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)

2019-2020 Batch onwards

Vision and Mission of the Institution:

VISION

A world renowned INDUSTRY-INTEGRATED INSTITUTION that imparts knowledge, skill, and research culture in young men and women to suit emerging young India.

MISSION

To provide quality education at affordable cost, and to maintain academic and research excellence with a keen focus on INDUSTRY-INTEGRATED RESEARCH AND EDUCATION.

MOTTO

Meaningful INDUSTRY-READY education and research by all means

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 **:** Remember the fundamental concepts and principles of various areas of mathematics.

PO2 **:** Demonstrate the concepts and theories of mathematics to the real world.

PO3 **:** Understand the significance of information from sources that include books, Journals, Scientific reports and the internet.

PO4 **:** 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.

PO5 **:** Create problem solving skills and apply them independently to problems in pure and applied mathematics.

PO6 **:** Develop proficiency in analyzing and solving scientific problems.

PO7 **:** Apply the techniques, skills and modern technology necessary to communicate effectively with professional responsibility.

PO8 **:** Solve complex mathematical problems using the knowledge of pure and applied mathematics.

PO9 **:** Explain the knowledge of contemporary issues in the field of mathematics and applied sciences.

Correlation between the POs and the PEOs

Program Outcomes		PEO1	PEO2	PEO3	PEO4
PO1	:		√	√	
PO2	:	√			
PO3	:			√	
PO4	:	√	√		√
PO5	:	√			√
PO6	:		√	√	
PO7	:	√			√
PO8	:		√		
PO9	:			√	√

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	√		√		√	√		√	√
PO2	√	√		√	√	√			
PO3		√		√	√	√			√
PO4			√			√		√	√
PO5	√	√		√	√				√
PO6	√		√			√		√	
PO7		√		√	√		√		√
PO8	√		√			√			
PO9		√			√		√		

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Scheme of curriculum for
M.Sc Mathematics
for the students admitted in the Batch during 2019 - 2020

Board of Studies – Mathematics (PG)

S.No	Sem	Part	Type	Sub Code	Subject	Credit	Hour	Int	Ext	Total
1	1	III	Theory		Algebra	4	6	40	60	100
2	1	III	Theory		Real Analysis	4	6	40	60	100
3	1	III	Theory		Ordinary Differential Equations	4	6	40	60	100
4	1	III	Theory		Latex & Mathematica	4	6	40	60	100
5	1	III	Theory		Functional Analysis	4	6	40	60	100
1	2	III	Theory		Complex Analysis	4	5	40	60	100
2	2	III	Theory		Partial Differential Equations	4	5	40	60	100
3	2	III	Theory		Mechanics	4	5	40	60	100
4	2	III	Theory		MATLAB	4	5	40	60	100
5	2	III	Theory		Graph Theory	4	5	40	60	100
6	2	III	Theory		Elective-I	4	5	40	60	100
1	3	III	Theory		Topology	4	6	40	60	100
2	3	III	Theory		Fluid Dynamics	4	6	40	60	100
3	3	III	Theory		Operations Research	4	6	40	60	100
4	3	III	Theory		Mathematical Statistics	4	6	40	60	100
5	3	III	Theory		Elective-II	4	6	40	60	100
6	3	III	Practical		Core Practical – VI – Industrial Training Report	2		50	-	50
1	4	III	Theory		Elective-III	4	5	40	60	100
2	4	III	Theory		Fuzzy Logic And Systems	4	5	40	60	100
3	4	III	Practical		Latex & MATLAB Practical	4	5	40	60	100
4	4	III	Theory		Linear Algebra	4	5	40	60	100
5	4	III	Project		Project	8	10	40	160	200
						90				**2250**

Elective Subjects:

		Subject Code	Subject Name
Elective-I	A		Numerical Methods
	B		Cryptography
	C		Astronomy
Elective-II	A		Control Theory
	B		Differential Geometry
	C		Probability Theory
Elective-I	A		Stochastic Processes
	B		Number Theory
	C		Operator Theory

Note :

1. Learning the courses – Packages like Mathematica, 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.

Mapping of Courses and POs:

S- Strong Correlation M – Medium Correlation B – Blank

Course Code	Course Name	Program Outcomes								
		P01	PO2	P03	P04	P05	P06	P07	PO8	PO9
	Algebra	S	S	S	S	M	S		M	
	Real Analysis	M	M	S	S	S	M		M	
	Ordinary Differential Equations	S	S	S	S	M	S		S	M
	Latex & Mathematica		S	M		M	S	S		
	Functional Analysis	M	M	S	S	M	M		M	M
	Complex Analysis	S	M	S	S	S	M		S	
	Partial Differential Equations	S	S	S	M	S	S		S	M
	Mechanics	M	S	M	M	M	S	M	S	S
	MATLAB		S	M			S	S		M
	Graph Theory	M	S	S	S	M	S	S		
	Elective-I	M	M	S	S	M	M			S
	Topology	M	M	S	S	M	M			M
	Fluid Dynamics	S	S	M	M	S	S	M	M	
	Operations Research	S	S	S	S	M	S	S		
	Mathematical Statistics	S	S	M	M	S	S	M		M
	Elective-II	M	M	S	S	M	M		S	
	Industrial Training Report		S	M		S	S	M		S
	Elective-III	M	M			S	M		M	
	Fuzzy Logic And Systems	M	M	S	S		M			M
	Latex & MATLAB Practical		S	M		M	S	S		S
	Linear Algebra	S	M	S	S	M	M			
	Project	M	S	S		S	S	M	M	S

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - I – Algebra	**4**	**6**	**0**	**0**	**Theory**

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

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:

Group Theory: Another counting principle – Sylow's theorem – Direct products.

UNIT-II:

Ring Theory: Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

UNIT-III:

Fields: Extension Fields – Roots of polynomials – More about roots.

UNIT-IV:

Fields: Elements of Galois theory – Finite Fields.

UNIT-V:

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 willey 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.
Chapter 7 -Section 7.1.
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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	L				M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5	L					M	H		
CO6	L			M	H	M			H

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - II - Real Analysis	**4**	**6**	**0**	**0**	**Theory**

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

Course Outcome:

CO1	:	Recall the basic concept of Riemann Stieltjes Integral.
CO2	:	Understand the concept of Convergence and Continuity.
CO3	:	Apply the concept of Functions Of Several Variables.
CO4	:	Examine the concept of Lebesgue Measure.
CO5	:	Explain the concept of Lebesgue Integral.
CO6	:	Discuss about theory of Lebesgue integration, Riemann integration and its properties..

UNIT-I:

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:

Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions – The Stone Weirstrass theorem

UNIT-III:

FUNCTIONS OF SEVERAL VARIABLES: Linear transformation – contraction principle – Inverse function theorem – Implicit function theorem.

UNIT-IV:

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

UNIT-V:

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

Text Book:

1.W. Rudin, "Principles of Mathematical Analysis" McGraw Hill, New York, 1976.
2.H.L. Roydon, "Real Analysis" Third Edition, Macmillan, New York, 1988.

Contents:

Unit I –III : Chapters 6, 7, 9 (Book: 1)
Unit IV –V : Chapters 3 and 4 (Book: 2)

Reference Book:

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L		H			M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5	L	L				M			H
CO6	L			M	H	M			H

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core - III - Ordinary Differential Equations	**4**	**6**	**0**	**0**	**Theory**

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

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

UNIT-II:
Systems of first order equations – existence and uniqueness theorem – Fundamental matrix.

UNIT-III:
Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

UNIT-IV:
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:
Fundamental results – Sturm's comparison theorem – Elementary linear oscillations. Comparison theorem of Hille-Winter – oscillations of $x'' + a(t)x = 0$ - Elementary non-linear oscillation.

Text Book:
1. S.G. Deo and V. Raghavendra, "Ordinary Differential Equations and Stability Theory".

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 – 6 : Section 6.1 –6.6

Reference Book:

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	H		M				H	
CO3		L				M	H		
CO4		L		M		H			H
CO5	L	L				M			H
CO6	L			M	H	M			H

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core IV- LATEX & Mathematica	**4**	**6**	**0**	**0**	**Theory**

Introduction: This paper provides knowledge about basics of Latex & Mathematica, which is one of the basic subjects of modern mathematics, which provides system oriented knowledge.

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 Mathematica software.
CO4	:	Apply the advanced mathematics in Mathematica.
CO5	:	Evaluate computation procedure for Series and limits.
CO6	:	Develop the knowledge of investigating and learning new LATEX & Mathematica packages on their own.

UNIT-I:

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

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.

Text Book:

1. H. Kopka and P.W. Daly, "A Guide to LATEX "3rd Edition, Addison – Wesley, UK, 1999.
2. S. Wolfram, "The Mathematica", 4th Edition, Cambridge University Press, Cambridge, 1999.

Contents:

Unit I -Chapter 2,3,4 : Section 2.5,3.1-3.3, 4.2,4.3,4.5,4.7,4.8. (Book: 1)
Unit II -Chapter 4,5 : Section 4.10,5.1-5.5. (Book: 1)
Unit III -Chapter 1: Section 1.0-1.6 (Book: 2)
Unit IV -Chapter 3: Section 3.1 –3.5. (Book: 2)
Unit V -Chapter 3: Section 3.6,3.7. (Book: 2)

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L	M				M	H	
CO2	L		H	M			M		
CO3		L		M		H	H		
CO4		L		M			H	M	H
CO5	L		M			H		H	
CO6	L			H		H			M

SEMESTER I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core V-Functional Analysis	**4**	**6**	**0**	**0**	**Theory**

Introduction: This paper provides knowledge about the Banach space, Conjugate space and the concept of Banach algebra which is one of the fundamental concept for further 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:

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:

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

UNIT III:

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

UNIT IV:

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

UNIT V:

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: Sections: 46 – 50.
Unit II: Sections: 51 – 54.
Unit III: Sections: 55 – 59.
Unit IV: Sections: 60 – 63.
Unit V: Sections: 64 – 68.

Reference Book:

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M	H					M	
CO2		L		M		H			H
CO3		L					H	M	
CO4	L	M					H		M
CO5	L			M		H		H	
CO6		L	M	H	H	M			

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 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:

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:

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:

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:

Series and Product Developments: 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.

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

Reference Books:

1. W. Rudin, "Real and Complex Analysis " McGraw-Hill Book Co., 1966.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	L				M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5		L		M		H		H	
CO6	L		M		H	M			

SEMESTER II

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

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

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:

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.

The diffusion equations: Elementary solutions of the diffusion equation – Separation of variables- The use of integral transforms.

Text Book:

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

Contents :

Unit I: Chapter – 2 Sections 1.1 – 1.4 Chapter – 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. 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	H					M	M	
CO3		L		H			H	M	
CO4		L		M		H			H
CO5			L	M		M		H	
CO6	L		M		H	M			H

SEMESTER II

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

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

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:

Introductory Concepts : Mechanical system – Generalized Coordinates – Constraints –Virtual Work – Energy and Momentum.

UNIT II:

Lagrange's Equations : Derivations of Lagrange's Equations : Derivations of Lagrange's Equations – Examples –Integrals of Motion.

UNIT III:

Hamilton's Equations: Hamilton's Principle – Hamilton's Equations.

UNIT IV:

Hamilton – Jacobi Theory: Hamilton's Principle function – Hamilton – Jacobi Equation – Separability.

UNIT V:

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L	M					H	
CO2	L		H				H	M	
CO3		L		M		H		H	
CO4		L		M		H	M		H
CO5			L	M		M		H	
CO6	L		M		H	M			H

SEMESTER II

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

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 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:

Introduction- Basics of MATLAB, Input – Output, File types – Platform dependence – General commands.

UNIT II:

Interactive Computation: Matrices and Vectors – Matrix and Array operations

UNIT III:

Programming in MATLAB: Scripts and Functions – Script files – Functions files-Language specific features – Advanced Data objects.

UNIT IV:

Plotting: Two-dimensional plots - Three-dimensional plots

UNIT V:

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

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: Sections 1.6.3-1.6.6
Unit II: Chapter 3: Sections 3.1, 3.2
Unit III: Chapter 4: Sections 4.1-4.4.
Unit IV: Chapter 6: Sections 6.1,6.2.
Unit V: 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L		H				H	M	
CO2	L	L	M					H	
CO3		L	L			M			H
CO4		L		M		H	M		H
CO5			L	M		M		H	
CO6	L		M		H	M			H

SEMESTER II

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

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

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:
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:
Trees: Elementary properties of trees, Centers and Centroids, Block-cut point trees, Independent cycles.

UNIT III:
Connectivity and Traversability: Connectivity and line connectivity, Eulerian graph, Hamiltonian graphs.

UNIT IV:
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:
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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L		H				H	M	
CO2	L	L	M					H	
CO3		L	L			M	H	M	
CO4		L		M		H	M		H
CO5	L		L		M			H	
CO6	L		M		H	M			H

SEMESTER II

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

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

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 :

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 II :

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 III :

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 :

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 :

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	L				M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5	L					M	H		
CO6	L			M	H	M			H

SEMESTER II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II-Cryptography and Network Security	**4**	**5**	**0**	**0**	**Theory**

Introduction: This paper provides knowledge on several cryptographic algorithms, OSI Security architecture, Public key cryptography, Authentication and hash function, Network and System level security.

Course Outcome:

CO1	:	Recall the basic concept of cryptography to ensure network security.
CO2	:	Understand the concept about the encryption techniques
CO3	:	Analyze Authentication and Hash functions.
CO4	:	Apply Network security and its applications.
CO5	:	Explain the need of System level security in order to detection of threads/function.
CO6	:	Develop the practical knowledge on Cryptography and Network Security.

UNIT I :

Introduction: OSI Security Architecture - Classical Encryption techniques - Cipher Principles - Data Encryption Standard - Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES - AES Cipher - Triple DES - Placement of Encryption Function - Traffic Confidentiality

UNIT II:

Public key cryptography: Key Management – Diffie -Hellman key Exchange - Elliptic Curve Architecture and Cryptography - Introduction to Number Theory - Confidentiality using Symmetric Encryption - Public Key Cryptography and RSA.

UNIT III:

Authentication and hash function : Authentication requirements - Authentication functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and MACs - MD5 message

Digest algorithm - Secure Hash Algorithm - RIPEMD - HMAC Digital Signatures - Authentication Protocols - Digital Signature Standard

UNIT IV:

Network security: Authentication Applications: Kerberos - X.509 Authentication Service - Electronic Mail Security - PGP - S/MIME - IP Security - Web Security.

UNIT V:

System level security: Intrusion detection - password management - Viruses and related Threats - Virus Counter measures - Firewall Design Principles - Trusted Systems.

Text Book:

1. William Stallings, "Cryptography And Network Security - Principles and Practices", Prentice Hall of India, Third Edition, 2003.

Contents:
Unit I : Chapter 1 to 7 : Sections 1.2-1.6, 2.1-2.3, 3.1-3.5, 5.1,5.2, 6.1, 7.1,7.2
Unit II : Chapter 9 to 10 : Sections 9.1,9.2, 10.1-10.4
Unit III : Chapter 11 to 13 : Sections 11.1-11.5, 12.1-12.3, 13.1-13.3
Unit IV : Chapter 14 to 17 : Sections 14.1,14.2, 15.1,15.2, 16.1,17.1-17.3
Unit V : Chapter 18 to 20 :Sections 18.1-18.3, 19.1,19.2, 20.1,20.2

Reference Book:
1.Atul Kahate by Cryptography and Network Security, Tata McGraw-Hill, 2003.

2.Bruce Schneier by Applied Cryptography, John Wiley & Sons Inc, 2001.

3. Charles B. Pfleeger and Shari Lawrence Pfleeger, by Security in Computing, Third Edition, Pearson Education, 2003.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L	M					H	
CO2	L	L				M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5	L		M			M	H		
CO6	L			M	H	M			H

SEMESTER II

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

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

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 ".

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	L				M			H
CO3	L	M					M	H	
CO4		L		M		H			H
CO5	L					M	H		
CO6	L			M	M	M			H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XI - Topology	**4**	**6**	**0**	**0**	**Theory**

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

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:

Topological spaces – Basis for Topology – The order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions – Metric Topology.

UNIT II:

Connectedness and Compactness: Connected Spaces – Connected sets in R – Components and path components – Local connectedness – Compact Spaces – Limit Point Compactness

UNIT III:

Countability and Separation Axioms: Countability Axioms – Separation Axioms Urysohn's Lemma – Urysohn Metrization Theorem.

UNIT IV:

The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

UNIT V:

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- Chapter2- 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	M	L	M					H	
CO2	L	L				M			H
CO3	L	M					H	H	
CO4		L		M		H			H
CO5		L		M		H		H	
CO6	L		M		H	M			

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XII - Fluid Dynamics	**4**	**6**	**0**	**0**	**Theory**

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

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 :

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:

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:

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:

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:

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 book:

1.L.M. Milne Thomson, "Theoretical Hydro Dynamics" McMillan Company, 5th Edition (1968).

2.N. Curle aand H.J. Davies, D Van Nostrand "Modern Fluid Dynamics – (Volume I) "
Company Limited., London (1968).

Contents:

Text book 1: Units I and II
Chapter I: Sections 1.0 – 1.3.
Chapter III: Sections 3.10 – 3.53 (omit 3.32, 3.44)
Text book 2: Units III, IV and V
Chapter III: Sections 3.1 – 3.7.5
Chapter V: Sections 5.1 – 5.5.5
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.Chanth &co 2003 edition

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L		M				H	
CO2	L		M			M			H
CO3	L	M					H	H	
CO4	L			M			H		
CO5		L		M		H		H	
CO6	L		M		H				H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XIII - Operations Research	**4**	**6**	**0**	**0**	**Theory**

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

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 :

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:

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

UNIT III:

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:

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

UNIT V:

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, omit 2.2.3 and 2.3.3.
Chapter 3: 3.1 –3.5 omits 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, omit 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, Macmillion, New York, 1990.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M			H
CO3		L		M		H	H		
CO4	L			H	M	H		H	
CO5		L		M			M	H	
CO6	L		M		H				H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XIV - Mathematical Statistics	**4**	**6**	**0**	**0**	**Theory**

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

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 :

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

UNIT II:

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

UNIT III:

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

UNIT IV:

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:

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 (2007), New Delhi.
2.S.P.Gupta, "Statistical Methods", Sultan chand & sons Educational publishers (2015), New Delhi.

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

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L		M				H	
CO2	L		H			M		H	
CO3		L		M		M	H		
CO4			L	H	M	H		H	
CO5		L		M			M		H
CO6	L		M		H				H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II-Control Theory	**4**	**6**	**0**	**0**	**Theory**

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

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 :
Observability: Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems

UNIT II:
Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – steering function – Nonlinear systems

UNIT III:
Stability: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems

UNIT IV:
Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback

UNIT V:
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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L		M				H	
CO2	L		H			M		H	
CO3		L		M	H	M			
CO4			L		M		H	H	
CO5		L		M		H	M		H
CO6	L		M		H				H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II - Differential Geometry	**4**	**6**	**0**	**0**	**Theory**

Introduction: This paper provides knowledge about basic concepts from differential geometry, emphasizing calculation methods and illustrating their utility by drawing examples from physics.

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 :

Curves: Analytic representation - Arc Length – Osculation plane.

UNIT II:

Curvature torsion – Formulas of Ferret - Contact – Natural equations – Helices – General solutions of Natural equations.

UNIT III:

Evolutes and Involutes - Elementary theory of surface: Analytic representation.

UNIT IV:

First fundamental form – Normal, Tangent plane – Developable surfaces - Second fundamental form.

UNIT V:

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.(Unit I to V)

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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M		H	
CO3		L				M	H		H
CO4		L		M			H		
CO5		L			M		M	H	H
CO6	L		M		H				H

SEMESTER III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective II-Probability Theory	**4**	**6**	**0**	**0**	**Theory**

Introduction: This paper provides knowledge about the building blocks of probability theory that are necessary to understand statistical inference.

Course Outcome:

CO1	:	Recall the basic concept of Probability and its axioms.
CO2	:	Understand the concept of independence and strong convergence.
CO3	:	Apply Law of large numbers and also random walk.
CO4	:	Classify the conditional expectations and conditional probabilities.
CO5	:	Prove the Central Limit theorem.
CO6	:	Develop the knowledge of Probability Theory in diverse situations.

UNIT I:

Probability - Random Variables and Measurability Results, Expectations and the Lebesgue Theory, Image Measure and the Fundamental Theorem of Probability.

UNIT II:

Independence and strong convergence-independence – convergence concepts, series and inequalities.

UNIT III:

Law of Large Numbers, Applications to Empiric Distributions, Densities, Queuing and Random walk.

UNIT IV:

Conditional Expectation, Conditional Probabilities. Probability Distributions and Characteristic Functions - Distribution Functions and Selection - Principle – Characteristic Functions, Inversion, and Levy's Continuity Theorem

UNIT V:

Weak limit Laws – Classical Central Limit theorems.

Text Book:

1. M.M. Rao, "Probability Theory with Applications " Academic Press, 1984. (Unit I to V).

Reference Books:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York,1996.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L		M					H
CO2	L		M			M	H		
CO3		L				M	H		H
CO4		L		L		M		H	
CO5		L			M		H		
CO6	L		M		H				H

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Core XV- Fuzzy Logic and System	**4**	**5**	**0**	**0**	**Theory**

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

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:

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:

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:

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

UNIT IV:

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:

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 Book:

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

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M					H
CO2	L		L			M	H		
CO3		L			M			H	H
CO4		L		M		M		H	
CO5		L		M		M	H		H
CO6	L		L		M				H

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Latex and MATLAB Practical	**4**	**5**	**0**	**0**	**Theory**

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 Outcome:

CO1	:	Apply the basic operations in Latex.
CO2	:	Demonstrate the list and tables in Latex.
CO3	:	Experiment the Latex operations for splitting and displaying equations.
CO4	:	Analyze the concept of matrix operations in Matlab.
CO5	:	Determine eigen values of matrices by plotting curves.

1. Different Font Sizes in LATEX and Preparation of Title page in LATEX
2. Divide the Document With Sectioning Hierarchy of Book Environment in LATEX
3. Making Lists Using Itemize Environment in LATEX
4. Preparing Table in LATEX
5. Splitting The Equations in LATEX
6. Equation Using Left Cases in LATEX
7. To find the addition of two matrices, Transpose of a matrix and matrix multiplication in matlab
8. Finding the determinant of a matrix.
9. Plotting a function.
10. Polar plot.
11. Straight line fit.
12. Exponential curve fitting.
13. Finding Eigen values and Eigen vectors of a matrix.
14. Matrix Factorizations.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	L		M					H
CO2	L		L			M		H	
CO3		L		M					H
CO4		L			M	M		H	
CO5		L		L		M	H		H
CO6	L		M		M				H

SEMESTER IV

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

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

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	:	Evaluate 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 Functional's - 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M		H	
CO3		L	L				M		H
CO4	L	L			M	M		H	
CO5		L		M		M			H
CO6	L		M		H		H		H

SEMESTER IV

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

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

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:

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:

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:

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:

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:

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(Sec 2.1-2.4), Appendix A(A.2, A.2.1-A.2.4, A.3) & Chapter 3(Sec 3.1,3.2)
Unit II : Chapter 3 (Sec 3.3 - 3.8)
Unit III : Chapter 4 (Sec 4.1 - 4.4)
Unit IV : Chapter 4 (Sec 4.5 - 4.7) & Chapter 5 (Sec 5.1 - 5.4)
Unit V : Chapter 10 (Sec 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M		H	
CO3		L	L				M		H
CO4	L	L			M	M		H	
CO5		L		M		M			H
CO6	L		M		H		H		H

SEMESTER IV

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

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

Course Outcome:

CO1	:	Recall the basic concept of Numbers and need of Number theory.
CO2	:	Understand the concept of Mobius function.
CO3	:	Apply the concept of Chebyshev's functions and its connections.
CO4	:	Analyze the properties of congruences and also reduced residue system.
CO5	:	Compare the concept of Groups and sub groups.
CO6	:	Develop the knowledge of Number Theory in different situations.

Unit I:

Introduction, Divisibility, Greatest common divisor, Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of the primes, The Euclidean algorithm, The greatest common divisor of more than two numbers.

Unit II:

Introduction, The Mobius function μ(n) , The Euler totient function $\varphi(n)$, A relation connecting φ and μ, A product formula for $\varphi(n)$, The Dirichlet product of arithmetical functions, Dirichlet inverses and the Mobius inversion formula, The Mangoldt function Λ(n), Multiplicative functions, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function λ(n).

Unit III:

Introduction, Chebyshev's functions $\psi(x)$ and$\vartheta(x)$, Relations connecting $\vartheta(x)$and π(x), Some equivalent forms of the prime number theorem, Inequalities for π(n) and p_n, Shapiro's Tauberian theorem, Applications of Shapiro's theorem, An asymptotic formula for the partial sums $\sum_{P\leq x}(1/P)$, The partial sums of the Mobius function, Brief sketch of an elementary proof of the prime number theorem, Selberg's asymptotic formula.

Unit IV:

Definition and basic properties of congruences, Residue classes and complete residue systems JO9, Linear congruences, Reduced residue systems and the Euler-Fermat theorem, Polynomial congruences module p. Lagrange's theorem, Applications of Lagrange's theorem, Simultaneous linear congruences. The Chinese remainder theorem, Applications of the Chinese remainder theorem, Polynomial congruences with prime power moduli.

Unit V:

Definitions, Examples of groups and subgroups, Elementary properties of groups, Construction of subgroups, Characters of finite abelian groups, The character group, The orthogonality relations for characters, Dirichlet characters,Sums involving Dirichlet characters.

Text Book:

1.T.M. Apostol, Introduction to Analytic Number Theory, Springer Verlag, 1976.

Contents:

Unit I: Chapter1: Sections:1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8.

Unit II: Chapter 2: Sections:2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12.

Unit III: Chapter 4: Sections: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11.

Unit IV : Chapter 5: Sections: 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9.

Unit V : Chapter 6: Sections: 6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8,6.9.

Reference Books:

1. Ivan Nivan and Herberts Zucherman, " An Introduction to Theory of Numbers", Third Edition, 1972, Wiley Eastern Limited, New Delhi.

2.Kennath and Rosan, "Elementary Number Theory and its Applications", Addison Wesley Publishing Company, 1968.

3.George E. Andrews, "Number Theory", Hindustan Publishing, New Delhi, 1989.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M		H	
CO3		L	L				M		H
CO4	L	L			M	M		H	
CO5		L		M		M			H
CO6	L		M		H		H		H

SEMESTER IV

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
	Elective III Operator Theory	**4**	**5**	**0**	**0**	**Theory**

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

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:

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:

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

Unit-III:

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

Unit-IV:

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:

Operators and Hilbert space -Adjont of an operators- Compactness of the adjoint operaors- 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								
	P01	**PO2**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**PO9**
CO1	L	M		M				H	
CO2	L		M			M		H	
CO3		L	L				M		H
CO4	L	L			M	M		H	
CO5		L		M		M			H
CO6	L		M		H		H		H