DEPARTMENT OF MATHEMATICS (PG)

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Rathinam Techzone, Pollachi Road, Eachanari,

Coimbatore – 641021

Syllabus for

M. Sc Mathematics

(I, II, III & IV Semester)

2021-2022 Batch onwards

Approved in the BOS Meeting held on ----------

Vision and Mission of the Institution:

VISION

To emerge as a world-renowned Institution that is integrated with Industry to impart Knowledge, Skills, Research Culture and Values in youngsters who can accelerate the overall development of India.

MISSION

To provide quality education at affordable cost, build academic and research excellence, maintain eco-friendly and robust infrastructure, and to create a team of well qualified faculty who can build global competency and employability among the youth of India.

MOTTO

Transform the youth into National Asset.

Vision and Mission of the Department:

VISION

The Department aspires to the highest standards of excellence in teaching, through preparing students for learning Pure, Applied and Industrial Mathematics for the Challenging Growth of Science and Technology.

MISSION

The Mission of the Department is to provide an environment where students can learn and become competent users of mathematics and mathematical application. Also to provide Quality Education, Research and Consultancy by Providing Highly Skilled mathematical Knowledge along with the Industrial collaboration.

Program Educational Objectives (PEO)

PEO1	:	To provide opportunities of higher studies in the professional area of Mathematics such as Research.
PEO2	:	To impart knowledge on various theoretical and practical aspects of Mathematics with respect to industry exposure.
PEO3	:	To develop independent learning skills and transferable skills among the students.
PEO4	:	To strengthen the students logical and analytical ability to deal with the generality and abstraction of mathematical principles.

Mapping of Institute Mission to PEO

Institute Mission	**PEO's**
Imparting Knowledge and Skill	PEO1, PEO3
Research Culture	PEO1, PEO4
Industry collaboration	PEO2

Mapping of Department Mission to PEO

Department Mission	**PEO's**
Imparting Critical thinking ability to become more Competency	PEO1, PEO3
Analytical Knowledge with Industry collaboration	PEO2
Research Culture	PEO1, PEO4

Program Outcomes (PO):

PO1	**:**	Equip the students with skills to analyze problems, formulate hypothesis, evaluate and validate results, and draw reasonable conclusions.
PO2	**:**	Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields.
PO3	**:**	Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
PO4	**:**	Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
PO5	**:**	Develop the knowledge to the students for competitive exam includes CSIR, NET, SET etc. and to win a range of rewarding positions in the public and private sectors.
PO6	**:**	Recognize the need to engage in lifelong learning through continuing education and research.
PO7	**:**	Encourage collaborative learning and application of mathematics to real life situations.
PO8	**:**	Explain the knowledge of contemporary issues in the field of mathematics and applied sciences.
PO9	**:**	Acquire advanced conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline.

Program Specific Outcomes (PSO)

PSO1	**:**	Solve complex problems by critical understanding, analysis and synthesis.
PSO2	**:**	Recognize the need to engage in lifelong learning through continuing education and research.
PSO3	**:**	Inculcate the capacity to transfer the mathematical knowledge for their industrial career.
PSO4	**:**	Demonstrate engagement with current research and developments in the subject.

Correlation between the POs and the PEOs

Program Outcomes		PEO1	PEO2	PEO3	PEO4
PO1	:			2	3
PO2	:	3	2		
PO3	:		2	3	
PO4	:	1		2	3
PO5	:			3	2
PO6	:	3	1	2	
PO7	:	2	3		1
PO8	:		3	1	
PO9	:	3	2		1
PSO1	:		1	2	3
PSO2	:	3		2	
PSO3	:		3	1	
PSO4	:	2	3		

Components considered for Course Delivery is listed below:
1. Class room Lecture
2. Laboratory class and demo
3. Assignments
4. Mini Project
5. Project
6. Online Course
7. External Participation
8. Seminar
9. Internship

Mapping of POs with Course Delivery:

Program Outcomes	Course Delivery								
	1	2	3	4	5	6	7	8	9
PO1	3		3		2	3		2	1
PO2	2	3		1	2				3
PO3	2		3		3	1		2	
PO4		2		2		3	2		1
PO5	1		1	2	2		3		
PO6	2	1	2			3		3	
PO7		3		2	1		2		2
PO8	3		1			2		1	
PO9		2	2		3		1		

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

M.Sc Mathematics Curriculum Structure – Regulation - 2021
(For the students admitted from 2021 onwards)

S.No	Sem	Part	Type	Sub Code	Subject	Credit	Hour	Int	Ext	Total
1	1	III	Theory		Abstract Algebra	4	5	40	60	100
2	1	III	Theory		Real Analysis	4	5	40	60	100
3	1	III	Theory		Ordinary Differential Equations	4	5	40	60	100
4	1	III	Theory		Optimization Techniques	4	5	40	60	100
5	1	III	Theory		Graph Theory	4	5	40	60	100
1	2	III	Theory		Complex Analysis	4	5	40	60	100
2	2	III	Theory		Linear Algebra	4	5	40	60	100
3	2	III	Theory		Partial Differential Equations	4	5	40	60	100
4	2	III	Theory		Mathematical Statistics	4	5	40	60	100
5	2	III	Theory& Practical		Latex	4	5	40	60	100
6	2	III	Theory		Elective-I	4	5	40	60	100
1	3	III	Theory		Topology	4	5	40	60	100
2	3	III	Theory		Functional Analysis	4	5	40	60	100
3	3	III	Theory		Mechanics	4	5	40	60	100
4	3	III	Theory		Control Theory	4	5	40	60	100
5	3	III	Theory		Elective-II	4	5	40	60	100
6	3	III	Practical		Core Practical – VI – Industrial Training Report	2		50	-	50
1	4	III	Theory		Operator Theory	4	5	40	60	100
2	4	III	Theory		Fluid Dynamics	4	5	40	60	100
3	4	III	Theory		Mathematical Methods	4	5	40	60	100
4	4	III	Theory		Elective-III	4	5	40	60	100
5	4	III	Project		Project	8	5	40	160	200
						90				**2250**

Elective Subjects:

		Subject Code	Subject Name
Elective-I	A		Numerical Analysis
	B		Differential Geometry
	C		Astronomy
Elective-II	A		Matlab
	B		Mathematical Modeling
	C		Programming and Mathematical Thinking
Elective-III	A		Stochastic Processes
	B		Number Theory and Cryptography
	C		Fuzzy Logic and Systems

Note :

1. Learning the courses – Packages like Latex and Matlab also Career Enhancement Course – student shall appear for the NSDC Certification.

@ - No End Semester Examination, only Internal Exam.
# - No Internal Examination, only End Semester Exam.

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - I – Abstract Algebra	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge on basic numerical and algebraic skills, group theory, ring theory, fields and linear transformation.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concept of Group Theory.
CO2	:	Explain the concept of Ring Theory.
CO3	:	Apply the concept of Fields and Roots of polynomials.
CO4	:	Examine the concept of finite Fields.
CO5	:	Compare the concept of Linear Transformations.
CO6	:	Develop the knowledge on applying finite fields, and Linear transformations.

Unit - I: **[12 Periods]**
Group Theory: Another counting principle – Sylow's theorem – Direct products.

Unit - II: **[12 Periods]**
Ring Theory: Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

Unit - III: **[12 Periods]**
Fields: Extension Fields – Roots of polynomials – More about roots.

Unit - IV: **[12 Periods]**
Fields: Elements of Galois theory – Solvability by Radicals.

Unit - V: **[12 Periods]**
Linear Transformations: Canonical forms: Triangular form – Trace and Transpose – Hermitian, unitary and normal Transformations.

Text Book:
1. I.N.Herstein, "Topics in Algebra" (II Edition), published by Wiley, 2015.

Contents :
UNIT I : Chapter 2 -Sections 2.11 to 2.13.
UNIT II : Chapter 3 -Sections 3.7 to 3.10.
UNIT III : Chapter 5 -Sections 5.1, 5.3 and 5.5.

UNIT IV : Chapter 5 -Section 5.6, 5.7.
UNIT V : Chapter 6 -Sections: 6.4,6.8 and 6.10.

Reference Books:

1. J.B.Fraleigh, "A First Course in Abstract Algebra", Narosa Publishing House, New Delhi, 1988
2. M.Artin, "Algebra", Prentice-Hall, Englewood Cliff, 1991.
3. T.W.Hungerford, "Algebra", Springer, New York, 1974

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3	2		1			3		1		2	3
CO2		3				2			3		2	3	
CO3	3	3			2		3	2		1		2	1
CO4		1		2		3			3	2	3		
CO5	1						3				2		1
CO6	3			1	2	2			1	3		1	2

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - II - Real Analysis	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides basic knowledge on measure theory, properties of integrals and the functions of several variables.

Course Focus on: Research

Course Outcome:

CO1	:	Construct rigorous mathematical proofs of basic results in real analysis.
CO2	:	Recognize the difference between pointwise and uniform convergence of a sequence of functions.
CO3	:	Apply the concept of Functions Of Several Variables and prove theorems.
CO4	:	Understand the concept of Lebesgue Measure and its properties.
CO5	:	Extend the concept of outer measure in an abstract space and integration with respect to a measure.
CO6	:	Discuss about theory of Lebesgue integration, Riemann integration and its properties..

Unit - I: **[12 Periods]**

Riemann Stieltjes Integral: Definition and Existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued function – rectifiable curves.

Unit - II: **[12 Periods]**

Sequences and Series of Functions: Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions – The Stone Weierstrass theorem

Unit - III: **[12 Periods]**

Functions of Several Variables: Linear transformation – contraction principle – Inverse function theorem – Implicit function theorem.

Unit - IV: **[12 Periods]**

Lebesgue Measure: Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's Theorem

Unit - V: **[12 Periods]**

Lebesgue Integral: The Lebesgue integral of bounded functions over a set of finite measure – integral of a non – negative function – General Lebesgue Integral.

Text Books:

1.W. Rudin, "Principles of Mathematical Analysis" McGraw Hill, New York, 1976(Units I to III).
2.H.L. Roydon, "Real Analysis" Third Edition, Macmillan, New York, 1988(Units IV and V).

Contents:

Unit I : Chapter 6: Page No. 120 – 137.
Unit II: Chapter 7: Page No. 143 – 165.
Unit III: Chapter 9: Page No. 204 – 223.
Unit IV: Chapter 3: Page No. 54 – 72.
Unit V: Chapter 4: Page No. 75 – 89.

Reference Books:

1. R.G.Bartle, "Elements of Real Analysis", 2nd Edition, John Wily and Sons, New York, 1976.
2. W.Rudin, "Real and Complex Analysis", 3rd Edition, McGraw-Hill, New York, 1986

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3		2		1		3		2	1		3
CO2	1		3			2			2		3	2	
CO3	3	2					3	3		1		2	
CO4		1		2		2			3		2		1
CO5	1	1				2			3			3	
CO6	1			3	3	2			3		1		3

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - III - Ordinary Differential Equations	**4**	**5**	**0**	**0**	**Theory**

Introduction : This course provides knowledge about the first and second order linear equations and the concept of successive approximations.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concept of Second order linear equations.
CO2	:	Demonstrate the concept of Existence and Uniqueness Theorem.
CO3	:	Apply the concept of Non-homogeneous linear systems.
CO4	:	Analyze the concept of Successive approximation.
CO5	:	Compare the concept of linear and non-linear oscillation
CO6	:	Develop the knowledge about existence, uniqueness, other properties of a solution of differential equations and concept of boundary value problems

Unit - I: **[12 Periods]**
Solutions in Power Series: Second order linear equations with ordinary points – Legendre equation and Legendre polynomials – Second order equations with regular singular points – Bessel equation.

Unit - II: **[12 Periods]**
System of Linear Differential Equations: Systems of first order equations – existence and uniqueness theorem – Fundamental matrix.

Unit - III: **[12 Periods]**
System of Linear Differential Equations: Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

Unit - IV: **[12 Periods]**
Existence and Uniqueness of Solutions: Successive approximation – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large – Existence and uniqueness of solutions of systems.

Unit - V: **[12 Periods]**
Boundary Value Problems: Introduction - Sturm-Liouville Problem – Green's function – Non-existence of solutions – Picard's theorem.

Text Book:

1. S.G. Deo and V. Raghavendra, "Ordinary Differential Equations and Stability Theory", McGraw Hill, New Delhi.

Contents:

Unit I -Chapter – 3 : Section 3.2 –3.5
Unit II -Chapter – 4 : Section 4.2 –4.4
Unit III -Chapter – 4 : Section 4.5 –4.7
Unit IV -Chapter – 5 : Section 5.3 –5.8
Unit V -Chapter – 7 : Section 7.1 –7.5

Reference Books:

1. E.A.Coddington and N.Levinson, "Theory of Ordinary Differential Equations", McGrawHill, New York, 1955.
2. D.A.Sanchez, "Ordinary Differential Equations and Stability Theory", W.H.Freeman &Co., San Francisco, 1968

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	2					3		2		3	
CO2	1	3		2				3			3		1
CO3		1				2	3			1	2		3
CO4		2		2		3			3	2		1	
CO5	1	1				2			3		3	2	
CO6	1			2	3	2			3		1		3

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core IV – Optimization Techniques	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge on concepts of Operations Research with specific applications in Linear, Non Linear and Dynamic Programming.

Course Focus on: Skill Development

Course Outcome:

CO1	:	Recall the fundamental concept of Linear Programming Problem.
CO2	:	Understand the concept of Advanced Linear Programming.
CO3	:	Examine the concept of Integer L.P. in a suitable way.
CO4	:	Construct the problems based on Classical optimization Theory.
CO5	:	Evaluate the problems on Non - linear programming.
CO6	:	Develop the problem solving techniques using operations research.

Unit - I : [12 Periods]

Introduction to L.P. –Graphical L.P. Solution – Sensitivity analysis Simplex Method – L.P. solution space in equation form –Transition from graphical to algebra solution – The simplex method – artificial starting solution – Special cases in simplex method applications. Duality – Primal and Dual – relationships - additional simplex algorithm for L.P.

Unit - II: [12 Periods]

Advanced Linear Programming – Generalized simplex tableau in matrix form – Decomposition algorithm –Matrix definition of dual problem –optimal dual solution.

Unit - III: [12 Periods]

Integer L.P. and Dynamic Programming – Integer Programming – Gomory cutting plane algorithm – Branch and Bound algorithm – Deterministic Dynamic programming – Recursive nature of computation in D.P. –Forward and Backward recursion.

Unit - IV: [12 Periods]

Classical optimization Theory – unconstraint – Necessary and sufficient Conditions –The Newton - Raphson method –constrained problems – Equality constraints (Jacobi method and Lagrangian method).

Unit - V: [12 Periods]

Non - linear programming - Direct search method –Gradient method–Separable programming – Quadratic programming.

Text Book:

1. Hamdy A Taha, Operations Research (Seventh Edition) –Prentice Hall of India Private Limited, New Delhi (2004).

Contents:

Unit-I: Chapter 2: 2.2, 2.3, (excluding 2.2.3 and 2.3.3).
Chapter 3: 3.1 –3.5 (excluding 3.3.3).
Chapter:4: 4.2 and 4.4
Unit-II: Chapter 7: 7.1.2, 7.4 and 7.5
Unit-III: Chapter 9: 9.2 and 9.3(excluding 9.2.2 and 9.2.4).
Chapter 10: 10.1 and 10.2
Unit-IV: Chapter 20: 20.1, 20.12, 20.2.1.
Unit-V: Chapter 21: 21.1, 21.2.1, 21.2.2

Reference Books:

1.G.Dantzig, Linear Programming and Extension, Princeton University Press, Princeton , 1963.

2.S.Ross, A Course in Simulation, Macmillian, New York, 1990.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2				1		1		3	
CO2	3		2			3			3		2		1
CO3		3		1		2	2			2	3		1
CO4	3			3	1	1		3		1		2	
CO5		3		2			2	3		3	1		3
CO6	3		2		3				1			2	

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core V - Graph Theory	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the concept of graphs, sub graphs, trees, connectivity, Euler tours, Hamilton cycles, matching, and coloring of graphs.

Course Focus on: Skill development

Course Outcome:

CO1	:	Recall the basic concepts involved in a graph.
CO2	:	Understand the concept of trees and its applications.
CO3	:	Apply the concept of Connectivity and Traversability.
CO4	:	Analyze the concept of Matching and coloring.
CO5	:	Evaluate the concept of planarity of graph.
CO6	:	Discuss about the application of Graph theory in computer science and other fields.

Unit - I: **[12 Periods]**
Graphs: Vertices of graphs, Walks and connectedness, Degrees, Operations on graphs, Blocks, Cut-points, bridges and blocks, Block graphs and cut- point graphs.

Unit - II: **[12 Periods]**
Trees: Elementary properties of trees, Centers and Centroids, Block-cut point trees, Independent cycles.

Unit - III: **[12 Periods]**
Connectivity and Traversability: Connectivity and line connectivity, Eulerian graph, Hamiltonian graphs.

Unit - IV: **[12 Periods]**
Matchings: Matchings coverings in Bipartite Graphs – Perfect Matchings.
Edge colourings: Edge chromatic number – Vizing's theorem.
Vertex Colourings: Chromatic Number – Brook's Theorem

Unit - V: **[12 Periods]**
Planarity: Planar graphs, outer planar graphs, Kuratowski's theorem

Text Book:
1.F. Harary, Graph theory, Narosa Publishing House, New Delhi, 1988.

Contents:

Unit I: Chapter 2,3: Sections 1,2.2,2.3,2.7,3.1,3.2,3.3
Unit II: Chapter 4: Sections 4.1,4.2,4.3,4.4
Unit III: Chapter 5,7: Sections 5.1,7.1,7.2
Unit IV: Chapter 10: Sections 10.1,10.2,10.3
Unit V: Chapter11: Sections 11.1,11.2,11.3.

Reference books:

1. J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

2. R. Balakrishnan and K. Renganathan, A textbook of Graph theory, Springer, 2000

3. Bela Bollobas, Modern Graph Theory Springer, 2002

4. G. Chartrand, L. Lesniak, Graphs & digraphs. Fourth edition. Chap- man & Hall/CRC, 2005.

5. Robin J. Wilson, Introduction to Graph Theory (4th Edition), Addison Wesley, 1996

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		2				3	2		2		1	3
CO2	1	1	2					3		2	1		
CO3		1		2		2	3					2	3
CO4		2		1		3	2		3	1		3	
CO5	1		2		2			3			2		3
CO6	2		3		3	2			2	1		2	

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core VI -Complex Analysis	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about functions of complex variable, analytic functions, harmonic functions and complex integration.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the concept of analytic functions.
CO2	:	Understand the concept of complex integration.
CO3	:	Apply the concept of calculus of Residues and its corresponding theorems.
CO4	:	Examine the series and product developments.
CO5	:	Prove the Riemann Mapping theorem.
CO6	:	Build deep knowledge of complex numbers and its functions in advanced level.

Unit - I: **[12 Periods]**

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 Riemann Surfaces.

Unit - II: **[12 Periods]**

Complex Integration: 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 Removable singularities, Taylor's Theorem – Zeros and Poles – The Local Mapping – The maximum principle – Chains and cycles.

Unit - III: **[12 Periods]**

The Calculus of Residues: The Residue theorem –The Argument principle – Evaluation of definite integrals. Harmonic functions: The Definitions and basic Properties – Mean value property –Poisson's Formula.

Unit - IV: **[12 Periods]**

Series and Product Developments: Weierstrass Theorem –The Taylor Series –The Laurent Series – Partial fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products.

Unit - V: **[12 Periods]**

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.

Text Book:
1.L.V. Ahlfors, " Complex Analysis", Mc Graw Hill, New York,1979.

Contents :
Unit I: Chapter – 2: Sections 1.1 – 1.4
Chapter – 2,3: Sections 2.1 – 2.4, 3.1, 3.2 and 3.4
Unit II: Chapter – 4 : Sections 1.1 – 1.5, 2.1 – 2.3, 3.1 - 3.4 and 4.1
Unit III: Chapter – 4: Sections 5.1 – 5.3, 6.1 – 6.3
Unit IV: Chapter – 5: Sections 1.1 – 1.3, 2.1 – 2.3
Unit V: Chapter – 6: Sections 1.1 – 1.4, 2.1 – 2.3.

Reference Books:

1. W. Rudin, "Real and Complex Analysis " McGraw-Hill Book Co., 1966.
2. R.V. Churchill & J. W. Brown , "Complex Variables & Applications", Mc.Graw Hill, 1990

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	2			3		3		1			3
CO2	1	1		1		2			3		2	2	
CO3	1	2			2		3	2		3			2
CO4		1		2		3			3		3	1	
CO5		1		2		3		3		2			3
CO6	1		2		3	2					3		

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core VII - Linear Algebra	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the concept of matrices, vectors, dual spaces and linear transformation.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concepts of Vector spaces.
CO2	:	Understand the concept of algebra of linear transformations.
CO3	:	Construct the algebra of polynomials .
CO4	:	Classify the concept of Annihilating polynomials and Invariant subspaces .
CO5	:	Discuss the concept of Decomposition .
CO6	:	Develop the concept of linear algebra to enhance ethical and legal environment.

Unit - I:
Systems of linear Equations – Matrices and Elementary Row operations – Row - Reduced echelon Matrices – Matrix Multiplication – Invertible Matrices – Vector spaces – Subspaces – Bases and Dimension – Computations concerning Subspaces.

Unit - II:
The algebra of linear transformations – Isomorphism of Vector Spaces – Representations of Linear Transformations by Matrices - Linear Functionals - The Double Dual – The Transpose of a Linear Transformation.

Unit - III:
The algebra of polynomials – Lagrange Interpolation – Polynomial Ideals – The prime factorization of a polynomial, Commutative rings – Determinant functions – Permutations and the uniqueness of determinants – Classical Adjoint of a (Square) matrix – Inverse of an invertible matrix using determinants.

Unit - IV:
Characteristic values – Annihilating polynomials, Invariant subspaces – Simultaneous triangulation and simultaneous Diagonalization – Direct-sum Decompositions.

Unit - V:
Invariant Direct sums – The Primary Decomposition Theorem – Cyclic subspaces – Cyclic Decompositions and the Rational Form.

Text Book:

1.Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice – Hall of India Private Limited, New Delhi , 1975.

Contents:

Unit – I - Chapters 1 and 2
Unit – II - Chapter 3
Unit – III - Chapter 4 and Chapter 5: Sections 5.1 to 5.4
Unit – IV - Chapter 6: Sections 6.1 to 6.6
Unit – V - Sections 6.7 and 6.8 and Chapter 7: Sections 7.1 to 7.4

Reference Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975.
2. I.S. Luther and I.B.S. Passi, Algebra, Vol.I – Groups, Vol.II- Rings, Narosa Publishing House (Vol.I – 1996, Vol.II- 1999)
3 N. Jacobson, Basic Algebra, Vols. I & II, Freeman, 1980 (also published by Hisdustan Publishing Company)

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	1	2		3				2			2		1
CO2	1		2			2		3		3		2	
CO3		1	2				2		3	1		3	2
CO4	2	3			3	1		3		1	3		2
CO5		1		2		2			3	2		1	
CO6	2		2		3		3		1		3	2	

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core VIII-Partial Differential Equations	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the second order and non linear partial differential equations, Laplace equation and wave equation.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concept of Non Linear partial differential equation of first order.
CO2	:	Illustrate the non Linear partial differential equation of second order.
CO3	:	Apply the solution of linear hyperbolic equations and its operations.
CO4	:	Examine the concept of Laplace equation with related problems.
CO5	:	Evaluate the concept of wave equations.
CO6	:	Develop the knowledge of partial differential equations and its applications.

Unit - I: **[12 Periods]**

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.

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.

Text Book:

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

Contents :

Unit I: Chapter – 2 Sections 2.8 – 2.11, 2.13
Unit II: Chapter – 3 Sections 3.1, 3.4 – 3.7
Unit III: Chapter – 3 Sections 3.8 – 3.11
Unit IV: Chapter – 4 Sections 4.1 – 4.6
Unit V: Chapter – 5 Sections 5.1, 5.2, 5.4

Reference Books:

1. Tyn Myint, U Lokenath Debnath, Partial Differential Equations for Scientists and Engineers, 3rd Edition. 2007

2. L.C.Evans, Partial Differential Equations AMS, Providence, R I, 2003.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1				3		3	1	2	1		3
CO2	1	3			3		2	2		1		3	
CO3		1		3			3	2			2		1
CO4		1		2		3			3		3	2	
CO5			1	2		2		3		3			1
CO6	1		2		3	2			3		2		3

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core IX - Mathematical Statistics	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the fundamental concepts of Statistics and its applications.

Course Focus on: Employability

Course Outcome:

CO1	:	Recall the fundamental concept of Random Variables.
CO2	:	Understand the concept of Discrete and continuous probability distribution function.
CO3	:	Apply the concept of Unbiasedness and Cramer-Rao inequality.
CO4	:	Evaluate the fitting of curves with related problems.
CO5	:	Classify the Analysis of Variance.
CO6	:	Develop the problem solving techniques using statistical tools.

Unit - I : [12 Periods]

Random Variables - Discrete and continuous random variables - Distribution function properties- Probability Mass Function-Probability Density Function-Mathematical Expectation - Theorems on Expectations.

Unit - II: [12 Periods]

Discrete and continuous probability distribution function and its Moment generating function - binomial and Poisson and normal distribution and their properties, simple problem.

Unit - III: [12 Periods]

Unbiasedness, Consistency, efficiency and sufficiency of estimators, factorization theorem and Rao-Blackwell theorem, Cramer- Rao inequality.

Unit - IV: [12 Periods]

Curve fitting and principles of least squares -fitting of curves- straight line-second degree parabola and power curve-correlation and regression analysis.(simple problems).

Unit - V: [12 Periods]

Student t-test, F-test, Chi-Square test for independence of Attributes, Analysis of Variance-One-way, Two-way Classification.

Text Books:

1.S.C.Gupta & V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan chand & sons Educational publishers, New Delhi(2007).
2.S.P.Gupta, "Statistical Methods", Sultan Chand & sons Educational publishers, New Delhi(2015).

Contents:

Unit-I: Text Book-1(Chapter-5)
Unit-II: Text Book-1(Chapter-8, 9)
Unit-III: Text Book-1(Chapter-17)
Unit-IV: Text Book-1(Chapter-10, 11)
Unit-V: Text Book-2 (Chapter- 5,6,7)

Reference Books:

1. S.C.Gupta & V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan chand & sons, Educational publishers, New Delhi(2012).
2. R.S.N. Pillai and V. Bagavathi, "Statistics", Sultan chand & sons Educational publishers, New Delhi(2007).
3. G.V. Shenoy, U.K. Srivastava, S.C. Sharma, "Business Statistics", New Age International Pvt Ltd Publishers, New Delhi(2014).
4. R.S. Bhardwaj, "Business Statistics", Anurag Jain For Excel books Publishers, Second Edition, New Delhi(2008).
5. D.N. Elhance, "Fundamentals of Statistics", Kitab Mahal Publishers, New Delhi(2002).

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2		1				3		2	1		3
CO2	1		3			2		3			3	2	
CO3		1		2		2	3			3		1	2
CO4			1	3	2	3		3		1	2		2
CO5		2		1			2		3	2		3	
CO6	1		2		3				3		1		2

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core X- LATEX	**4**	**4**	**0**	**1**	**Theory &Practical**

Introduction: This course provides knowledge about basics of Latex that is used to produce high quality scientific documents, like articles, books, dissertations and technical reports.

Course Focus on: Skill Development

Course Outcome:

CO1	:	Recall the basics of Latex software while preparing a Document.
CO2	:	Understand the Mathematical formulas and Drawing tools of Latex.
CO3	:	Analyze the need of Latex software.
CO4	:	Apply the advanced mathematics with Latex tools.
CO5	:	Discuss the coding Series, symbols and limits.
CO6	:	Develop the knowledge of investigating and learning new LATEX package on their own.

Unit - I: **[12 Periods]**
Commands and Environments-Command names and arguments, Declarations Lengths, special Characters.

Unit - II: **[12 Periods]**
Document layout and organization – Document class, Page style, Parts of the document, Centering and indenting, Lists, Theorem–like declarations, Boxes, Tables.

Unit - III: **[12 Periods]**
Footnotes and marginal notes, Mathematical formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements.

Unit – IV: **[12 Periods]**
Packages: Fine–tuning mathematics, Drawing pictures with LATEX - Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color, Classes: article, book, report, beamer, slides.

List of Programs

1. Illustrate different font sizes in Latex.
2. Prepare a title page in Latex document.
3. Create the section hierarchy of book environment in Latex.
4. Prepare a list using itemize environment in Latex.

5. Prepare a table in Latex.
6. Prepare a table in Latex with multiple title row.
7. Split the equations in Latex.
8. Type an equation using left cases and right cases in Latex.
9. Type a system of equations in Latex.
10. Type a Binomial equations in Latex.

Text Book:

1. H. Kopka and P.W. Daly, "A Guide to LATEX "3rd Edition, Addison – Wesley, UK, 1999.

Contents:

Unit I -Chapter 2 : Sections 2.1 - 2.5.
Unit II -Chapter 3,4: Sections 3.1-3.3, 4.2,4.3,4.5,4.7,4.8.
Unit III -Chapter 4,5 : Sections 4.10,5.1-5.4.
Unit IV -Chapter 5,6: Sections 5.6 -6.2.

Reference Books:

1. L. Lamport. LATEX: A Document Preparation System, User's Guide and Reference Manual. Addison-Wesley, New York, second edition, 1994.
2. Stefan Kottwitz, "LaTeX Beginner's Guide: Create High-quality and Professional-looking Texts, Articles, and Books for Business and Science Using LaTeX" Packt Publishing, 2011.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1			2		1		2	3		2		3	
CO2	1		3	2			2			3	2		1
CO3		1		3		3	3				1	2	
CO4	2			2			2	2	3	1		3	
CO5	1		2			3		3			2		3
CO6		2		3		2			2	1		1	

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective I-Numerical Analysis	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge on solution of non linear equations, Boundary and Characteristic value problems and Numerical solution of PDE.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the concept of numerical differentiation and integration and its applications.
CO2	:	Understand the concept of solving system of equations through various methods.
CO3	:	Apply various methods for obtaining a better solution for ODE.
CO4	:	Analyze the concept of boundary value problems and characteristic equations.
CO5	:	Evaluate the numerical solution of Partial differential equations.
CO6	:	Develop the practical knowledge on solving problems using Numerical Methods.

Unit - I : [12 Periods]

Solution of system of equations: The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal Iteration – Relaxation method – Systems of Nonlinear equations.

Unit - II : [12 Periods]

Solution of nonlinear equations: Newton's method – Convergence of Newton's method – Bairstow's Method for quadratic factors.

Numerical differentiation and integration: Derivatives from Differences tables – Higher order derivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

Unit - III : [12 Periods]

Solution of ordinary differential equations: Taylor series method – Euler and Modified Euler methods – Rungekutta methods – Multistep methods – Milne's method – Adams Moulton method.

Unit - IV : [12 Periods]

Boundary value problems and characteristic value problems: The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

Unit - V: [12 Periods]

Numerical solution of partial differential equations: (Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences.

Textbook:

1. C.F.Gerald and P.O.Wheatley, Applied Numerical Analysis, 5th Edition, Addison Wesley, (1998).

Contents:

Unit I : Chapter 1: Sections: 1.4, 1.8, 1.11,
Chapter 5: Sections: 5.2, 5.3, 5.6, 5.7.
Unit II : Chapter 2: Sections: 2.3 - 2.5, 2.7, 2.10 - 2.12.
Unit III : Chapter 6: Sections: 6.2 - 6.7.
Unit IV : Chapter 7: Sections: 7.2 – 7.5.
Unit V : Chapter 7: Sections: 7.6,7.7
Chapter 8 : Sections: 8.1 -8.4**.**

Reference Books:

1. S.C. Chapra and P.C. Raymond, "Numerical Methods for Engineers" Numerical Methods for Engineers Tata McGraw Hill, New Delhi, (2000)

2. R.L. Burden and J. Douglas Faires, P.W.S.Kent "Numerical Analysis " Publishing Company, Boston (1989), Fourth Edition.

3. S.S. Sastry, "Introductory methods of Numerical Analysis " Prentice Hall of India, New Delhi, (1998).

4. P.Kandasamy et al., "Numerical Methods", S.Chand & Co.Ltd., New Delhi

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2	1				3		2			3		2
CO2		1		2		2			3	2		1	
CO3		2	2				3	3			2		1
CO4	1		3	2		3			2	1		3	

CO5		3			3	2	2				2		3
CO6	2		1		2	3		1	3	2		3	

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective I - Differential Geometry	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about basic concepts of differential geometry, emphasizing calculation methods and illustrating their utility.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the concept of Analytic representation through curves.
CO2	:	Understand the concept of Curvature torsion.
CO3	:	Compare the concepts of Evolutes and Involutes.
CO4	:	Apply the First & Second Fundamental form of Normal,
CO5	:	Prove the theorems on Mesniers, Eulers of some surfaces.
CO6	:	Develop the knowledge of Differential geometry to diverse situations in mathematical contexts.

Unit - I : **[12 Periods]**
Curves: Analytic representation - Arc Length – Osculation plane.

Unit - II: **[12 Periods]**
Curvature torsion – Formulas of Ferret - Contact – Natural equations – Helices – General solutions of Natural equations.

Unit - III: **[12 Periods]**
Evolutes and Involutes - Elementary theory of surface: Analytic representation.

Unit - IV: **[12 Periods]**
First fundamental form – Normal, Tangent plane – Developable surfaces - Second fundamental form.

Unit - V: **[12 Periods]**
Meusnier's theorem – Euler's Theorem – Dupin's indicatrix –Some surfaces.

Text Book:

1. D. Struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing Company, 1961.

Contents:

Unit I: Chapter 1: Sections:1.0-1.3.

Unit II: Chapter 1: Sections:1.4-1.10.

Unit III: Chapter 1,2: Sections:1.11, 2.0,2.1.

Unit IV: Chapter 2: Sections:2.2-2.5.

Unit V: Chapter 2: Sections:2.5-2.8.

Reference Books:

1. M. Spivak, "A Comprehensive Introduction to Differential Geometry" Publish or Perish, 1979.

2. J. A. Thorpe, "Elementary Topics in Differential Geometry " Springer-Verlag, 1994

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	2		3		1		3		2		1	3
CO2			2			2		3			2	3	
CO3	1	2				2	3		2	2	1		3
CO4		1		2			3				3	2	
CO5		1			2		2	2	3	3		2	1
CO6	2		2		3	2			3	1		3	

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective I-Astronomy	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the Solar system, Celestial sphere, Dip-Twilight & Keplar's laws.

Course Focus on: Employability

Course Outcome:

CO1	:	Recall the General description of Solar system.
CO2	:	Understand the concept of Celestial sphere and Diurnal motion also length of the day.
CO3	:	Apply the knowledge of Twilight.
CO4	:	Analyze refraction with respect to tangent formula.
CO5	:	Explain the concept of Kepler's Law.
CO6	:	Discuss about the application of Astronomy in real world.

UNIT I :

General description of the Solar system - Comets and meteorites – Spherical trigonometry.

UNIT II:

Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

UNIT III:

Dip – Twilight – Geocentric parallax.

UNIT IV:

Refraction – Tangent formula – Cassini's formula.

UNIT V:

Kepler's laws – Relation between true eccentric and mean anamolies.

Text Book:

1. S.Kumaravelu and Susheela Kumaravelu "Astronomy" (Unit I to V).

Reference Book:

1. W.M.Smart. "Text book of Spherical Astronomy ".
2. Ramachandran .G.V – "Astonomy".

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		1		2			3		1	2		3	
CO2	2		3	1	2	2			3		2		1
CO3	1		2		1		1	3		3	2		2
CO4		1		2		3	2	2	1		1	2	
CO5	2	3	1	3		2	1			2		1	3
CO6		2		1	3		2	3	2		1	3	

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XI - Topology	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about topological spaces and continuous functions, connectedness, compactness, separation axioms and further related topics.

Course Focus on: Research

Course Outcome:

CO1	:	Remember the basic terminologies of Topology.
CO2	:	Understand about Connectedness and Compactness with its limits.
CO3	:	Apply the idea of Countability and Separation Axioms.
CO4	:	Analyze the concept of regular spaces.
CO5	:	Prove the theorems on Complete Metric spaces.
CO6	:	Develop the knowledge about the mathematical results like Uryzohn's Lemma and understand the dynamics of the proof techniques.

Unit - I: **[12 Periods]**
Topological spaces – Basis for Topology – The order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions – Metric Topology.

Unit - II: **[12 Periods]**
Connectedness and Compactness: Connected Spaces – Connected sets in R – Components and path components – Local connectedness – Compact Spaces – Limit Point Compactness

Unit - III: **[12 Periods]**
Countability and Separation Axioms: Countability Axioms – Separation Axioms Urysohn's Lemma – Urysohn Metrization Theorem.

Unit - IV: **[12 Periods]**
The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

Unit - V: **[12 Periods]**
Complete Metric Spaces – Compactness in Metric Spaces – Pointwise and Compact Convergences – The Compact-Open Topology – Ascoil's Theorem – Baire Spaces – A Nowhere-Differentiable Function.

Text Book:

1.James R. Munkres, "Topology; A First Course" Prentice Hall of India Private Limited, New Delhi, 2000.

Contents:

Unit I- Chapter 2- sections 12-20.
Unit II- Chapter 3- sections 23-28.
Unit III- Chapter 4- sections 30-34.
Unit IV- Chapter 5- sections 37,38.
Unit V- Chapter 7- sections 43-47
Chapter 8- sections 48,49.

Reference Books:

1. J. Dugundji, "Topology", Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Private Limited.).
2. George F. Simmons, "Introduction to Topology and Modern Analysis", McGraw Hill Book Company, 1963.
3. J.L. Kelley, "General Topology", Van Nostrand, Reinhold Co., New York, 1995.
4. L. Steen and J. Seebach, "Counter examples in Topology", Holt, Rinehart and Winston, New York, 1970.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2		2		1		3	3		2		3	
CO2	1	2		1		2			2		2	1	
CO3		1		2			3	2		1		2	3
CO4		1	3			3			3		3	1	
CO5	2		2	3		2		3		2			3
CO6	1		2		3	1	1				1		2

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XII-Functional Analysis	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge on the Banach space, Conjugate space and Banach algebra which is the fundamental concept for further research.

Course Focus on: Research

Course Outcome:

CO1	:	Understand the concept Banach Spaces and Hahn Banach theorem.
CO2	:	Analyze the Conjugate of an operator and Orthogonal components.
CO3	:	Apply the different types of operators with respect to conjugate space.
CO4	:	Recall the knowledge of Matrices, Determinants of Operator.
CO5	:	Evaluate the formula for spectral radius.
CO6	:	Develop the knowledge about numerical analysis and operator equations.

Unit - I: **[12 Periods]**

Banach spaces – The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N** - The open mapping problem.

Unit - II: **[12 Periods]**

The conjugate of an operator – Hilbert spaces – The definition and some simple properties – Orthogonal complements - Orthonormal sets.

Unit - III: **[12 Periods]**

The Conjugate space H* - The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.

Unit - IV: **[12 Periods]**

Matrices – Determinants and the spectrum of an operator – The spectral theorem.

Unit - V: **[12 Periods]**

The definition and some examples of Banach algebra – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius.

Text Book:

1. G.F. Simmons, "Introduction to Topology and Modern Analysis", McGraw –Hill Book Company, London, 1963.

Contents:

Unit I: Chapter 9: Sections: 46 – 50.
Unit II: Chapter 10: Sections: 51 – 54.
Unit III: Chapter 10: Sections: 55 – 59.
Unit IV: Chapter 11: Sections: 60 – 63.
Unit V: Chapter 12: Sections: 64 – 68.

Reference Books:

1. C. Goffman & G. Pedrick, "A First Course in Functional Analysis", Prentice Hall of India, Delhi, 1987.
2. G. Bachman and L. Narici, "Functional Analysis", Academic Press, New York, 1966.
3. L.A. Lusternik and V.J. Sobolev, "Elements of Functional Analysis", Hindustan Publishing Corporation, New Delhi, 1971.
4. A.E.Taylor,"Introduction to Functional analysis", John Wiley and Sons, Newyork,1958.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2		2				1		1		3	
CO2	3		2			3			3		2		1
CO3		3		1		2	2			2	3		1
CO4	3			3	1	1		3		1		2	
CO5		3		2			2	3		3	1		3
CO6	3		2		3				1			2	

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XIII-Mechanics	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about basic concepts of Mechanics, which is one of the important aspects of advanced mathematics.

Course Focus on: Skill development

Course Outcome:

CO1	:	Recall the basic concepts of mechanical system.
CO2	:	Understand the concept of Lagrange's equation s and its derivations.
CO3	:	Evaluate the concept of Hamilton's equations.
CO4	:	Examine the concept of Jacobi theory and its equation.
CO5	:	Apply the concept of Canonical Transformations.
CO6	:	Develop the knowledge of advanced mechanics.

Unit - I: **[12 Periods]**
Introductory Concepts : Mechanical system – Generalized Coordinates – Constraints –Virtual Work – Energy and Momentum.

Unit - II: **[12 Periods]**
Lagrange's Equations : Derivations of Lagrange's Equations : Derivations of Lagrange's Equations – Examples –Integrals of Motion.

Unit - III: **[12 Periods]**
Hamilton's Equations: Hamilton's Principle – Hamilton's Equations.

Unit - IV: **[12 Periods]**
Hamilton – Jacobi Theory: Hamilton's Principle function – Hamilton – Jacobi Equation – Separability.

Unit - V: **[12 Periods]**
Canonical Transformations: Differential forms and Generating Functions – Lagrange and Poisson Brackets.

Text Book:

1. D.T. Greenwood, "Classical Dynamics" Dover Publication, New York, 1997.

Contents:
Unit-I: Chapter 1: Sections 1.1 – 1.5
Unit-II: Chapter 2: Sections 2.1 – 2.3
Unit-III: Chapter 4: Sections 4.1 – 4.2
Unit-IV: Chapter 5: Sections 5.1 – 5.3
Unit-V: Chapter 6: Sections 6.1, 6.3

Reference Books:

1. F. Gantmacher, "Lectures in Analytic Mechanics" MIR Publishers, Moscow, 1975.

2. I.M. Gelfand and S.V. Fomin, "Calculus of Variations", Prentice Hall.

3. S.L. Loney, "An Elementary Treatise on Statics" Kalyani Publishers, New Delhi, 1979.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		3	1	2	2			3		2		1
CO2	1		2		1		1	3		3	2		2
CO3		2	2	1		3	2	2				2	
CO4	1		2		3		3		3		1		3
CO5	2		2		1		3	3		2		3	
CO6	1	2		1		2			2		2	1	

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XIV -Control Theory	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about analysis and design of control systems, Observability, Controllability, Stability and Optimal control.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concept of Linear systems and Observability Grammian.
CO2	:	Understand about the reconstruction kernel with their Nonlinear Systems.
CO3	:	Build the Controllability Grammian Constant coefficient systems and Adjoint systems.
CO4	:	Apply the concept of steering function with Nonlinear systems.
CO5	:	Analyze the concept of Asymptotic Stability of Linear Systems with the help of uniform stability.
CO6	:	Develop the concept of Stabilization via linear feedback control, Controllable subspace and Stabilization with restricted feedback.

Unit - I : **[12 Periods]**
Observability: Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems

Unit - II: **[12 Periods]**
Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – steering function – Nonlinear systems

Unit - III: **[12 Periods]**
Stability: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems

Unit - IV: **[12 Periods]**
Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback

Unit - V: **[12 Periods]**

Optimal control: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems

Text Book:

1.Elements of Control Theory by K.Balachandran and J.P.Dauer, Narosa, New Delhi, 1999.

Contents:

Unit -I : Chapter 2.
Unit -II : Chapter 3: Sections: (3.1 - 3.3)
Unit - III: Chapter 4.
Unit - IV: Chapter 5.
Unit - V : Chapter 6.

Reference Books:

1. R.Conti, "Linear Differential Equations and Control " Academic Press, London, 1976.

2. R.F.Curtain and A.J.Pritchard, ""Functional Analysis and Modern Applied Mathematics Academic Press, New York, 1977.

3. J.Klamka, "Controllability of Dynamical Systems " Kluwer Academic Publisher, Dordrecht, 1991.

4. D.L.Russell, "Mathematics of Finite Dimensional Control Systems "Marcel Dekker, New York, 1979.

5. E.B. Lee and L. Markus, "Foundations of optimal Control Theory "John Wiley, New York, 1967

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2		2		3			3	2		1	
CO2	1	1					2				3	2	
CO3	1			2	3	2		3	3		1		3
CO4	3	3		1		2			3		2	3	
CO5	3	3					3	2		1		2	1
CO6		1		2		3			3	2	3		

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II - Matlab	**4**	**4**	**0**	**1**	**Theory & Practical**

Introduction: This course provides knowledge about the use of Matlab in modern computing environments for the purpose of symbolic and numerical problem solving and visualization.

Course Focus on: Employability

Course Outcome:

CO1	:	Understand the basic comments of Matlab.
CO2	:	Recall the concept of Matrices and Vectors.
CO3	:	Explain the concept of Scripts and Functions in files.
CO4	:	Classify the concept of Two and Three dimensional plots.
CO5	:	Apply the concept of Linear Algebra, Finding Eigen Values and Vectors.
CO6	:	Develop the knowledge of problem solving techniques in Matlab.

Unit - I: **[12 Periods]**
Introduction- Basics of MATLAB, Input – Output, File types – Platform dependence – General commands. Interactive Computation: Matrices and Vectors – Matrix and Array operations

Unit - II: **[12 Periods]**
Programming in MATLAB: Scripts and Functions – Script files – Functions files-Language specific features – Advanced Data objects.

Unit - III: **[12 Periods]**
Plotting: Two-dimensional plots - Three-dimensional plots.

[12 Periods]

Unit – IV:
Applications – Linear Algebra - Solving a linear system – Finding Eigen values and Eigen vectors – Matrix Factorizations.

List of Programs

1. Program to solve geometry and trigonometry problem.
2. Program to illustrate the row and column vector operations in a given matrix.
3. Program to illustrate the creation of sub matrix form a given matrix.
4. Program for friction experiment.

5. Program to create vertical bar, horizontal bar, stairs, stem plots of a function.
6. Program to create mesh and surface plots for a given function.
7. Program to create various views of 3D plots.
8. Program to plot a function and curve corresponds to the interpolation method.
9. Program to calculate value and finding roots of a polynomial.
10. Program to determine a function that best fits the given data.

Text Book:

1. Rudra Pratap, Getting Started with MATLAB-A Quick Introduction for Scientists and Engineers, Oxford University Press, 2003.

Contents:

Unit I: Chapter 1,3: Sections 1.6.3-1.6.6, 3.1, 3.2
Unit II: Chapter 4: Sections 4.1-4.4.
Unit III: Chapter 6: Sections 6.1, 6.2.
Unit IV: Chapter 5: Sections 5.1,5.2.

Reference Books:

1. William John Palm, "Introduction to Matlab 7 for Engineers " McGraw-Hill Professional, 2005.

2.Dolores M. Etter, David C. Kuncicky, "Introduction to MATLAB 7 " Prentice Hall, 2004

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		2		1		1	3		3	2		2
CO2		1		2		3	2	2	1		1	2	
CO3	2	3	1	3		2	1			2		1	3
CO4		1		2		2			3	2		1	
CO5		2	2				3	3			2		1
CO6	1		3	2		3			2	1		3	

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II – Mathematical Modeling	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge to build mathematical models of real-world systems, analyze them and make predictions about behavior of these systems.

Course Focus on: Research

Course Outcome:

CO1	:	Use mathematical equations to model real-life problems.
CO2	:	Interpret numerical results given by program in order to predict the behavior of the system.
CO3	:	Apply computational methods and concepts from prerequisite mathematical content to analyze scientific problems.
CO4	:	Make predictions of the behavior of a given physical system based on the analysis of its mathematical model.
CO5	:	Construct a mathematical model of a given physical system and analyze it.
CO6	:	Model real-world problems mathematically and analyze those models.

Unit - I : **[12 Periods]**

Need and Techniques of Mathematical Modeling:

Simple situations requiring Mathematical Modeling – The techniques of Mathematical Modeling – Classification of Mathematical Models – Some characteristics of Mathematical Models – Mathematical Modeling through Geometry , Algebra, Trigonometry and Claculus – Limitations of Mathematical Modeling.

Unit - II: **[12 Periods]**

Mathematical Modelling through Partial Differential Equations:

Situations giving rise to Partial differential equations models – Mass Balance Equations – Momentum Balance Equations – Variational Principles – Probability generation function – Model for a traffic flow in a highway – Nature of Partial differential equations – Initial and boundary conditions.

Unit - III: **[12 Periods]**

Mathematical Modelling through Functional integral and Differential-Difference equations:

Mathematical Modeling through Functional equations – Mathematical Modeling through integral equations – Mathematical Modeling through Delay-Differential and Differential-Difference equations.

Unit - IV: **[12 Periods]**

Mathematical Modelling through Calculus of Variations and Dynamic Programming :

Optimization principles and Techniques – Mathematical Modeling through Calculus of Variations – Mathematical Modeling through Dynamic Programming.

Unit - V: Mathematical Modelling Mathematical Programming, Maximum and Maximum-Entropy Principle : **[12 Periods]**

Mathematical Modeling through Linear Programming – Mathematical Modeling through Non-linear Programming – Mathematical Modeling through Maximum Principle – Mathematical Modeling through the use of principle of Maximum Entropy.

Text Book:

1. J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

Contents:

Unit I: Chapter 1 : Sections 1.1-1.9
Unit II: Chapter 6 : Sections 6.1-6.8
Unit III: Chapter 8 : Sections 8.1-8.3
Unit IV: Chapter 9 : Sections 9.1-9.3
Unit V: Chapter 10 : Sections 10.1-10.4

Reference Book:

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East – West Press Pvt Limited, New Delhi, 19.
2.Singh – Mathematical Modelling, International Book house – 2003.
3. Frank R. Giordano, Maurice D.Weir and William P. Fox, - A first course in mathematical modelling, Thomson Learning, London and New York, 2003.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	2		3				2			2		1
CO2	1		2			2		3		3		2	
CO3		1	2				2		3	1		3	2
CO4	2	3			3	1		3		1	3		2
CO5		1		2		2			3	2		1	
CO6	2		2		3		3		1		3	2	

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II- Programming and Mathematical Thinking	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the concept of dual spaces, reflectivity, Banach space and Hilbert space.

Course Focus on: Skill Development

Course Outcome:

CO1	:	Familiarize with the introduction to python language, python functions and python control structures.
CO2	:	Understand the usage of Python libraries.
CO3	:	Learn and understand Python programming basics and paradigm.
CO4	:	Understand and use object based software concepts in Mathematics.
CO5	:	Demonstrate an understanding of the object oriented and distributed data models.
CO6	:	Learn mathematical background for analysis of algorithm in Python.

Unit - I: **[12 Periods]**

An overview of Python: Introduction –Values, types and names – Integers – Floating-point numbers – Strings.

Python programs: Statements – Conditionals – Iterations.

Unit - II: **[12 Periods]**

Python functions: Function definitions – Recursive functions – Functions as values – Lambda expressions.

Tuples: Ordered pairs and n-tuples – Tuples in Python – Files and databases.

Unit - III: **[12 Periods]**

Sequences: Properties of sequences –Monoids – Sequences in Python – High-order sequence functions – Parallel processing.

Streams: Dynamically-generated sequences – Generator functions – Endless streams – Programming with streams – Distributed processing.

Unit - IV: **[12 Periods]**

Sets: Mathematical sets – Sets in Python – Flats, files, sets and tuples – Other representation of sets.

Mappings: Mathematical mappings – Python dictionaries – Dictionary or function – Multisets.

Unit - V: **[12 Periods]**

Relations: Mathematical terminology and notation – Representation in programs – Graphs – Paths and transitive closure – Relational database operations.

Objects: Objects in programs – Defining classes – Inheritance and hierarchy of classes – Objected oriented programming – Recursively defined objects.

Text Book:

1."Programming and Mathematical Thinking – A gentle introduction to Discrete Math featuring Python", Allan M. Stavely, First Edition, The New Mexico Tech Press, USA(2014).

2. "Doing Math with Python" , Amit Saha, No Starch Press, USA.

Contents:

Unit-I: Chapter 2: Sections 2.1 – 2.5
Chapter 3: Sections 3.1 – 3.3
Unit-II: Chapter 4: Sections 4.1 – 4.4
Chapter 5: Sections 5.1 – 5.3
Unit-III: Chapter 6: Sections 6.1 - 6.6
Chapter 7: Sections 7.1 – 7.6
Unit-IV: Chapter 8: Sections 8.1 - 8.5
Chapter 9: Sections 9.1 – 9.5
Unit-V: Chapter 10: Sections 10.1 – 10.5
Chapter 11: Sections 11.1 – 11.6

Reference Books:

1. Maria Litvin and Gary Litvin, "Coding in Python and Elements of Discrete Mathematics" Skylight Publishing, USA(2019).

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2			3		3		1			3
CO2	1	1		1		2			3		2	2	
CO3	1	2			2		3	2		3			2
CO4		1		2		3			3		3	1	
CO5		1		2		3		3		2			3
CO6	1		2		3	2					3		

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XV - Operator Theory	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the concept of dual spaces, reflectivity, Banach space and Hilbert space.

Course Focus on: Research

Course Outcome:

CO1	:	Remember the concept of Dual space considerations.
CO2	:	Understand the concept of Reflexivity and reconvergence.
CO3	:	Apply the concept of Compact operators and its properties.
CO4	:	Analyze the Banach space operators.
CO5	:	Evaluate the concept of Operators and Hilbert space.
CO6	:	Develop the knowledge of Operator Theory in various fields.

Unit - I : **[12 Periods]**

Dual space considerations: Representation of Dual space- Dual of $l^P(n)$-Dual of some sequence spaces- Duals of C[a,b] and L^P[a,b]- Seperability revisited.

Unit - II: **[12 Periods]**

Reflexivity and reconvergence: Reflexivity- Best approximation in reflexive space.

Unit - III: **[12 Periods]**

Compact operators- Some characterizations - Space of compact operators- Further properties.

Unit - IV: **[12 Periods]**

Spectral result for Banach space operators - Eigen Spectrum and approximate Eigen spectrum- Spectrum and resolvent set- Spectral radius-Spectral mapping theorem- Gelfant Mazar theorem and spectral radius formula.

Unit - V: **[12 Periods]**

Operators and Hilbert space -Adjoint of an operators- Compactness of the adjoint operators- Sesquilinear function - self adjoint, normal and Unitary operator- Numerical range and Numerical radius- Some characterizations.

Text Book:

1.M.Thamban Nair, "Function Analysis A First course" 2002,New Delhi, Prentice hall of India.

Contents:

Unit-I: Chapter 8-section 8.1
Unit-II: Chapter 8-section 8.2
Unit-III: Chapter 9-section 9.1 to 9.3
Unit-IV: Chapter 10-section 10.1 to 10.2
Unit-V: Chapter 11-section 11.1 to 11.2

Reference Books:

1. G.M.Simmons, "Introduction to Topology and Modern Analysis " 1963, Tokyo, MEC Graw Hills.
2. V.S. Sundhar, "Functional Analysis: Spectral Theory " 1997, New Delhi, Hindustan Agency.
3. A.E. Tailor and D.C. Lay, " Introduction to functional Analysis" 1980, 2nd Edition, Newyork, Willey.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		2	3	1			3		1		2	3
CO2		3				2			3		2	3	
CO3	3	3			2		3	2		1		2	1
CO4		1		2		3			3	2	3		
CO5	1						3				2		1
CO6	3			1	2	2			1	3		1	2

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XVI - Fluid Dynamics	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about fluid flow, energy equation, conservative forces and its applications.

Course Focus on: Research

Course Outcome:

CO1	:	Remember the basic concept of fluid flow.
CO2	:	Understand the energy equation of flow of a fluid.
CO3	:	Apply the concept of two dimensional motion of fluid and the lift forces.
CO4	:	Analyze viscous flow and the steady flow of fluids.
CO5	:	Explain the concept of boundary layer.
CO6	:	Develop the knowledge of Fluid Dynamics and its applications.

Unit - I : **[12 Periods]**

Introduction -Velocity -Stream line & path line Stream tubs - fluid body-density-pressure. Differentiation following the fluid -equation of continuous-boundary conditions -kinematical and physical -rate of change of linear momentum-equation of motion of an in viscid fluid.

Unit - II: **[12 Periods]**

Introductory Euler's momentum theorem -conservative forces-Bernouli theorem -energy equation for in viscid fluid -circulation -Kelvin's theorem -vortex motion Helemholtz equation .

Unit - III: **[12 Periods]**

Two dimensional motion -two dimensional function -complex potential basic singularties-sourse vortex-doublet circle theorem flow past a circular cylinder with circulation -conformal transformation -Blasius theorem-lift forces.

Unit - IV: **[12 Periods]**

Viscous flows- Navier stokes equations-verticity and circulation in viscous fluid -steady flow through an arbitrary cylinder under pressure-steady couette flow between cylinder in relative motion -steady flow between parallel planes.

Unit - V: **[12 Periods]**

Laminar boundary layer in incompressible flow -boundary layer concept-boundary layer equation-displacement thickness-momentum thickness-kinetic energy thickness-integral equation of boundary layer-flow parallel to semi infinite plate- Blasius equation and its solution in series.

Text books:

1. L.M. Milne Thomson, "Theoretical Hydro Dynamics" McMillan Company, 5th Edition, 1968 (Units I and II).
2. N. Curle aand H.J. Davies, D Van Nostrand "Modern Fluid Dynamics – (Volume I) " Company Limited., London ,1968. (Units III, IV and V).

Contents:

Unit I: Chapter I: Sections 1.0 – 1.3.
Unit II: Chapter III: Sections 3.10 – 3.53 (omit 3.32, 3.44)
Unit III: Chapter III: Sections 3.1 – 3.7.5
Unit IV: Chapter V: Sections 5.1 – 5.5.5
Unit V: Chapter VI: Sections 6.1 – 6.3.1 (omit 6.2.2.)

Reference books:

1. F.D Shanthi Swarup, "Fluid dynamics ", Krishna Prakashan private limit ,2000
2. M.D Raisinghania, "Fluid dynamics with hydro dynamics " S.Chand &co 2003 edition

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2	1				3		2			3		2
CO2		1		2		2			3	2		1	
CO3		2	2				3	3			2		1
CO4	1		3	2		3			2	1		3	
CO5		3			3	2	2				2		3
CO6	2		1		2	3		1	3	2		3	

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XVII – Mathematical Methods	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about integral equations, transforms, Fourier series and its applications.

Course Focus on: Research

Course Outcome:

CO1	:	Remember the basic concept of integral equations.
CO2	:	Understand about the boundary value problems.
CO3	:	Apply the concept of two dimensional motion of fluid and the lift forces.
CO4	:	Analyze viscous flow and the steady flow of fluids.
CO5	:	Explain the concept of boundary layer.
CO6	:	Develop the knowledge of Fluid Dynamics and its applications.

Unit - I: **[12 Periods]**

Integral equations: Types of Integral equations – Integral Fredholm Alternative - Approximate method – Equation with separable Kernel - Volterra integral equations – Fredholm's theory.

Unit - II: **[12 Periods]**

Application of integral equations to ordinary integral equations and singular integral equations: Initial value problems - Boundary value problems – singular integral equations – Abel Integral equation.

Unit - III: **[12 Periods]**

Fourier Transforms: Fourier Transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives - convolution integral – Parseval's Theorem - Solution of Laplace Equations by Fourier transform.

Unit - IV: **[12 Periods]**

Hankel transforms: Properties of Hankel Transforms – Hankel transformation of derivatives of functions - The Parseval's relation – relation between Fourier and Hankel transforms - Axisymmetric Dirichlet problem for a half space – Axisymmetric Dirichlet problem for a thick plate.

Unit - V: **[12 Periods]**

Calculus of variations: Variation and its properties – Euler's(Euler Lagranges) equation – functionals dependent on the functions of several independent variables – variational problems in parametric form –applications.

Text Books:

1. Linear Integral Equations Theory and Technique, R.P.Kanwal, Academic Press, New York, 1971.
2. The Use of Integral Transforms, I.N.Sneddon, McGraw-Hill, NewYork, 1972.
3. Differential Equations and Calculus of Variations, L.Elsgolts, Mir Publishers, Moscow, 1970.

Contents:

Unit I :Chapter 2: 2.3 - 2.7, 2.9 – 2.10, 2.16. (Book 1)
Unit II :Chapter 5: 5.2– 5.4, 5.6 – 5.7, 5.10 – 5.12. (Book 1)
Unit III :Chapter 2: 2.3- 2.5, Chapter 3: 3.3- 3.4. (Book 2)
Unit IV :Chapter 5: 5.1– 5.2, Chapter 8: 8.1– 8.2. (Book 2)
Unit V :Chapter 6: 6.1-6.3,6.4-6.7 (Book 3)

Reference Books:

1. H.T. Davis – Introduction to nonlinear differential and integral equations, Dover Publications, 1962.
2. A.H. Nayfeh – Perturbation Methods, John Wiley & sons New York, 1973
3. Don Hong, J. Wang and R. Gardner. Real analysis with introduction to wavelets and applications, Academic Press Elsevier (2006)

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2			3		3		1			3
CO2	1	1		1		2			3		2	2	
CO3	1	2			2		3	2		3			2
CO4		1		2		3			3		3	1	
CO5		1		2		3		3		2			3
CO6	1		2		3	2					3		

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective III - Stochastic Processes	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about stochastic processes and concepts pertaining to stochastic modelling.

Course Focus on: Research

Course Outcome:

CO1	:	Remember the basic concepts of Stochastic processes.
CO2	:	Understand the concepts of Bernoulli trails.
CO3	:	Apply the concept of Poisson process and its extensions.
CO4	:	Classify the conditional expectations and conditional probabilities.
CO5	:	Prove the theorems on queuing model .
CO6	:	Develop the knowledge of Stochastic Processes in diverse situations.

Unit - I: **[12 Periods]**
Stochastic processes: Some notions - Introduction-Specification of stochastic processes – stationary processes – Mortingales – Difference equation: Differentiable- Difference equations. Markov chain - Definition and examples – High transition probabilities.

Unit - II: **[12 Periods]**
Generalization of independent Bernoulli trails: sequence of chain dependent trails – Classification of states and chain: Determination of higher transition probabilities – Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of states.

Unit - III: **[12 Periods]**
Markov processes with discrete state space: Poisson process and its extensions - Poisson process – Poisson process and related distributions – Generalizations of Poisson process – Birth death process.

Unit - IV: **[12 Periods]**
Markov processes with discrete state space (continuous time Markov chains)- Randomization Derived Markov chain – Erlang process. Markov process with continuous state space: Introduction: Brownian motion – Wiener process – Differential equations for a wiener process – Kolmogorov equation.

Unit - V: **[12 Periods]**
Stochastic Processes in Queueing system: General concepts – The queuing model M/M/1 : Steady state behavior. Transient behavior of M/M/1 model – Birth and death processes - The model M/M/S.

Text Book :
1. J.Medhi, Stochastic Processes, Wiley Eastern Limited.

Contents:
Unit I : Chapter 2: Sections 2.1-2.4,
Chapter 3: Sections 3.1,3.2
Unit II : Chapter 3: Sections 3.3 - 3.8
Unit III : Chapter 4: Sections 4.1 - 4.4
Unit IV : Chapter 4: Sections 4.5 - 4.7
Chapter 5: Sections 5.1 - 5.4
Unit V : Chapter 10: Sections 10.1 - 10.3, 10.4 (only 10.4.1, 10.4.2, 10.4.2.1)

Reference Books:

1., S.Karlin and M.Taylor, "A First course in Stochastic Process" Second Edition, Academic Press, Newyork (1975).

2.U, Narayan Bhat, "Elements of Applied Stochastic processes " 2nd edition, Wiley, New York (1968)

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1		2		1				3		2	1		3
CO2	1		3			2		3			3	2	
CO3		1		2		2	3			3		1	2
CO4			1	3	2	3		3		1	2		2
CO5		2		1			2		3	2		3	
CO6	1		2		3				3		1		2

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective III - Number Theory and Cryptography	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides knowledge about the concept of divisibility, functions, groups and basic properties.

Course Focus on: Employability

Course Outcome:

CO1	:	Recall the basic concept of Numbers and need of Number theory.
CO2	:	Understand the concept of Finite fields and Jacobi symbol.
CO3	:	Gain knowledge about message authentication and hash functions.
CO4	:	Learn fundamentals of cryptography and its application to network security.
CO5	:	Learn about how to maintain the Confidentiality, Integrity and Availability of a data.
CO6	:	Understand various protocols for network security to protect against the threats in the networks.

Unit - I: **[12 Periods]**

Divisibility and Euclidean algorithm – Congruence, Euler's Theorem, Wilson's Theorem, Chinese Remainder Theorem, Primitive roots - Applications to Factoring.

Unit - II: **[12 Periods]**

Finite Fields – Quadratic Residues – Quadratic Reciprocity – The Jacobi symbol.

Unit - III: **[12 Periods]**

Cryptosystems – Enciphering Matrices – Public Key Cryptography – Concepts of Public Key Cryptography – Modular Arithmetic – RSA.

Unit - IV: **[12 Periods]**

Pseudo primes and Strong Pseudo primes – The rho method – Fermat factorization and factor bases and Algorithm – The Continued fraction method and Algorithm.

Unit - V: **[12 Periods]**

Elliptic Curves – Basic Facts, Elliptic curves Cryptosystems, Elliptic curve Factorization.

Text Book:

1. "A Course in Number Theory and Cryptography" by Neal Koblitz, , Springer – Verlag, New York,

1987.

Contents:

Unit I: Chapter 1 : Sections 1.1-1.4
Unit II: Chapter 2 : Sections 2.1-2.2
Unit III: Chapters 3&4 : Sections 3.1-3.2, 4.1-4.2
Unit IV: Chapter 5 : Sections 5.1-5.4
Unit V: Chapter 6 : Sections 6.1-6.2,6.4

Reference Books:

1. "An Introduction to Theory of Numbers" by Ivan Nivan and HerbertsZucherman, Third Edition Wiley Eastern Limited, New Delhi, 1972 .
2. "Introduction to Analytic Number Theory" by Tom Apostol, Narosa Publications, New Delhi .
3. "Elementary Number Theory" by David M. Burton, Wm. C. Brown Publishers, Dubuque, Lowa, 1989.
4. "Cryptography and Network Security Principles and Practice" by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3		2		1		3		2	1		3
CO2	1		3			2			2		3	2	
CO3	3	2					3	3		1		2	
CO4		1		2		2			3		2		1
CO5	1	1				2			3			3	
CO6	1			3	3	2			3		1		3

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective III - Fuzzy Logic and Systems	**4**	**5**	**0**	**0**	**Theory**

Introduction: This course provides basic knowledge on fuzzy sets, fuzzy logic, fuzzy decision making and fuzzy control systems.

Course Focus on: Research

Course Outcome:

CO1	:	Recall the basic concepts of fuzzy set and its properties.
CO2	:	Understand the concept of Fuzzy relations.
CO3	:	Examine the concept of Fuzzy Measures.
CO4	:	Evaluate the concept of Uncertainty.
CO5	:	Apply the concept of fuzzy theory in Real world.
CO6	:	Discuss and develop new technologies so as to improve computing facility to maintain environment sustainability.

Unit - I: **[12 Periods]**

Crisp Sets and Fuzzy Sets: Introduction-Crisp sets: The Notion of Fuzzy Sets-basic concepts of Fuzzy sets – Classical Logic: complement-Fuzzy Union-Fuzzy interaction – Combination of operations– General aggregation of operations.

Unit - II: **[12 Periods]**

Fuzzy Relations: Crisp and Fuzzy relations – Binary relations – Binary relations on a single set – Equivalence and similarity relations – Compatibility on Tolerance Relations-Orderings - Morphism – Fuzzy relations Equations.

Unit - III: **[12 Periods]**

Fuzzy Measures: General discussion – Belief and plausibility Measures –Probability measures – Possibility and Necessity measures – Relationship among Classes of Fuzzy Measures.

Unit - IV: **[12 Periods]**

Uncertainty and Information: Types of uncertainty – Measures of Fuzziness-Classical Measures of Uncertainty – Measures of Dissonance-Measures of Confusion – Measures of Non-Specificity – Uncertainty and Information – Information and Complexity – Principles of Uncertainty and information.

Unit - V: **[12 Periods]**

Applications: Natural, life and Social Sciences - Engineering - Medicine - Management and decision making – Computer Sciences-System Science-Other Applications.

Text Book:

1. George J. Klir and Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice- Hall of India Private Limited-Fourth printing-June 1995.

Contents:

Unit I: Chapter 1: 1.1-1.5 ,
Chapter 2: 2.2 – 2.6
Unit II: Chapter 3: 3.1-3.8
Unit III: Chapter 4: 4.1-4.5
Unit IV: Chapter 5: 5.1 -5.9
Unit V: Chapter 6: 6.2 -6.8

Reference Books:

1. George J. Klir and Boyuan**,** Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice-Hall of India Private Limited.

2. D. DuBois and H.M. Prade, Fuzzy Sets and Systems: Theory and Applications, Academic Press, 1994.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes									Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1		1	2		2		3		3	2		1	2
CO2	1		1	3		2		1			2	3	
CO3	2	1		2	1		3		2	1	3		2
CO4		2	2	1		3	2	2				2	
CO5	1		2		3		3		3		1		3
CO6		1		2	2	3		2	3	2		1	