time estimates and critical path with saddle point, rectangular game with out saddle point, Principle of dominance, Graphical method.

Unit-V

Queuing Theory: Introduction, queuing system Transient and steady traffic inlets, Distribution of arrival distribution of departure, M/M/I: ∞/ FCFS model nonlinear programming: Kuhn-Tucker conditions.

Books Recommended:

1. Linear Programming by G. Hadley, Narosa Publishing House, 1995.
2. Operations Research by R.K. Gupta.
3. Introduction to Operations Research (Sixth Edition) by F.S. Hillier and G.J. Lieberman Mc Graw Hill International Edition, Industrial Engineering Series, 1995.
4. Operations Research by S.D. Sharma.

FUZZY SETS THEORY

THEORY

Total Marks: 100 (70+30)

Course Objective(s): To get the basic knowledge of Fuzzy Set and the applications and also the operations, norm of it is expressed.

Course Outcome(s): After completing this course, the student will be able to:

CO 1 - Understand the concept of Fuzzy sets.

CO 2 - Express operations on fuzzy sets

CO 3 – Apply Relation between fuzzy sets and its compositions

CO 4 – State Fuzzy graphs.

CO 5 - Express the Fuzzy measures

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
FUZZY SETS THEORY Subject code – MSCMODL 403	**CO 1** - Understand the concept of Fuzzy sets.	**1,4,6,8,9**	**2,3**
	CO 2 - Express operations on fuzzy sets	**2,4,5,8,9**	**1,3**
	CO 3 – Apply Relation between fuzzy sets and its compositions	**1,3,5,6,8,**	**1,3**
	CO 4 – State Fuzzy graphs.	**2,4,5,8,9,10**	**1,2,3**
	CO 5 - Express the Fuzzy measures	**2,4,5,7,8**	**1,2**

CO-PO and CO-PSO Mapping

Subject	**FUZZY SETS THEORY**												
Code	**MSCMODL 403**												
Course outcomes CO **MSCMODL101**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO403. 1	2	-	-	2	-	1	-	1	2	-	-	2	2
CO403. 2	-	2	-	3	2	-	-	2	1	-	2	-	3
CO403. 3	2	-	2	-	1	1	-	3	-	-	1	-	2
CO403.4	-	2	-	2	1	-	-	2	3	3	1	1	2
CO403.5	-	2	-	3	2	-	3	2	-	-	2	2	-
Average CO **MSCMODL403**													

Note: 1- Low relation

2- Average relation

3- Good relation

Unit- I

Fuzzy Sets-Basic definitions, A-level sets, convex fuzzy sets, Basic operations on fuzzy sets Types of fuzzy sets, Cartesian products, Algebraic products, Bounded sum and difference, t- Norms and t- co norms.

Unit-II

The Extension Principle – The Zadeh's extension principle, Image and inverse image of fuzzy sets, Fuzzy numbers, Elements of fuzzy arithmetic.

Unit-III

Fuzzy Relation and Fuzzy Graphs-Fuzzy relation on fuzzy sets, Composition of fuzzy relations, Min-Max composition and its properties, Fuzzy equivalence relation, Fuzzy compatibility relations, Fuzzy relationequations, Fuzzy graphs, Similarity relation.

Unit-IV

Possibility Theory-Fuzzy measures, Evidence theory, Necessity measure, Possibility measure, Possibility distribution, Possibility theory and fuzzy sets, Possibility theory versus probability theory.

Unit-V

Fuzzy Logic-An overview of classical logic, Multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic variables and hedges, Inference from conditional fuzzy propositions, the compositional rule of inference.

Books Recommended:

1. Fuzzy set theory and its Applications by H.J. Zimmermann, Allied Publishers Ltd., New Delhi, 1991.
2. Fuzzy sets and Fuzzy logic by G.J. Klir and B. Yuan Prentice-Hall of India, New Delhi, 1995.
3. Fuzzy Sets, Uncertainty and Information by G.J.Klir, Tina A. Folger Prentice-Hall of India.

ELECTIVE 4

THEORY

Total Marks: 100 (70+30)

APPROXIMATION THEORY

Course Objective(s): Approximation theory is one of the oldest branches of Mathematics. In this course we introduce the basic concepts of Approximation theory In Normed Linear Spaces, Chebyshev Polynomials, Interpolation, Best Approximation In Normed Linear Spaces and some Projection.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.
APPROXIMATION THEORY Subject code – MSCMODL404	**CO 1** - Understand the concepts of Approximation In Normed Linear Spaces.	**2,4,5,6,8,10**	**2,3**
	CO 2 - Solve Chebyshev Polynomials.	**1,3,5,6,8,9**	**1,3**
	CO 3 – Describe Interpolation.	**1,3,5,7,9**	**1,3**
	CO 4 – Discuss Best Approximation In Normed Linear Spaces.	**2,4,6,8,9**	**2,3**
	CO 5 - Study the various Projection.	**2,4,5,7,8,10**	**1,2,3**

CO-PO and CO-PSO Mapping

Subject	**APPROXIMATION THEORY**												
Code	**MSCMODL 404**												
Course outcomes CO **MSCMODL404**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PSO 1**	**PSO 2**	**PSO 3**
CO404. 1	-	2	-	2	3	1	-	2	-	3	-	2	2
CO404. 2	2	-	3	-	2	1	-	1	2	-	2	-	3
CO404. 3	2	-	3	-	2	-	1	-	3	-	2	-	2
CO404.4	-	2	-	3	-	1	-	2	1	-	-	2	1
CO404.5	-	2	-	3	2	-	1	2	-	3	2	3	2
Average CO **MSCMODL 404**													

Note: 1- Low relation

2- Average relation

3- Good relation

UNIT I

Approximation In Normed Linear Spaces: Existence- Uniqueness – convexity – Characterization of best uniform approximations –Uniqueness results – Haar subspaces – Approximation of real valued functions on an interval.

UNIT II

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Chebyshev Polynomials: Properties – More on external properties of Chebyshev polynomials – Strong uniqueness and continuity of metric projection – Discretization – Discrete best approximation.

UNIT III

Interpolation: Introduction – Algebraic formulation of finite interpolation – Lagrange's form –extended Haar subspaces and Hermite interpolation – Hermite – Fejer interpolation.

UNIT IV

Best Approximation In Normed Linear Spaces: Introduction – Approximative properties of sets – Characterization and Duality.

UNIT V Projection Continuity of metric projections – Convexity, Solarity and Cheyshevity of sets – Best simultaneous approximation.

Books Recommended:

1. Hrushikesh N. Mhaskar and Devidas V. Pai., "Fundamentals of approximation theory", Narosa Publishing House, New Delhi, 2000.

2. Ward Cheney and Will light, "A course in approximation theory", Brooks / Cole Publishing Company, New York, 2000.

3. Cheney E.W.,"Introduction to approximation theory", McGraw Hill, New York, 1966.

4. Singer I. ,"Best Approximation in Normed Linear Spaces by element of linear subspaces", Springer-Verlag, Berlin ,1970

MATHEMATICAL MODELING

Course Objective(s): This course gives the basic concept of Mathematical modelling, so that students from various fields like Engineering, Economics, Biology, Epidemiology etc. can apply its concept.

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

CO 1 - Discuss the basic features of mathematical modelling.
CO 2 - Apply the mathematical modeling using ODE of first order.
CO 3 – Explain the discrete model and its applications.
CO 4 – Get the application of continuous and spatial models
CO 5 - Use the modelling using graph theory.

Skills that students will obtain after completion of the course:

COURSE NAME	C.O.	P.O.	P.S.O.

MATHEMATICAL MODELING Subject code – MSCMODL404	**CO 1** - Discuss the basic features of mathematical modelling.	**1,2,3,7,8**	**2,3**
	CO 2 - Apply the mathematical modeling using ODE of first order.	**2,3,4,5,6,10**	**1,3**
	CO 3 – Explain the discrete model and its applications.	**4,5,8,9**	**2,3**
	CO 4 – Get the application of continuous and spatial models	**4,8,9,10**	**1,2,3**
	CO 5 - Use the modelling using graph theory.	**2,5,8,9**	**2,3**

CO-PO and CO-PSO Mapping

Subject	MATHEMATICAL MODELING												
Code	MSCMODL404												
Course outcomes CO MSCMODL404	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3
CO404. 1	2	2	1	-	-	-	3	3	-	-	-	3	2
CO404. 2	-	2	3	2	1	2	-	3	-	-	2	-	3
CO404. 3	-	-	-	2	3	-	-	2	3	-	-	2	2
CO404.4	-	-	-	3	-	-	-	3	2	1	2	2	1
CO404.5	-	2	-	-	2	-	-	3	2	-	-	2	3
Average CO MSCMODL 404													

Note: **1- Low relation**

2- Average relation

3- Good relation

Unit - I

Techniques, classification and simple illustrations. Mathematical Modelling through ordinary differential equation of first order.

Unit – II

Mathematical Modelling through systems of ordinary differential equation of first order. Mathematical Modelling through ordinary differential equation of second order.

Vinita Asha

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Unit - III

Mathematical Modelling through difference equation. Mathematical Modelling through partial differential equations.

Unit - IV

Mathematical Modelling through graphs. Mathematical Modelling through functional Integral, Delay-differential.

Unit - V

Mathematical Modelling through calculus of variations and dynamic programming. Mathematical Modelling through mathematical programming, maximum principle and maximum entropy principle.

Books Recommended:

1. J.N. Kapur, Mathematical Modeling, New Age International Limited.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd.
3. Mathematical Models in the Social, Management and Life Sciences, D.N. Burghes and A.D. Wood, John Wiley & Sons.
4. Mathematical Modeling, J.G. Andrews & R.R Mclone, Butterworths (Pub.) Inc
5. Mathematical Modelling : Dr. Maurya Navkar pub. Ajmer