KALAIGNAR KARUNANIDHI GOVERNMENT ARTS COLLEGE FOR WOMEN

(Autonomous)

(Re-Accredited with B^{++} By NAAC)

PUDUKKOTTAI – 622 001.

DEPARTMENT OF MATHEMATICS

COURSE PATTERN & SYLLABI

2021 – 2022 ONWARDS

M.Sc., MATHEMATICS

KALAIGNAR KARUNANIDHI GOVERNMENT ARTSCOLLEGE FOR WOMEN (AUTONOMOUS), PUDUKKOTTAI – 622 001

M.Sc., MATHEMATICS COURSE PATTERN

2021- 2022 Onwards

Sem.	Subject Code	Title of the Course	Instruction Hours	Credits	Exam. Hours	CIA	SE	Total
I	21PMA01	Algebra	6	5	3	25	75	100
	21PMA02	Real Analysis	6	5	3	25	75	100
	21PMA03	Differential Equations	6	5	3	25	75	100
	21PMA04	Methods of Applied Mathematics	6	4	3	25	75	100
	21PMAE1	Elective Paper I	6	4	3	25	75	100
		TOTAL	**30**	**23**				**500**
II	21PMA05	Linear Algebra	6	5	3	25	75	100
	21PMA06	Real Mathematical Analysis	6	5	3	25	75	100
	21PMA07	Complex Analysis	6	5	3	25	75	100
	21PMA08P	Programming in PYTHON Practical	6	4	3	25	75	100
	21PMAE2	Elective Paper II	6	4	3	25	75	100
		TOTAL	**30**	**23**				**500**
	21PMASS1	Number Theory	-	-	3	-	100	
III	21PMA09	Topology	6	5	3	25	75	100
	21PMA10	Stochastic Processes	6	5	3	25	75	100
	21PMA11	Differential Geometry	6	5	3	25	75	100
	21PMA12	Functional Analysis	6	4	3	25	75	100
	21PMAE3	Elective Paper III	6	4	3	25	75	100
		TOTAL	**30**	**23**				**500**
	21PMASS2	Theory of fields	-	-	3	-	100	
IV	21PMA13	Measure Theory and Integration	5	5	3	25	75	100
	21PMA14	Optimization Techniques	5	4	3	25	75	100
	21PMAE4	Elective Paper IV	6	4	3	25	75	100
	21PMAE5	Elective Paper V	4	4	3	25	75	100
	21PMA15PR	Project(Including Library Reference 6 hours)	10	4				100
		TOTAL	**30**	**21**				**500**
			120	**90**				**2000**

COURSE PATTERN

M.Sc., Mathematics – CBCS

SEMESTER I

Sl.No.	Title of the Course	Hours/week	Credit	Ex. Hours	Max. Marks SE + CIA 75 + 25
1	Algebra	6	5	3	100
2	Real Analysis	6	5	3	100
3	Differential Equations	6	5	3	100
4	Methods of Applied Mathematics	6	4	3	100
5	Elective Paper I	6	4	3	100
	Total	**30**	**23**		**500**

SEMESTER II

	Title of the Course	Hours/week	Credit	Ex.Hours	Max. Marks SE + CIA 75 + 25
1	Linear Algebra	6	5	3	100
2	Real Mathematical Analysis	6	5	3	100
3	Complex Analysis	6	5	3	100
4	Programming in PYTHON Practical	6	4	3	100
5	Elective Paper II	6	4	3	100
	Total	**30**	**23**		**500**
6	Number Theory	-	-	3	100

SEMESTER III

Sl.No.	Title of the Course	Hours/week	Credit	Ex. Hours	Max. Marks SE + CIA 75 + 25
1	Topology	6	5	3	100
2	Stochastic Processes	6	5	3	100
3	Differential Geometry	6	5	3	100
4	Functional Analysis	6	4	3	100
5	Elective Paper IV	6	4	3	100
	Total	**30**	**23**		**500**
6	Theory of fields	-	-	3	100

SEMESTER IV

Sl.No.	Title of the Course	Hours/week	Credit	Ex.Hours	Max. Marks SE + CIA 75 + 25
1	Measure Theory and Integration	5	5	3	100
2	Optimization Techniques	5	4	3	100
3	Elective Paper IV	6	4	3	100
4	Elective Paper V	4	4	3	100
5	Project	10	4	-	100
	Total	**30**	**21**		**500**

OVERALL TOTAL SEMESTER WISE

Semester	No. of Courses	Marks	Credits
I	5	500	23
II	5	500	23
III	5	500	23
IV	5	500	21
	20	**2000**	**90**

OVERALL TOTAL COURSE WISE

Subject	No. of Courses	Credit/Course	Total Credits
Core Courses	10 4	5 4	50 16
Elective Courses	5	4	20
Project	1	4	4
Total	**20**		**90**

- 10 core courses credits. - 5
- 4 core courses credits - 4
- All Elective courses have equal credits - 4
- Elective courses offered byMathematics Department - 7
- Hours allotted for each course - 6
- No. of units in each course - 5
- Exam. Hours for each course - 3
- Maximum marks for each course–Ext. - 75
- Maximum marks for each course-CIA. - 25
- Total Marks - 2000

Title of Proposed Core Courses

M.Sc., Mathematics

List of Core Courses

Sl. No.	Code	SubjectCode	Title of The Course
1	CC-I	21PMA01	Algebra
2	CC - II	21PMA02	Real Analysis
3	CC – III	21PMA03	Differential Equations
4	CC - IV	21PMA04	Methods of Applied Mathematics
5	CC - V	21PMA05	Linear Algebra
6	CC - VI	21PMA06	Real Mathematical Analysis
7	CC – VII	21PMA07	Complex Analysis
8	CC – VIII	21PMA08	Programming in PYTHON Practical
9	CC – IX	21PMA09	Topology
10	CC – X	21PMA10	Stochastic Processes
11	CC – XI	21PMA11	Differential Geometry
12	CC - XII	21PMA12	Functional Analysis
13	CC - XIII	21PMA13	Measure Theory and Integration
14	CC - XIV	21PMA14	Optimization Techniques

List of Elective Courses (Any Five)

Sl. No.	Code	Subject Code	Title of The Paper
1	ELC – I	21PMAE1	Number theory and Cryptography
2	ELC - II	21PMAE2	Mathematical Probability and Statistics
3	ELC –III	21PMAE3	Graph Theory
4	ELC –IV	21PMAE4	Fuzzy Mathematics
5	ELC - V	21PMAE5	Fluid Dynamics
6	ELC - VI	21PMAE6	Advanced Numerical Analysis
7	ELC - VII	21PMAE7	Transform Theory on Function Spaces

Extra Core Courses

Sl. No.	Code	Subject code	Title of the Paper
1	CC- XV	21PMA15	Fixed Point Theory
2	CC- XVI	21PMA16	Non Linear Differential Equations
3	CC- XVII	21PMA17	Fundamentals of Domination in Graphs

Self Study Courses

Sl. No.	Code	Subject Code	Title of the Paper
1	SS1	21PMASS1	Number Theory
2	SS2	21PMASS2	Theory of fields
3	SS3	21PMASS3	MATLAB Theory

QUESTION PAPER PATTERN – M.Sc., Mathematics

THEORY (Except Core Course VIII)

Part	**Type**	**Qn. No.**	**Unit**	**Marks for each Qn.**	**Total Marks**
A	Answer All the Questions	1 & 2	I	2	20
		3 & 4	II		
		5 & 6	III		
		7 & 8	IV		
		9 & 10	V		
B	Internal Choice – Answer All the Questions	11a / 11b	I	5	25
		12a / 12b	II		
		13a / 13b	III		
		14a / 14b	IV		
		15a / 15b	V		
C	Answer any Three Questions	16	I	10	30
		17	II		
		18	III		
		19	IV		
		20	V		
	External Marks CIA				75 25
	Max. Marks				100

CONTINUOUS INTERNAL ASSESSMENT PATTERN - P.G.

Theory Paper (Except Core Course VIII)

Exam.	Max. Marks	Converted to
Mid Sem.	40	5
End Sem.	40	5
Model	75	5
Seminar	5	5
Assign.	5	5
Total		**25**

Programming in Phython Practical Core Course VIII

External : 60 Marks (Performance in Practical: 50 Marks, Viva: 10 Marks)

CIA : 40 Marks (Model Exam: 30, Class Performance: 10 Marks)

Passing minimum:

PG:

Semester Exam. : 37.5 Marks (50% of Max. Marks 75)

CIA : 12.5 Marks (50% of Max. Marks 25)

Total : 50 Marks

M.Sc., MATHEMATICS

2021– 2022onwards

Sub.Code:21PMA01

Semester: I **Hours/Week: 6 hrs**

CoreCourse: I **Credit: 5**

ALGEBRA

Course Objectives

The objective of this programme is

CO-1	To understand the group, normal subgroups and quotient groups.
CO-2	To learn the concept the Cayley's theorem.
CO-3	To determine the sylow's theorem and their applications
CO-4	To find the concepts and properties of ring theory.
CO-5	To apply the concept Euclidean and polynomial rings.

UNITI

Group Theory

1.1 Definition of a Group
1.2 Some Examples of Groups
1.3 Some Preliminary Lemmas and Subgroups
1.4 A counting Principle
1.5 Normal Subgroups and Quotient Groups

UNITII

GroupTheory

2.1 Homomorphism
2.2 Automorphism.
2.3 Cayley's Theorem
2.4 Permutation Groups

UNITIII

GroupTheory

3.1 Another Counting Principle
3.2 Sylow's Theorem.
3.3 Direct Products
3.4 Finite Abelian groups

UNITIV

Ring Theory

4.1 Definition and Examples of Rings
4.2 Some Special Classes of Rings
4.3 Homomorphisms - Ideals and Quotient Rings
4.4 More Ideals and Quotient Rings
4.5 The Field of Quotients of an Integral Domain

UNITV

Ring Theory

5.1 Euclidean Rings
5.2Polynomial Rings
5.3 Polynomials over the Rational Field
5.4 Polynomial Rings over Commutative Rings

TEXTBOOK:

1. Topics in Algebra, I. N. Herstein,2nd Edition,Wiley India Pvt.Ltd.Reprint 2016.
UNIT I : Chapter 2: 2.1 - 2.6.
UNIT II : Chapter 2: 2.7- 2.10.
UNIT III : Chapter3: 2.11 - 2.14.
UNIT IV : Chapter3: 3.1 - 3.6.
UNIT V : Chapter3: 3.7, 3.9-3.11.

REFERENCES BOOKS:

1. Modern Algebra,Surjeet Singh and Qazi Zameerudin,Vikas Publishing House Pvt. Ltd.,1986.
2. A First Course in Abstract Algebra, John B. Fraleigh, AddisonWesley Publishing Company

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the concept of importance of algebaric properties of groups.	K3
CO2	Develope the group structure to finite permutations groups(Cayley's theorem)	K3
CO3	Analyze the concepts of solvability of groups	K4
CO4	Compare ring theory given specific conditions	K5
CO5	Solve the polynomial rings	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code:21PMA02

Semester: I **Hours/Week :6**

Core Course:II **Credit:5**

REAL ANALYSIS

Course Objectives

The objective of this programme is

CO-1	To understand the concepts of The Real and Complex Number Systems in detail.
CO-2	To provide the deep knowledge about Basic Topology.
CO-3	To determine the concept of Numerical Sequences and Series
CO-4	To find theconcept of continuity, compactness and connectedness.
CO-5	To apply the concept of Differentiationand Taylors theorem.

UNIT I

The Real and Complex Number Systems:

1.1 Introduction
1.2 Ordered sets
1.3 Fields and the real field
1.4 The extended real number system
1.5 The complex field and euclidean spaces

UNIT II

Basic Topology:

2.1Finite, Countable and Uncountable sets
2.2 Metric spaces
2.3 Compact sets
2.4 Perfect sets
2.5 Connected sets

UNIT III

Numerical Sequences and Series:

3.1 Convergent sequences, subsequences and cauchy sequences
3.2 Upper and lower limits, some special sequences and series
3.3The number e and the root and ratio tests
3.4 Power series, summation by parts and absolute convergence
3.5 Addition and multiplication of series and rearrangements

UNIT IV

Continuity:

4.1 Limits of functions
4.2 Continuous functions, continuity and compactness
4.3 Continuity and connectedness
4.4 Monotonic functions
4.5 Infinite limits and limits at infinity

UNIT V

Differentiation:

5.1 The derivative of a real function
5.2 Mean value theorems and the continuity of derivatives
5.3 L'Hospital' rule and derivatives of higher order
5.4 Taylor's theorem
5.5 Differentiation of vector valued functions

TEXT BOOK:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw – Hill International Book Company, Singapore, (1982).

UNIT I : Chapter 1
UNIT II : Chapter 2
UNIT III: Chapter 3
UNIT IV: Chapter 4
UNIT V : Chapter 5

REFERENCE BOOKS:

1. Tom Apostol, Mathematical Analysis, Addison Wesley Publishing Company, London-1971.
2. R. G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, New York, 1982.
3. Kenneth A. Ross, Elementary Analysis: The theory of Calculus, Springer, NewYork, 2004.
4. K. R. Stromberg, An Introduction to Classical Real Analysis, Wadsworth, 1981.
5. G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw – Hill,New Delhi, 2004.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the concept of real and complex number systems	K3
CO2	Classify the concept of analysis of Basic Topology	K3
CO3	Compare the concepts of limits ,continuity, differetiability integrability of real functions and topology on real numbers	K4
CO4	Importance the results of limits continuity, differetiability integrability of real functions and topology on real numbers	K5
CO5	Adapt ideas and techniques in multidisciplines by utilizing the theory and applications of real analysis	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code:21PMA03

Semester: I **Hours/Week :6**

Core Course: III **Credit:5**

DIFFERENTIAL EQUATIONS

Course Objectives

The objective of this programme is

CO-1	To understand the main purpose of the course is to introduce of second order linear equations.
CO-2	To provide the concept of Power Series Solution and special
CO-3	To determine the concept of the Existence and Uniqueness
CO-4	To apply the method of first order PDE
CO-5	To apply the concept mathematical models of physical or engineering processes.

UNIT I

Second Order Linear Equations

1.1 The general solution of the homogeneous equation
1.2 The use of known solution to find another
1.3 The method of undermined co-efficients
1.4 The method of variation of parameters

UNIT II

Power Series Solution and special functions

2.1 Ordinary points and Regular Singular points
2.2 Regular singular points(continued) and Gauss's hypergeometric equation

Some Special functions of Mathematical Physics:

2.3 Legendre polynomial and properties of legendre polynomials
2.4 Bessel functions and the gamma function
2.5 Properties of Bessel functions

UNIT III

Systems of First Order Equations

3.1 Homogeneous linear System with constant coefficients

The existence and uniqueness solutions

3.2 The method of successive approximations
3.3 Picard's theorem

UNIT IV

Partial Differential Equations of the First Order

4.1 Linear equations of the first order
4.2 Integral Surfaces passing through a given curve
4.3 Surfaces orthogonal to a given system of surfaces
4.4 Non-linear PDE of first order

UNIT V

Partial Differential Equations of the First Order (Contd.)

5.1 Compatible system of first order equations
5.2 Charpit's method
5.3 Special types of first order equations
5.4 Jacobi's method

TEXT BOOKS:

1. Differential Equations with Applications and Historical Notes, George .F. Simmons – Tata McGraw-Hill Publishing Company Limited, New Delhi, 25th Reprint 2001. (UNIT I, II & III)
2. Elements of Partial Differential Equations - IAN Sneddon – McGraw Hill Book Company (1988) (UNIT IV&V)

UNIT I : Chapter 3: 3.15, 3.16, 3.18 & 3.19
UNIT II: Chapter 5: 5.28 to 5.30
Chapter 6: 6.32 to 6.35
UNIT III: Chapter 7: 7.38
Chapter 11: 11.55, 11.56
UNIT IV: Chapter 2: Sections 4 to 7
UNIT V : Chapter 2: Sections 9 to 11 &13

REFERENCE BOOKS:

1. An Elementary Course in Partial Differential Equations – T. Amarnath – Narosa Publishing House, Chennai, 1997
2. An Introduction to Ordinary Differential Eqautions – E.A. Coddington - Prentice – Hall of India Pvt. Ltd., New Delhi, 1994

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Construct Second Order Linear Equations using the methods of known solution to find another,undermined co-efficient and variation of parameters	K3
CO2	Classify the power series solution for special ODE functions	K3
CO3	Analyzed the concept of the Existence and Uniqueness Theorem and its ramifications	K4
CO4	Determined surfaces solution for given PDE functions and its orthogonal surfaces	K5
CO5	Solve the solutions of first order PDE using by some methods.	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code:21PMA04

Semester: I **Hours/Week :6**

Core Course: IV **Credit:4**

METHODS OF APPLIED MATHEMATICS

Course Objectives

The objective of this programme is

CO-1	To understand the Functional with problems fundamentals of integral equations and differential
CO-2	To provide the deep knowledge about integral equation.
CO-3	To determine the solution for the integral equation by some methods.
CO-4	To apply the some important concept Fourier Transforms
CO-5	To apply the concept integral transforms, integral equations and calculus ofvariations as tools for problem solving.

UNIT I

Calculus of Variations

1.1 Functionals, Strong and Weak Variations and the variational notation and the first variation

1.2 Commutative character of the operators δ and d/dx and the Simplest variational Problem and the Euler Equation and commutative character of the operations of variation and integration

1.3 Theorems, other form of Euler's Equation and Solutions of Euler's Equation and Geodesics

1.4 Variational Problems involving several unknown functions and functional dependent on higher order derivatives

1.5 Variational problems involving several independent variables

UNIT II

Integral Equations

2.1 Introductionand Relation between differential and integral equations

2.2 Relationship between Linear differential equations & Volterra integral equations

2.3 Alternative procedure to establish the relationship between differential equation andVolterra integral equations

1.4 The Green's function and its use in reducing boundary value problems to integral equations

1.5 Fredholm equations with separable kernels

UNIT III

Integral Equations (Contd.)

3.1 Fredholm equations with symmetric kernels: Hilbert Schmidt Theory

3.2 Hilbert Schmidt Method

3.3 Iterative methods for the solution of integral equations of the second kind

3.4 The Neumann Series

3.5 Orthogonal kernels

UNIT IV

FourierTransforms

4.1Dirichlet's Conditions, FourierSeries, Fourier Integral Formula and Fourier Transforms or complex Fourier Transform

4.2 Inversion theorem complex Fourier Transform, Fourier Sine Transform, Inversion formula for Fourier Sine Transform, Fourier Cosine Transform and Inversion formula for Fourier Cosine Transform

4.3 Linearity Properties of Fourier Transforms, Change of scale Property and Shifting Property

4.4 Convolution and Convolution for Fourier Transforms

4.5 Parseval's Identity for Transforms and Fourier Transforms of the derivatives of the function

UNIT V

Hankel Transforms

5.1 Hankel Transform (Definition) and Inverse Formula for the Hankel Transform

5.2 Some important results for Bessel function

5.3 Linearity Properity

5.4 Hankel Transform of the derivatives of a function and Hankel Transform of differential operators

5.5 Parseval's Theoerm

TEXT BOOKS:

1. Higher Mathematics for Engineering and Science,M.K. Venkataraman, The National Publishing Company, Madras, Revised and enlarged fourth Edition. Reprinted December 2001(For Units I to III).
2. Integral Transforms, A. R. Vasistha,R.K. Gupta,Krishna Prakashan Mandir Pvt. Ltd. India, 2002 (For Unit IV &V).

UNIT I : Chapter 9: Section 1 to 13 (Text Book1)
UNIT II: Chapter 10: Section 1 to 6 (Text Book1)
UNIT III: Chapter 10: Section 7 to 11 (Text Book1)
UNIT IV: Chapter 6: Section 6.1to 6.21(Text Book2)
UNIT V: Chapter 9: Section 9.1to 9.7 (Text Book2)

REFERENCE BOOKS:

1. Methods of Applied Mathematics,Francis B. Hildebrand, Prentice Hall of India Pvt. Ltd., New Delhi (1968), SecondEdition
2. The Use of Integral Transforms,IAN N. Sneddon, (For UnitV).

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify the externals and functional Euler equations Understand the basic properties of Fourier and Hankel transforms	K3
CO2	Analysis the classical Fredholm theory solve the differential and integral equations	K3
CO3	Evaluate the extrenals of functionals apply the acquried knowledge in solving applied Problems.	K4
CO4	Calculate the knowledge of Fourier transforms	K5
CO5	To adapt the Hankel transforms	K6

M.Sc., Mathematics

2021 – 2022 Onwards

Sub. Code:21PMA05

Semester:II **Hours/Week :6**

Core Course: V **Credit:4**

LINEAR ALGEBRA

Course Objectives

The objective of this programme is

CO-1	To understand the concepts of vector spaces such as independence, basis, dimensions, orthogonality.
CO-2	To provide the important concepts of vector spaces such as independence, basis, dimensions, orthogonality CO3
CO-3	To undersand the concept of extension field, roots of polynomia and the concept of Galois thery and finite field.
CO-4	To understand the concept of algebra linear transformation. Important concept of canonical forms such as nilpotent, Hermitian, unitary and normal transformations.
CO-5	To recognized the conceptTrace and Transpose and determinants

UNIT I

Vector Spaces

1.1 Elementary Basic Concepts
1.2 Linear Independence and Bases
1.3 Dual Spaces
1.4 Inner Product Spaces

UNIT II

Fields

2.1 Extension Fields
2.2 Roots of Polynomials
2.3 Construction with Straightedge and Compass
2.4 More about Roots

UNIT III

Fields

3.1The Elements of Galois Theory
3.2 Solvability by Radicals
3.3 Finite Fields
3.4 Wedderburn's Theorem on finite division rings.

UNIT IV

Linear Transformations

4.1The Algebra of Linear Transformations
4.2 Characteristic Roots
4.3 Matrices
4.4 Canonical Forms: Triangular Form
4.5 Canonical Forms: Nilpotent Transformations.

UNITV

Linear Transformations

5.1 Canonical Forms: A Decomposition of V: Jordon form
5.2 Trace and Transpose
5.3 Determinants
5.4 Hermitian, Unitary and Normal Transformations
5.5 Real Quadratic form.

TEXT BOOKS:

Topics in Algebra, I. N. Herstein, 2nd Edition, Wiley India (P) Ltd.Reprint 2016, NewDelhi.

UNIT I: Chapter 4: 4.1 to4.4
UNIT II: Chapter 5: 5.1, 5.3. - 5.5.
UNIT III: Chapter 5: 5.6. - 5.7, 7.1, 7.2
UNIT IV: Chapter 6: 6.1 - 6.5
UNIT V: Chapter 6: 6.6, 6.8 - 6.11

REFERENCE BOOKS:

1. A First Course in Abstract Algebra, John B.Fraleigh, Addison WesleyPublishing Company.
2. A Course in Abstract Algebra, Vijay, K. Khanna and S.K.Bhambri, Vikas Publishing House Pvt. Limited, 1993.
3. Algebra, Serge Lang, Springer International Edition, Revised Third Edition,2002.
4. S.Kumaresan, “Linear Algebra” Prentoice Hall of India Pvt Ltd.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Develop the theory of vector spaces and fields	K3
CO2	Classify the roots of polynomial in extension field	K4
CO3	Compare the relation between the roots of polynomial and Galois group.	K4
CO4	Evaluate the characteristic roots of algebra linear transformation	K5
CO5	Create the canonical form of linear transformation.	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code : 21PMA06

Semester:II **Hours/Week : 6**

Core Course: VI **Credit : 5**

REAL MATHEMATICAL ANALYSIS

Course Objectives

The objective of this programme is

CO-1	To understand the concepts of The Riemann-Stieltjes integration of real-valued functions..
CO-2	To provide the uniform convergence, continuity, differentiation and integration
CO-3	To undersand the Stone-Weierstrass theorem, The exponential and Logarithmic functions
CO-4	To understand\ the concept contraction principle and the inverse function theorem.
CO-5	To recognizedthe implicitfunction theorem and the rank theorem of real valued functions

UNIT I

The Riemann-Stieltjes integral:

1.1Definition and existence of the integral
1.2 Properties of the integral
1.3 Integration and differentiation
1.4 Integration of vector valued functions
1.5 Rectifiable curves.

UNIT II

Sequences and series of functions:

2.1 Discussion of Main problem
2.2 Uniform Convergence , Uniform convergence and continuity
2.3 Uniform convergence and Integration, Uniform convergence and differentiation
2.4 Equicontinuous families of functions

UNIT III

Sequences and series of functions:

3.1 The Stone-Weierstrass theorem.

Some special functions:

3.2 Power series
3.3 The exponential and Logarithmic functions

UNIT IV

Functions of several variables:
4.1 Linear transformations
4.2 Differentiation
4.3 The contraction principle
4.4 The inverse function theorem.

UNIT V

Functions of several variables:
5.1The implicitfunction theorem
5.2 The rank theorem
5.3 Determinants
5.4 Derivatives of higher order
5.5 Differentiation of integrals.

TEXT BOOK:

Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw – Hill International Book Company, Singapore, 1982.

UNIT 1: Chapter 6
UNIT 2: Chapter 7 section 7.1 to 7.25
UNIT 3: Chapter 7 section 7.26 to 7.33
Chapter 8 section 8.1 to 8.6
UNIT 4: Chapter 9 section 9.1 to9.25
UNIT 5: Chapter 9 section 9.26 to9.43.

REFERENCES BOOKS:

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, India, 1997.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, 3rd Ed., McGraw- Hill, New Delhi, 2004.
3. S. C. Malik, Mathematical Analysis, Willey Eastern Ltd., New Delhi, 1985.
4. N. L. Carothers, Real Analysis, Cambridge University Press, UK, 2000

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the Riemann- stieltjes integration for rectifiable curve.	K3
CO2	Classify some real valued functions into convergent and uniform convergent.	K4
CO3	Motive the concept of The Stone-Weierstrass theorem and Power series	K4
CO4	Explain the concept of Differentiation and The contraction principle.	K5
CO5	Create the implicity function theorem and the rank theorem of real valued functions.	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code : 21PMA07

Semester:II **Hours/Week : 6**

Core Course: VII **Credit : 5**

COMPLEX ANALYSIS

Course Objectives

The objective of this programme is

CO-1	To understand the various concepts about the, analytic functions in the complex plane.
CO-2	To provide the deep knowledge about mapping.
CO-3	To understand the concept complex integral calculus
CO-4	To understandthe applications of Cauchy's theorem
CO-5	To recognizedthe applications of Singularities andresidues

UNIT I

Elementary Properties of AnalyticFunctions

1.1 Introduction to the Concept of an Analytic Function
1.2 Power Series
1.3 Linear Fractional Transformations
1.4 Exponential and Trigonometric Functions.

UNITII

Conformal Mappings

2.1 Definition and Properties of Conformal Mappings
2.2 Elementary Conformal Mappings.

UNITIII

Complex Integral Calculus

3.1 Basic Definition and Properties of Complex Integration
3.2 Cauchy's Theorems.

UNITIV

Complex Integral Calculus

4.1 General Form of Cauchy's Theorem
4.2 Cauchy's Integral Formula and its Applications.

UNITV

Complex Integral Calculus

5.1 Singularities
5.2 Calculus of Residues.

TEXT BOOK: Complex Analysis (Second Edition), V. Karunakaran, Narosa Publishing House, New Delhi,2005.

UNIT I: Chapter 2: 2.1 – 2.4

UNIT II: Chapter 3: 3.1 ,3.2
UNIT III: Chapter 4: 4.1 ,4.2
UNIT IV: Chapter4: 4.3,4.4
UNIT V: Chapter 4: 4.5,4.6

REFERENCE BOOKS:

1. Complex Analysis, Lars V. Ahlfors, McGraw Hill International Edition (1979) , ThirdEdition
2. The Elements of Complex Analysis, B. Choudhary, New Age International(P) Limited, Publishers, New Delhi, 1992.
3. Mathematical Analysis, Tom P. Apostol, Narosa Publishing House, New Delhi,1985.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the concept of an anlytic function ,power series and exponentional and trigonometric functions	**K3**
CO2	Analysis the Conformal Mapping	**K4**
CO3	Evaluate integrals along a path in the complex plane and explain the Cauchy's Theorem	**K4**
CO4	Interpret the Cauchy's integral formula and its applications	**K5**
CO5	To adapt singularities and solutions of complex integrals using the residues	**K6**

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code : 21PMA08P

Semester:II **Hours/Week : 6**

Core Course: VIII **Credit : 4**

PROGRAMMING IN PYTHON PRACTICALS

Course Objectives

The objective of this programme is

CO-1	To understand the basics of algorithmic problemsolving.
CO-2	To read and write simple Python programs
CO-3	To undersand the Python programs with conditionals,loops and Python functions.
CO-4	To understand the Python data structures – lists, tuples.
CO-5	To recognizedthe input/output with files in Python.

UNIT I:

Algorithmic Problem Solving and Data Expressions and Statements

UNIT II:

Python Input and Output Statements

UNIT III:

Control Flow, Functions

UNIT IV:

Lists, Tuples, Dictionaries

UNIT V:

Files, Modules, Packages

TEXT BOOK : "Problem solving and Python Programming", S A Kulkarni, yesdee publishing Pvt. Ltd., First Published 2017.

UNIT I:Chapter 1,2
UNIT II: Chapter 3
UNIT III: Chapter 4
UNIT IV: Chapter 5
UNIT V: Chapter 6

REFERENCE BOOK: "Core Python Programming",Wesley J. Chun,Prentice Hall India – Second Edition.

Laboratory Exercise:

1. Write a program to create a bio-data form.
2. Write a program using five operators.
3. Write a program to compute the area of trapezium.
4. Write a user-defined function in Python to check whether the given number is prime or not.
5. Write a Python program to compute to calculate and print the sum of the series.
6. Write a Python program to compute Gregory series for calculating the value of π.
7. Write a Python program to compute the sum and average of numbers from 0 up to n.
8. Write a Python program to generate the Tribonacci sequence for n numbers.
9. Write a Python program to generate the perfect numbers up to a max range.
10. Write a Python program to compute Highest Common Factor of two numbers.
11. Write a Python program to generate Lucas sequence of N numbers.
12. Write a user-defined Python function permute (x,y) which returns the numbers of different permutations of y items taken from a set of x items.
13. Write a user-defined Python function combination (x,y) which returns the number of different unordered combination of y items taken from a set of x items.
14. Write a Python program to convert all the principle diagonal elements to 1's.
15. Write a Python program to check whether a given matrix is a symmetric matrix.
16. Write a Python program to display the given name in reverse order with space between them.
17. Write a Python program using string function.
18. Write a Histogram program using loops.
19. Write a Python program to generate Fibonacci series of N terms .
20. Write a Python program to transpose a matrix using nesting loop.
21. Write a Python program to generate matrix multiplication.
22. Write a Python program to compute percentage and class of a student.
23. Write a Python program to compute quadratic equations.
24. Write a Python program to compute mean, variance and standard deviation of a list of numbers.
25. Write a Python program to perform a linear search on a list.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Develop algorithmic solutions to simple computational problems	K3
CO2	Analysis Read, write, execute by hand simple python programs.	K4
CO3	Structure simple Python programs for solving problems.	K4
CO4	Interpret decompose a python program into functions.	K5
CO5	Read and write data from/to files in Python programs.	K6

M.Sc., Mathematics
2021 – 2022 Onwards

Sub. Code : 21PMA09

Semester:III **Hours/Week : 6**

Core Course: IX **Credit :5**

TOPOLOGY

Course Objectives

The objective of this programme is

CO-1	To understand the basics of algorithmic problemsolving.
CO-2	To read and write simple Python programs
CO-3	To understand the Python programs with conditionals,loops and Python functions.
CO-4	To understand the Python data structures – lists, tuples.
CO-5	To recognizedthe input/output with files in Python.

UNIT I

Topological Spaces:

1.1 Topological spaces
1.2 Basis for a topology andthe order topology
1.3 The product topology on X×Y
1.4 The subspace topology
1.5 Closed sets and limit points.

UNIT II

Continuous Functions :

2.1 Continuous functions
2.2 The product topology
2.3 The metric topology
2.4metric topology (continued).

UNIT III

Connectedness:

3.1 Connected spaces
3.2 connected subspaces of the Real line
3.3 Components and local connectedness.

UNIT IV

Compactness:

4.1 Compact spaces
4.2 Compact subspaces of the Real line
4.3 Limit Point Compactness
4.4 Local Compactness.

UNIT V

Countability And Separation Axioms

5.1 The Countability Axioms
5.2 The separation Axioms
5.3 Normal spaces and the UrysohnLemma (Statement only)- Completely Regular Spaces.
5.4 The Urysohn Metrization Theorem
5.5 Tietz Extension Theorem (Statement only)

TEXT BOOK

1. Topology (2^{nd} Edition) , James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi , 2007.

UNIT I : Chapter 2: Section 12 to 17
UNIT II : Chapter 2: Section 18 to 21
UNITIII : Chapter 3 : Section 23 to 25
UNIT IV : Chapter 3: Section 26 to 29
UNIT V : Chapter 4: Section 30 to 34& 35.

REFERENCE BOOK

1. Topology, J.Dugundji, Prentice Hall of India, New Delhi, 1975.
2. Introduction to Topology and Modern Analysis, George F.Simmons, McGraw Hill Book Co., 1963

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	To develop about several constructions of topological spaces	**K3**
CO2	To survey constructed various topologies on sets and compare them.	**K4**
CO3	To agree of basis to generate topology and justified connectedness In topological spaces.	**K5**
CO4	To compare nature of compact topological spaces on real line.	**K5**
CO5	To adapt the categories separation axioms on different topological spaces.	**K6**

M.Sc. Mathematics
2021 – 2022 onwards

Semester:	**III**	**Sub. Code :**	**21PMA10**
Core Course:	**X**	**Hours/Week :**	**6**
		Credit :	**5**

STOCHASTIC PROCESSES

Course Objectives

The objective of this programme is

CO1	Explain the Stochastic Processes.
CO2	Discuss the theory ofMarkov Chains system and Determination of Higher Transition Probabilities.
CO3	To Know the concept of Markov Processes with Discrete State Space.
CO4	Develop Stochastic Renewal Processes in their respective field of interest.
CO5	Analyze the Stochastic Processes in Queuing and Reliability.

UNIT I

Stochastic Processes:

1.1Some Notions: Specification of Stochastic Processes

1.2 Stationary Processes

Markov Chains:

1.3 Definitions and Examples

1.4 Higher Transition Probabilities

1.5 Generalization of Independent Bernoulli Trials: Sequence of Chain Dependent Trials

UNIT II

Markov Chains:

2.1 Classification of States and Chains

2.2 Determination of Higher Transition Probabilities

2.3 Stability of a Markov system

2.4 Graph Theoretic Approach

UNIT III

Markov Processes with Discrete State Space: Poisson Process and its Extensions

3.1 Poisson Process

3.2 Poisson Process and Related Distributions

3.3 Generalizations of Poisson Process

3.4 Birth and Death Process.

UNIT IV

Renewal Processes and Theory

4.1 Renewal process
4.2 Renewal Processes in Continuous Time
4.3 Renewal Equation
4.4 Stopping Time: Wald's Equation
4.5 Renewal Theorems

UNIT V

Stochastic Processes in Queueing and Reliability:

5.1 Queueing Systems: General Concepts
5.2 The Queueing Model M/M/1: Steady state Behaviour
5.3 Transient Behaviour of M/M/1 Model
5.4 Birth and Death Processes in Queueing Theory: Multichannel Models

TEXT BOOKS:

1. J. MEDHI, Stochastic Processes Second Edition, New Age International pvt. Ltd., First Reprint 1996.
   UNIT I : Chapter 2: 2.1 - 2.3 , Chapter 3: 3.1 - 3.3
   UNIT II : Chapter 3: 3.4 - 3.7
   UNIT III : Chapter 4: 4.1 - 4.4
   UNIT IV : Chapter 6: 6.1 - 6.5
   UNIT V : Chapter 10: 10.1 - 10.4

REFERENCE BOOK

1. J.Medhi, Stochastic Processes. 2nd Edition Wiley Eastern Limited,1994
2. J. MEDHI, Stochastic Processes ,Third Edition, New Age International pvt. Ltd., 2015.
3. Samuel Karlin & Howard M.Taylor, A First and second course in Stochastic processes, Academic press, 1975.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the concept of Stochastic Processes.	**K3**
CO2	Develop the theory ofMarkov Chains system and Determination of Higher Transition Probabilities.	**K3**
CO3	Classify the concept of Markov Processes with Discrete State Space	**K4**
CO4	Evaluate Stochastic Renewal Processes in their respective field of interest.	**K5**
CO5	Develop the Stochastic Processes in Queueing and Reliability.	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

Semester: III | **Sub. Code : 21PMA11**
Core Course: XI | **Hours/Week : 6**
Credit : 5

DIFFERENTIAL GEOMETRY

Course Objectives

The objective of this programme is

CO1	To introduce space curves, surfaces and its applications.
CO2	To be able to understand the fundamental theorem for space curves.
CO3	To study the parametric curves on surfaces help us to study theproperties of surfaces.
CO4	To study the orthogonal trajectories and families of curves.
CO5	Important concept of geodesic equations and geodesic curvatures.

UNIT I

Theory of Space Curves

1.1 Introduction and Representation of Space Curves and Unique Parametric Representation of a space curve, Arc – length

1.2 Tangent and osculating plane, principal normal and binormal, Curvature and torsion and Behaviour of a curve near one of its points

1.3 The curvature and torsion of a curve as the intersection of two surfacesand Contact between curves and surfaces

1.4 Osculating circle and osculating sphere and Locus of centers of spherical curvature

1.5 Tangent surfaces, involutes and evolutes.

UNIT II

2.1 Bertrand Curves

2.2 Intrinsic equations of space curves

2.3 Fundamental Existence Theorem for space curves

2.4 Helices

2.5 Examples I.

UNIT III The First Fundamental form and Local Intrinsic Properties of a surface:

3.1 Introduction, Definition of a surface andNature of points on a surface

3.2 Representation of a surface and Curves on surfaces

3.3 Tangent Plane and surface normal

3.4 The general surfaces of revolution

3.5 Helicoids.

UNIT IV

4.1 Metric on a surface – The first fundamental form
4.2 Direction Coefficients on a surface
4.3 Families of curves and Orthogonal Trajectories
4.4 Double family of curves and Isometric correspondence
4.5 Intrinsic Properties and Examples II.

UNIT V

Geodesics on a surface:

5.1 Introduction, Geodesics and their differential equations and Canonical geodesic equations
5.2 Geodesics on surface of revolution, Normal property of geodesics and Differential equations of geodesics using normal property,
5.3 Existence Theorems and Geodesic parallels, Geodesics polar coordinates
5.4 Geodesic curvature and Gauss - Bonnet Theorem
5.5 Gaussian curvature and Surfaces of constant curvature.

TEXT BOOK:

1. Differential Geometry**,**A First Course, D.Somasundaram, Narosa Publishing House Chennai, Fourth Reprint 2010.

UNIT I : Chapter 1: Sec. 1. 1 -1.13
UNIT II : Chapter 1: Sec. 1.14 - 1.19
UNITIII : Chapter 2: Sec. 2.1 -2.8
UNIT IV : Chapter 2: Sec. 2.9 - 2.16
UNITV : Chapter 3: Sec. 3.1 -3.13

REFERENCE BOOKS:

1. T.J. Wilmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002, (Indian Print).
2. J.N.Sharma, A.R.Vasistha, Differential Geometry, KedarnathRam Nath, Meerut, 1998.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply the concept are length, tanget, normal, binormal, curvature and torsion	**K3**
CO2	Identify concept of local intrinsic properties of a surface, families of curves and isometric correspondence	**K3**
CO3	Examine canonical geotesic equations, Casuss Bonnet theorem and Gaussian Curvature	**K4**
CO4	Agree the concept of the second fundamental form and developables.	**K5**
CO5	Adapt the developables associated with curves on surfaces, Minimal surfaces, ruled surfaces and Paralled Surfaces.	**K6**

M.Sc., Mathematics

2021 – 2022 onwards

Semester: III **Sub. Code : 21PMA12**
Core Course: XII **Hours/Week : 6**
Credit : 4

FUNCTIONAL ANALYSIS

Course Objectives

The objective of this programme is

CO1	The possibility of studying linear transformations of one Banach space into another which have the additional property of being continuous.
CO2	Know about, when the two vectors are orthogonal in Hilbert spaces.
CO3	The advantage of the metric structure of such a space by focusing our attention on its operators.
CO4	To get the importance of theory of matrices in spectral theory.
CO5	To study a Banach algebra and variety of mathematical idea's from some theorem.

UNIT I

Algebras, Banach Spaces:

1.1 Banach Spaces ,The definition and some examples
1.2 Continuous linear transformation
1.3 The Hahn- Banach theorem
1.4 The open mappingtheorem.

UNIT II

Hilbert Spaces:

2.1 The definition and some simple properties
2.2 Orthogonal complements
2.3 Orthonormal sets
2.4 The Conjugate Space H*

UNITIII

Banach Spaces :

3.1The conjugate of an operator.

Hilbert Spaces:

3.2 The adjoint of an operator
3.3 Self -adjoint operators
3.4 Normal and unitaryoperators.

UNIT IV

Finite-Dimensional Spectral Theory:

4.1 Matrices
4.2 Determinants and the spectrum of an operator
4.3 The SpectralTheorem

UNITV

General Preliminaries on Banach Algebras:

5.1 The definition and someexamples
5.2 Regular and Singular elements
5.3 Topological divisors of zero
5.4 The spectrum
5.5 The formula for the spectral radius.

TEXT BOOK

1. Introduction to Topology and Modern Analysis, G.F.Simmons, McGraw – Hill International Ed. 2004. Sixth reprint 2006.

UNIT I : Chapter 8 : Section 45 only
Chapter 9 : Sections 46, 47, 48, 50
UNIT II : Chapter 10 : Sections 52 -55
UNIT III : Chapter 9 : Section 51
Chapter 10 : Sections 56 -58
UNIT IV : Chapter 11 : Sections 60 – 62
UNIT V : Chapter 12 : Sections 64 - 68

REFERENCE BOOKS

1. Functional Analysis, B.V.Limaye, Wiley Eastern Limited, Bombay, Second Print,1985.
2. Functional Analysis, K.Yosida, Springer – Verlag ,1974.
3. Functional Analysis, Laurent Schwarz, Courant Institute of Mathematical Sciences, New York University,1964.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Develop a Banach space, state and prove Hahn Banach theorem and open mapping theorem	**K3**
CO2	Apply the concept of Hilbert spaces and orthogonal	**K3**
CO3	Analyses the some importance of operators	**K4**
CO4	Agree the concept of Spectral theorem	**K5**
CO5	Discuss the Banach Algebras	**K6**

M.Sc. Mathematics

2021 – 2022 onwards

Semester: IV **Sub. Code : 21PMA13**

Core Course: XIII **Hours/Week : 5**

Credit : 5

MEASURE THEORY AND INTEGRATION

Course Objectives

The objective of this programme is

CO1	To introduce concepts of outer measures and integration on R.
CO2	Provide the relationship between Riemann and Lebesgue integrals
CO3	To introduce the concepts of measure and integral with respect to a measure, to show their basic properties, and to provide a basis for further studies
CO4	To learner will be studied in Measure theory & Integration such as Convergence in Measure
CO5	Learner will be derive integration and derivatives by using the product Measure and Fubini's theorem

UNIT I

Measure on the Real line

1.1 Lebesgue outer measure
1.2 Measurable sets
1.3 Regularity
1.4 Measurable functions
1.5 Borel and Lebesguemeasurability.

UNIT II

Integration of Functions of a Real Variable

2.1 Integration of non-negative functions
2.2 The General integral
2.3 Integration of series
2.4 Riemann and Lebesgue integrals.

UNIT III

Abstract Measure spaces

3.1 Measures and outer measures
3.2 Completion of a measure
3.3 Measure spaces
3.4 Integration with respect to a measure.

UNIT IV

Convergence

4.1 Convergence in Measure
4.2 Almost uniform convergence
4.3 Signed Measures and the Hahn Decompostion
4.4 The Jordan Decomposition

UNIT V

Measure and Integration in a Product Space

5.1 Measurability in a Productspace
5.2 The product Measure and Fubini's Theorem.

TEXT BOOKS:

1. G.De Barra, Ph.D., Measure Theory and Integration,New age international (P) Limited.

UNIT I : Chapter II : Sections 2.1 to2.5
UNIT II : Chapter III : Sections 3.1 to3.4
UNIT III : Chapter V : Sections 5.1,5.4 to5.6
UNIT IV : Chapter VII : Sections 7.1 and7.2,
Chapter VIII : Sections 8.1 and 8.2
UNIT V : Chapter X : Sections 10.1 and10.2

REFERENCE BOOKS:

1. Measure and Integration, by M.E. Munroe, Addison - Wesley Publishing Company, Second Edition,1971.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify the basic properties on sets in real line and measure on a real line, outer measure, measurable sets and measurable functions.	**K3**
CO2	Classify the Borel set and Lebegue measurability.	**K4**
CO3	Motive the signification of abstract measure space.	**K4**
CO4	Explain Hahn Decomposition and Jordan Decomposition.	**K5**
CO5	Improve radon Nikodym theorem and Fubini theorem.	**K6**

M.Sc. Mathematics

2021 – 2022 Onwards

Semester: IV	**Sub. Code : 21PMA14**
Core Course: XIV	**Hours/Week : 5**
	Credit : 4

OPTIMIZATION TECHNIQUES

Course Objectives:

The objective of this programme is

CO1	To impart knowledge in Integer Linear Programming.
CO2	Know the concept of Replacement and MaintenanceModels.
CO3	Analysis the concept of DynamicProgrammingand its applications.
CO4	Understand the concept of Classical Optimization Methods.
CO5	Performance measures of queues and optimal use of Inventory.

UNITI

Integer Linear Programming

1.1 Introduction and Types of Integer Programming Problems
1.2 Enumeration and Cutting Plane Solution Concept
1.3 Gomary's all integer cutting plane method
1.4 Gomary's mixed- integer cutting plane method
1.5 Branch and Bound method.

UNIT II

Replacement and MaintenanceModels

2.1 Introduction
2.2 Types of Failure
2.3 Replacement of items whose efficiency deteriorates with time
2.4 Replacement of items that completely fail
2.5 Other Replacement Problems.

UNIT III

DynamicProgramming

3.1 Introduction
3.2 Dynamic Programming Terminology
3.3 Developing Optimal Decision Policy
3.4 Dynamic programming under Certainty
3.5 Dynamic programming approach for solving Linear Programming problem.

UNIT IV

Classical Optimization Methods

4.1 Introduction
4.2 Unconstrained Optimization
4.3 Constrained Multivariable Optimization with Equality Constraints
4.4 Constrained Multivariable Optimization with Inequality Constraints.

UNIT V

Deterministic Inventory Models

5.1General inventory model

5.2 Static EOQ Models and Dynamic EOQ Models

Probabilistic Inventory Models

5.3 Continuous Review Models

5.4 Single-Period Models

5.5 Multiperiod Models.

TEXT BOOKS

1. Operations Research, Theory and Applications, J.K.Sharma, Macmillan Publishers India Limited. (Reprinted 2009), India. (For UNIT I, II, III and IV)
2. Operations Research, An introduction, Hamdy A. Taha (Sixth Edition), Prentice Hall of India Pvt. Ltd. New Delhi 2005.(UNIT V)

UNIT I :	Chapter 7:	7.1 to 7.6.
UNIT II :	Chapter 17:	17.1 to 17.5.
UNIT III:	Chapter 22:	22.1 to 22.5
UNIT IV:	Chapter 23:	23.1 to 23.4.
UNIT V :	Chapter 11:	11.1 to 11.4 & Chapter 16: 16.1 to 16.3

REFERENCE BOOKS

1. Operations Research, Kanti Swarup, P.K. Gupta and Man Mohan, Sultan Chand &Sons, New Delhi,1997
2. Operations Research, P.K. Gupta, D.S. Hira, S. Chand & Company Ltd. NewDelhi
3. Optimization Theory and Application, S.S. Rao (Second Edition) Wiley Eastern Limited, Dec.1977.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify integer programming problem and various methods of LPP.	**K3**
CO2	Classify the replacement and maintenance models .	**K4**
CO3	Motive thedynamic programming approach for solving Linear Programming problem.	**K4**
CO4	Classifications of unconstraint and constraint optimization	**K5**
CO5	Classifications of deterministic and probabilistic Inventory models.	**K6**

M.Sc. Mathematics
2021– 2022 Onwards

Core Course: XV

Sub. Code : 21PMA15
Hours/Week : 6
Credit : 5

FIXED POINT THEORY

Course Objectives

The objective of this programme is

CO1	To impart knowledge in Metric Contraction Principle.
CO2	Know the concept of Hyper Convex Spaces.
CO3	Analysis the concept of Normal Structures in Metric Spaces its
CO4	Understand the concept of Metric Fixed Point Theory.
CO5	Performance Fixed Point Theory in Banach Lattices.

UNIT I

Metric Contraction Principle

1.1 Banach's Contraction Principles and Extensions of Banach's Principle
1.2 The Caristi and Ekeland Principle
1.3 Equivalent of the Caristi
1.4 Ekeland Principle
1.5 Set valued Contractions and Generalised Contractions

UNIT II

Hyper ConvexSpaces

2.1Hyper Convexity
2.2 Properties of Hyper Convex Spaces and A Fixed Point Theorem
2.3 Intersection of Hyper Convex Spaces
2.4 Approximate fixed Points
2.5 Isbell's hyper convex hull

UNIT III

Normal Structures in Metric Spaces

3.1 A fixed point theorem and Structure of the fixed point set
3.2 Uniform normal Structure and Uniform relative normal structure
3.3 Quasi normal structure
3.4 Stability and normal Structure and Ultra metric spaces
3.5 Fixed point set structure and Separable case

UNIT IV

Metric Fixed PointTheory

4.1 Contraction mapping
4.2 Basic theorems for non and expansive mapping
4.3 A closer look at 11
4.4 The Goebel and Karlovitz Lemma
4.5 Orthogonal Convexity

UNIT V

Fixed Point Theory in BanachLattices:

5.1 Structure of the fixed Point set
5.2 Asmptotically regular mapping
5.3 Set valued mappings
5.4 Fixed point theory in Banach Lattices.

TEXT BOOKS:

1. An Introduction to Metric spaces and Fixed Point Theory, Mohamed A.Khasi and William A.Kirk, A.Wiley, Inter Science Publication John Wiley and Sons,Inc.1 Edition(2001).
2. Topology of Metric Spaces, S. Kumaresan, Narosa Publishing House, Mumbai, 2005.

UNIT I : Chapter 3: Sec. 3.1 - 3.6
UNIT II : Chapter 4: Sec. 4.2 - 4.7
UNIT III: Chapter 5: Sec. 5.1 - 5.8
UNIT IV: Chapter 8: Sec. 8.1 - 8.6
UNIT V : Chapter 8: Sec. 8.7 - 8.10

REFERENCE BOOKS:

1. Topics in metric fixed point theory – kazimierz Goebel W.A.Kirk Cambridge University1990.
2. Topics in metric fixed point theory – N.G. Lioyd Cambridge University 1992, Wiley Press publishing.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify the importance of Metric Contraction Principle.	**K3**
CO2	Apply the Hyper Convex Spaces concepts to articulate approximate fixed Points by identifying, analyzing and practicing strategic decisions.	**K4**
CO3	Explain the Normal Structures in Metric Spaces.	**K4**
CO4	Apply and extend Metric Fixed PointTheory to analyze real worldsystems.	**K5**
CO5	Discuss Build and solve Fixed Point Theory in BanachLattices.	**K6**

M.Sc. Mathematics

2021 – 2022 Onwards

Sub. Code : 21PMA16

Core Course: XVI **Hours/Week : 6**

Credit : 5

NON-LINEAR DIFFERENTIAL EQUATIONS

Course Objectives

The objective of this programme is

CO1	Introduce oscillations or wild chaotic fluctuations produced by a nonlinear system.
CO2	Discuss solution behaviour of nonlinear differential equations
CO3	Develop clear thinking and analyzing capacity for advanced research.
CO4	To know the concept of Linear Systems.
CO5	To analysis the concept of stability.

UNIT I

First order systems in two variables andlinearization

1.1 The general phase plane
1.2 Some population models
1.3 linear approximation at equilibrium points
1.4 Linear systems in matrix form

UNIT II

Averaging methods

2.1 An energy balance method for limit cycles and amplitude and frequency estimates
2.2 Slowly varying amplitudes and nearly periodic solutions
2.3 periodic solutions: Harmony balance
2.4 Equivalent linear equation by harmonic balance
2.5 Accuracy of a periodestimate

UNIT III

Perturbation methods

3.1 Outline of the direct method, Forced oscillations far from resonance and forced oscillations near resonance with weak excitation
3.2 Amplitude equation for undamped pendulum and Amplitude perturbation for the pendulum equation
3.3 Lindstedt's Method and Forced oscillation of a self
3.4 Excited equation
3.5 The Perturbation Method and Fourierseries

UNIT IV

Linear Systems

4.1 Time Varying Systems
4.2 Constant co-efficient system
4.3 Periodic coefficients
4.4 Floquet Theory
4.5Wronskian.

UNIT V

Stability

5.1Poincare stability
5.2 solutions, paths and norms
5.3 Liapunov stability stability of linear systems
5.4 Comparison theorem for the zero solutions of nearly linearsystems.

TEXT BOOKS:

1. Non-Linear Ordinary Differential Equations – D.W.Jordan & P.Smith, Clarendon Press, Oxford,1977.

REFERENCE BOOKS:

1. Differential Equations by G.F.Simmons, Tata McGraw Hill, NewDelhi,1979.
2. Ordinary Differential Equations and Stability Theory by D.A.Sanchez,Freeman1968
3. Notes on Nonlinear systems by J.K.Aggarwal, Van Nostrand,1972.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	To Understand the dynamics of basic population models.	**K3**
CO2	To classify the approximate solutions of nonlinear equations using averaging and perturbation methods.	**K4**
CO3	To examine the concepts of stability in different perspectives.	**K4**
CO4	To explain qualitative properties of solutions of linear and nonlinear systems.	**K5**
CO5	To estimate their problem solving capabilities.	**K6**

M.Sc. Mathematics

2021 – 2022 Onwards

Core Course: XVII

Sub. Code : 21PMA17
Hours/Week : 6
Credit : 5

FUNDAMENTALS OF DOMINATION IN GRAPHS

Course Objectives

The objective of this programme is

CO1	Explain basic concepts in Bounds in terms of degree, with an emphasis on applications and modeling.
CO2	Discuss the key ideas, theorems, and proofs of the important
CO3	To learn to model problems using graphs and to solve these problems algorithmically.
CO4	To develop rigorous logical thinking and analytical skills by graph theoretic concepts.
CO5	To know the concept of Global domination for solving real time problems.

UNIT I

Bounds in terms of degree

1.1Bounds in terms of order and size

1.2 Bounds in terms of degree, diameter andgirth

UNIT II

Bounds in terms of covering

2.1Bounds in terms of independence and covering

2.2 Product graphs and Vizing's conjecture

2.3 Grid graphs

UNIT III

Varieties of domination

3.1Varieties of domination

3.2 Multiple dominations

3.3 Parityrestrictions.

UNIT IV

Location of dominating sets

4.1 Locating domination

4.2 Distancedomination.

UNITV

Global domination

5.1Strong and Weak domination

5.2 Global and Factor domination.

TEXT BOOKS:

1. Fundamentals of Domination in Graphs,. Teresa W Haynes, Stephen THedetniemi, Peter J Slater, Marceal Dekker, 1998, Marcel Dekkerinc.,270- Madison Avenue, Newyork.

REFERENCE BOOKS:

1. Domination in graphs Advanced TopicsTeresa W.Haynes, Stephen T.Hedetniemi, and Peter.J.Slater, Marceal Dekker, 1998.,Marcel Dekker inc., 270- Madison Avenue, NewYork.
2. Theory of Domination in Graphs, V.R.Kulli., VishwaInternational Publications, 2010.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Understand the concept of Bounds in terms of degree.	**K3**
CO2	Understand the concept and properties of Bounds in terms of covering.	**K4**
CO3	Formulate and prove central theorems about Varieties of domination.	**K4**
CO4	Discuss the concept of Location of dominating sets.	**K5**
CO5	Use graph theory as a Global domination.	**K6**

M.Sc. Mathematics

2021 – 2022 onwards

ElectiveCourse: I **Sub. Code : 21PMAE1**

Hours/Week : 6

Credit : 4

NUMBER THEORY & CRYPTOGRAPHY

Course Objectives

The objective of this programme is

CO1	To introduce students to some of the basic ideas of number theory.
CO2	To use this as a context in which to discuss the development of mathematics through examples,
CO3	To illustrate different methods of proof in the context of elementary number theory, and will apply some basic techniques of number theory to cryptography.
CO4	To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
CO5	To introduce classical encryption techniques and concepts of modular arithmetic and number theory.

UNIT I

Some Topics in Elementary Number Theory

1.1 Divisibility and Euclidean algorithm

1.2 Congruence

1.3 Applications to Factoring.

UNIT II

Finite Fields and Quadratic Residues

2.1 Finite Fields

2.2 Quadratic Residues and Reciprocity

UNIT III

Cryptography

3.1 Some simple Cryptosystems

3.2 Enciphering Matrices

Public Key

3.3 The idea of public key Cryptography

3.4 RSA.

UNIT IV

Primality and Factoring

4.1 Pseudo primes

4.2 The rho method

4.3 Fermat factorization and factor bases

4.4 The Continued fraction method

UNIT V

Elliptic Curves

5.1 Basic Facts
5.2 Elliptic curves Cryptosystems
5.3 Elliptic curve Factorization.

TEXT BOOKS

"A Course in Number Theory and Cryptography" by Neal Koblitz, , Springer – Verlag, New York, 1987.

UNIT I : Chapter 1, Sections 2- 4
UNIT II : Chapter 2, Sections 2.1-2.2
UNIT III : Chapter 3, Sections 3.1-3.2
Chapter 4, Sections 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, 1972, Wiley Eastern Limited, New Delhi.
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.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify the various properties of and relating to the integers including the well ordering principle, primes, unique factorization, the division algorithm, and greatest common divisors.	**K3**
CO2	Analysis understand the concept of congruence and use various results related to congruencies including the Chinese Remainder Theorem	**K4**
CO3	Analysis and understand how number theory is related to and used in cryptography	**K4**
CO4	Justify the knowledge on standard algorithms used to provide confidentiality, integrity andauthenticity.	**K5**
CO5	Discuss how to deploy encryption techniques to secure data in transit across data networks	**K6**

M.Sc. Mathematics

2021 – 2022 onwards

ElectiveCourse:II

Sub. Code : 21PMAE2
Hours/Week : 6
Credit : 4

MATHEMATICAL PROBABILITY AND STATISTICS

Course Objectives

The objective of this programme is

CO1	To identity the Distribution function and mathematical expectations.
CO2	To classify the marginal distribution and correlation coefficients.
CO3	To analysis the special distribution.
CO4	To conclude the working principles and utilities of various cryptographic algorithms including secret key cryptography, has hes and message digests, and public key algorithms.
CO5	To discuss the Limiting distributions.

UNIT I

Distribution of Random variables:

1.1The probability set function and random variables
1.2 The probability density function and the distribution function
1.3 Mathematical expectation.
1.4 Certain probability models.
1.5 Some special mathematical expectation and Chebyshev's inequality

UNIT II

Conditional probability and Stochastic Independence

2.1 Conditional probability.
2.2 Marginal and Conditional Distributions
2.3 The correlation coefficients
2.4 Stochastic Independence

UNIT III

Some Special Distribution

3.1 The binomial, Trinomial, Multinomial distributions
3.2 The poisson distribution
3.3 The Gamma and chi-square distributions
3.4 The normal distributions.

UNIT IV

Distributions of function of random variables

4.1 Sampling theory, Transformation of variables of the discrete type

4.2 Transformation of variables of the contious type, The t and F distribution

4.3 Distributions of the order statistics

4.4 The moment generating function technique

4.5 The distribution of $\bar{x}$ and ns^2 / σ^2

UNIT V

Limiting distributions

5.1 Limiting distributions

5.2 Stochastic convergence

5.3 Limiting moments, Generating functions

5.4 The central Limit theorem, Some theorems on Limiting distributions

TEXT BOOK:

Introduction to Mathematical statistics, fourth edition Robert V. Hogg & Allen, T.Craig Macmillan publishing co., Inc. new york

UNIT I : Chapter 1: Section1.4 – 1.11
UNIT II: Chapter 2: Section 2.1 – 2.4
UNIT III: Chapter 3: Section 3.1 - 3.5
UNIT IV: Chapter 4: Section 4.1- 4.4, 4.6, 4.7, 4.8
UNIT V: Chapter 5: Section 5.1 – 5.5

REFERENCE BOOKS:

1. An Introduction in probability theory and mathematical statistics – V.K. Rohatgi Willey Eastern Ltd..
2. Fundamentals of Statistics Vol. I – A.M. Goon, M.K. Gupta, B. Dos Gupta, World Press,Calcutta
3. Introduction to Mathematical Statistics, R. V. Hogg, A. T. Craig, Macmillan Publishing Co., Inc., New York, 1978.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	To identify the Chebyshev's Inequality	**K3**
CO2	To inspect the stochastic Independence	**K4**
CO3	To examine the gamma and chi square distribution.	**K4**
CO4	To evaluate the t and F distributions. .	**K5**
CO5	To develop investigate limiting distributions.	**K6**

M.Sc., Mathematics

2021 – 2022 onwards

ElectiveCourse:III **Sub. Code : 21PMAE3**

Hours/Week : 6

Credit : 4

GRAPH THEORY

Course Objectives

The objective of this programme is

CO1	To identity Grasp the type of graphs, features, properties of special graphs
CO2	To classify the properties of different types of trees
CO3	To analysis and formulate the prove central theorems about trees, matching, connectivity, colouringand planar graphs
CO4	To conclude the concept of graph, tree, Euler graph, cut set and Combinatorics
CO5	To discuss the uses of graph theory as a modelling tool.

UNIT I

Path and circuits

1.1 Isomorphism,

1.2 Subgraph and a puzzle with multicolored cubes

1.3Walks, paths, and circuits, Connected graphs, Disconnected graphs and components

1.4 Euler graphs, Operations on graphs and more on Euler graphs

1.5 Hamiltonian Paths and circuits and the Travelling salesman problem

UNIT II

Trees and Fundamental circuits

2.1 Trees, Some properties of trees and Pendant vertices in a tree

2.2 Distance and centers in a tree and spanning trees

2.3 Fundamental circuits

2.4 Finding all Spanning trees of a graph

2.5 Spanning trees in a weighted graph

UNIT III

Cut sets and Cut vertices

3.1 Cut sets, Some properties of Cut sets and all cut sets in a graph

3.2 Fundamental circuits and cut sets and Connectivity and Separability

Planar and Dual graphs

3.3 Combinatorial vs Geometric graphs and Planar graphs

3.4 Kuratowski's two graphs

3.5 Different representations of a Planar graphs, Geometric Dual and thickness and crossings.

UNIT IV

Coloring, covering and Partitioning

4.1 Chromatic Number, Chromatic Partitioning and Chromatic Polynomial
4.2 Matchings
4.3 Covering
4.4 The four color problem

UNIT V

Labelings

5.1 Graceful labeling, Sequential Functions
5.2 Application
5.3 Magic Graphs and Conservative Graphs

Domination

5.4 Domination Number and Minimal Dominating Sets
5.5. Bounds for the Domination Number(Bounds Only), Global Dominating Sets

TEXT BOOKS

1. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo (Unit I to unit IV)
2. Topics in Graph Theory and Algorithm, M.Murugan, Muthali Publishing House, Chennai, 2003 (Unit V)

UNIT I : Chapter 2: Section 2.1-2.10
UNIT II : Chapter 3: Section 3.1 – 3.4,3.7-3.10
UNIT III : Chapter 4: Section 4.1 - 4.5
Chapter 5: Section 5.1 - 5.4,5.6,5.9
UNIT IV : Chapter 8: Section 8.1- 8.6
UNIT V : Chapter 10: Section 10.3– 10.7
Chapter 11: Section 11.1,11.2,11.4,11.5

REFERENCE BOOKS:

1. Graph Theory with Applications – J.A. Bondy & U.S.R. Murthy – Macmillan- London
2. Graph Theory – Frank Harary – Narosa Publishing House – Chennai – Tenth Reprint(2001)
3. A Text Book of Graph Theory – R. Balakrishnan & K.Ranganathan– Springer International Edition (2000) (Unit 1 to Unit4)

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify Grasp the type of graphs, features, properties of special graphs	**K3**
CO2	Inspect the concept and properties of different types of trees	**K4**
CO3	Examine and formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs	**K4**
CO4	Evaluate the concept of graph, tree, Euler graph, cut set and Combinatorics	**K5**
CO5	Discuss the use graph theory as a modelling tool.	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

ElectiveCourse:IV **Sub. Code : 21PMAE4**
Hours/Week : 6
Credit : 4

FUZZY MATHEMATICS

Course Objectives

The objective of this programme is

CO1	To develop the characteristics of fuzzy sets and classifications.
CO2	To classify some theorem of fuzzy set.
CO3	To distinguish the fuzzy number and l-R representation of fuzzy sets.
CO4	To explain the fuzzy relations and fuzzy graph.
CO5	To construct the Decision Making in FuzzyEnvironment.

UNITI

Fuzzy Set Theory

1.1 Fuzzy Set: Definition
1.2 Types of Fuzzy Sets
1.3 Characteristics of Fuzzy Sets
1.4 Other important operations
1.5 General properties: Fuzzy Vs crisp

UNITII

Operations on FuzzySets

2.1 Introduction, Some important Theorems
2.2 Extension Principle for Fuzzy Setsand Fuzzy Compliments
2.3 Further Operations on Fuzzy Sets and t–norms and t- conforms
2.4 Definition of Intersection and Union by Hamacher
2.5 Extension principle for fuzzy sets and general theorems

UNIT III

Fuzzy Numbers andArithmetic

3.1 Introduction znd Fuzzy Numbers
3.2 Algebraic Operations with Fuzzy Numbers and Binary Operation of Two Fuzzy Numbers
3.3 Some special extended operations
3.4 Extended Operations for L-R Representations of Fuzzy sets
3.5 Fuzzy Arithmetic and Arithmetic Operations on Fuzzy Numbers in the form of α-cut sets.

UNITIV

Fuzzy Relations and FuzzyGraphs

4.1 Introduction
4.2 Projections and cylindrical fuzzy relations
4.3 Composition
4.4 Properties of Min-Max composition
4.5 Fuzzy Graphs.

UNITV

Decision Making in FuzzyEnvironment

5.1 Introduction and Individual Decision Making
5.2 Multiperson Decision Making
5.3 Multicriteria Decision Making
5.4 Fuzzy Ranking Method
5.5 Fuzzy Linear Programming.

TEXT BOOKS:

1. Fuzzy Sets and Applications – Dr. Sudhir, K. Pundir, Dr. Rimple Pindir – Pragati Prakashan, India First Edition, 2006. (Unit I,II,III& V)
2. Fuzzy Set Theory and its Applications – H.J. Zimmermann – Springer International Edition – Fourth Edition. 2006. (Unit IV)

UNITI : Chapter 1 : 1.16 to1.21
UNITII : Chapter 2 : 2.1 to2.7,2.10
UNITIII: Chapter 3 : 3.1 to3.8
UNITIV: Chapter 4:4.1-4.4,4.8
UNITV : Chapter 10 : 10.1 and10.6

REFERENCE BOOKS

1. Fuzzy Sets and Fuzzy Logic - George J.Klir and Bo Yuan – Prentice Hall of India, New Delhi,2004.
2. Introduction to Fuzzy Arithmetic Theory and Applications – Arenold Kaufmannand Madan M. Gupta – Van Nostrand Reinhold, NewYork.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify the importance fuzzy set	**K3**
CO2	Inspect the operations on fuzzy.	**K4**
CO3	Examine the fuzzy number.	**K4**
CO4	Explain the fuzzy relations and fuzzy graph	**K5**
CO5	Discuss the decision making and fuzzy environment	**K6**

M.Sc., Mathematics

2021 – 2022 onwards

ElectiveCourse: V **Sub. Code : 21PMAE5**
Hours/Week : 6
Credit : 4

FLUID DYNAMICS

Course Objectives

The objective of this programme is

CO1	To apply the subject of almost all fields of engineering, astrophysics, biomedicine, and metrology. Basic concepts of fluid dynamics are delt with in this paper.
CO2	To analysis the concepts of irrotational motion, two dimensional motion and real fluids.
CO3	To inspect clear knowledge about fluid dynamics and apply this concepts on real time problems.
CO4	Todeduct the concepts of the laminar boundary layer.
CO5	To modify the necessary theoretical background for solving a variety of problems.

UNIT I

Kinematics of fluid in motion

1.1 Real Fluids and Ideal Fluids, Velocity of a fluid at a point
1.2 Stream lines and path lines and Steady and unsteady flows
1.3 The velocity potential and Vorticity vector
1.4 Local and particle rates of change
1.5 The Equation of continuity & Worked Examples.

UNIT II

Equations of motion of a fluid

2.1 Euler's Equations of motion
2.2 Bernoulli's Equation & Worked Examples
2.3 Discussion of the case of steady motion under conservative body

Some three dimensional flows:

2.4 Sources, Sinks and doublets.

UNIT III

Some Two-Dimensionalflows:

3.1 Meaning of two dimensional flow
3.2 The stream function

3.3 The Complex potential for two dimensional, Irrotational, Incompressible flow

3.4 Complex velocity potentials for standard two dimensional Flows & Some worked examples

3.5 Milne Thomson circle Theorem &Some applications of circle theorem and theorem of Blasius

UNIT IV

Viscous flow:

4.1 Stress components in a real fluid, Relation between Cartesian components of stress

4.2 Translational motion of fluid elements

4.3 The rate of strain quadric and principal stresses

4.4 Relations between stress and rate of strain

4.5 Coefficient of viscosity and Laminar flow - Navier and Stokes equations of motion of a viscous fluid.

UNIT V

Some solvable problems in viscous flow:

5.1 Steady motion between parallelplanes

5.2 Steady flow through tube of uniform circular cross section.

Steady viscous flow in tubes of uniform cross section:

5.3 A uniqueness theorem

5.4 Tube having uniform elliptic cross section

5.5 Tube having Equilateral Triangular Cross Section

TEXT BOOKS:

1. Text Book of Fluid Dynamics – F. Chorlton – CBS Publications & Distributors, New Delhi –(First Indian Edition,1985)

UNIT I :	Chapter 2:	2.1 - 2.8
UNIT II :	Chapter 3:	3.4 - 3.7
	Chapter 4:	4.2
UNIT III:	Chapter 5:	5.1, 5.3 - 5.6, 5.8, 5.8.1& 5.9
UNIT IV:	Chapter 8:	8.1 - 8.4, 8.7 - 8.9
UNIT V :	Chapter 8:	8.10.1, 8.10.2, 8.11 -8.11.3

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply laws of discrete mechanics to continuous systems	**K3**
CO2	Classify the basic principles of multi-variable calculus, differential equationsand complex variables to fluid dynamic problems.	**K4**
CO3	Analyze fluid flow problems with the application of the momentum andenergyUnderstand the fuzzy number.	**K4**
CO4	Deduct modeling approximations in finding exact solutions	**K5**
CO5	Improve boundary layer equations by logical reasoning.	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

ElectiveCourse:VI **Sub. Code : 21PMAE6**
Hours/Week : 6
Credit : 5

ADVANCED NUMERICAL ANALYSIS

Course Objectives:
The objective of this programme is

CO1	To understand appropriate numerical methods to solve algebraic and transcendental
CO2	To perform an error analysis for various numerical methods and derive appropriate
CO3	To develop appropriate numerical methods to solve a system of linear equations.
CO4	To learn special kinds of differential equations such as elliptic, parabolic and hyperbolic differential equations
CO5	To learn ordinary differential equations find its solution by Predictor-Corrector methods.

UNITI

Transcendental and PolynomialEquations

1.1 Iterations methods based on second degree equations
1.2 Rate of convergence
1.3 General Iteration methods
1.4 Polynomial equations.

UNITII

System of Linear Algebraic Equations and Eigen valueproblems

2.1 Iteration methods
2.2 Eigen values and eigen vectors (Jacobi method for symmetric matrices - Given method and Power method only).

UNITIII

Interpolation andApproximation

3.1 Hermite Interpolation
3.2 Piecewise and Spline Interpolation
3.3 Bivariate Interpolation, Approximation
3.4 Least square Approximation

UNITIV

Differentiation andIntegration

4.1 Numerical differentiation
4.2 Partial differentiation
4.3 Numerical integration
4.4 Methods based on undetermined coefficients (Trapezoidal method, Simpson's method, Gauss Quadrature methods, Gauss- Chebyshev Integration methods, Gauss- Legendre Formulas, Gauss- Chebyshev Formulas only & for **n = 1, 2 only**), Composite integration methods

UNITV

Ordinary Differential Equations

5.1 Numerical methods
5.2 Single step methods
5.3 Predictor-Corrector methods

TEXT BOOK:

1. Numerical Methods for Scientific and Engineering Computation' - M.K.Jain, S.R.K.Iyengar and R.K.Jain (**5thEdition**), New Age International (P) Ltd, Publishers, India 5th reprint, 2007.

   UNIT 1: Chapter 2: 2.4 - 2.6 and 2.9.
   UNIT 2: Chapter 3: 3.4 and 3.5.
   UNIT 3: Chapter 4: 4.5 to 4.9.
   UNIT 4: Chapter 5: 5.2, 5.5, 5.6, 5.8 (Gauss method only) and 5.9.
   UNIT 5: Chapter 6: 6.3, 6.4, 6.7

REFERENCE BOOKS:

1. Numerical Methods for Engineers – S.C. Chopra, P.C. Raymond, Tata McGraw Hill, New Delhi,2000
2. Numerical Analysis – R.L. Burden, J. Douglas Faires, P.W.S. Kent Publishing Company, Boston, 1989 (Fourth Edition).
3. Introductory Methods of Numerical Analysis – S. S. Sastry, Prentice Hall ofIndia, New Delhi(1998)

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Identify and solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.	**K3**
CO2	Discover numerical methods for various mathematical operations and tasks such as interpolation, differentiation, integration and the solution of linear and nonlinear equations.	**K4**
CO3	Analyze and evaluate the accuracy of common numerical methods.	**K4**
CO4	Demonstrate understanding of the numerical methods in real life problems.	**K5**
CO5	Estimate the numerical methods using software's.	**K6**

M.Sc., Mathematics

2021 – 2022 Onwards

Elective Course:VII

Sub. Code : 21PMAE7
Hours/Week : 6
Credit : 5

TRANSFORM THEORY ON FUNCTION SPACES

Course Objectives

The objective of this programme is

CO1	To analyze Fourier Transform on L^p space
CO2	To demonstrate and developed Fourier Transform on L^1 space
CO3	To examine and compare the relationship between L^p space and continuous function
CO4	To explain extend the Gelfand Theory of Commutative Banach algebras
CO5	To Compose and Classify Maximal ideal space of Bounded Holomorphic functions.

UNIT I

L^p Spaces

1.1 Convex functions and inequalities
1.2 The L^p Spaces
1.3 Approximation by continuous functions.

UNIT II

Fourier transforms:

2.1 Formal properties
2.2 The inversion theorem
2.3 The Plancherel theorem
2.4 The Banach Algebra $L^1(R)$

UNIT III

H^p Spaces:

3.1 Sub harmonic functions
3.2 The Spaces H^p and N
3.3 The Spaces H^2
3.4 The theorem of F. and M.Riesz

UNIT IV

H^p Spaces:

4.1 Factorization theorems
4.2 The shift operator
4.3 Conjugate functions

UNIT V

Elementary theory of banach algebras

5.1 Introduction
5.2 The invertible elements
5.3 Ideals and homomorphisms
5.4 Applications

TEXT BOOK:

1. Walter Rudin, 2010, Real and Complex analysis - Tata McGraw – Hill 3rd Edition, Ninth Reprint, New Delhi

   UNIT I : Chapter 3
   UNIT II : Chapter 9
   UNIT III : Chapter 17 – 17.1 to 17.4
   UNIT IV : Chapter 17 – 17.5 to 17.8
   UNIT V : Chapter 18

REFERENCES:

1. Devendra Kumar and Dimple Singh, Fourier Transform in (R) Spaces, $p \geq 1$ Gen. Math. Notes, Vol. 3, No. 1, March 2011, pp.14-25 ISSN 2219-7184.

2. Hermann Render , The Maximal Ideal Space Of $H\infty(D)$ With Respect To The Hadamard Product, Proceedings Of The American Mathematical Society Volume 127, Number 5,Pages 1409–1411 S 0002-9939(99)04697-3 Article electronically published on January 29, 1999.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Apply laws of discrete mechanics to continuous systems	**K3**
CO2	Analyze basic principles of multi-variable calculus, differential equations and complex variables to fluid dynamic problems.	**K4**
CO3	Analyze fluid flow problems with the application of the momentum andenergyUnderstand the fuzzy number.	**K4**
CO4	Assess the modeling approximations in finding exact solutions	**K5**
CO5	Design the boundary layer equations by logical reasoning.	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

Self studycourse – I **Sub. Code : 21PMASS1**
Credit : -

NUMBER THEORY

Course Objectives:

The objective of this programme is

CO1	To demonstrate and apply division algorithm in integers and define factorization using primes
CO2	To classify and Solve the Chinese Reminder problem using
CO3	To determine Quadratic residues
CO4	To explain and illustrate arithmetic functions and also analyze their properties
CO5	To recall prime factorization and solve special types of Diophantine equations

UNITI

Divisibility Theory in the Integers:

1.1 The Division Algorithm
1.2 The Greatest Common Divisor
\ 1.3 The Euclidean Algorithm
1.4 The Diophantine Equation ax +by = c

Primes and Their Distribution:

1.5 The Fundamental Theorem of Arithmetic and the Sieve of Eratosthenes

UNITII

The Theory of Congruences:

2.1 Basic Properties of Congruence
2.2 Binary and Decimal Representation of Integers
2.3 Linear Congruences and the Chinese Remainder Theorem

Fermat's Theorem :

2.4 Fermat's Little Theorem and Pseudoprime Wilson's Theorem and the Fermat
2.5 Kraitchik Factorization Method

UNIT III

Number – Theoretic Functions:

3.1 The Sum and Number of Divisors
3.2 The Mobius Inversion Formula
3.3 The Greatest IntegerFunction

Euler's Generalization of Fermat's Theorem:

3.4 Euler's Phi-Function and Euler's Theorem
3.5 Some properties of the Phi-Function

UNITIV

Primitive Roots and Indices:

4.1The Order of an Integer Modulo n
4.2 Primitive Roots for Primes
4.3 Composite Numbers having Primitive Roots
4.4 The Theoryof Indices

UNITV

The Quadratic Reciprocity Law:

5.1 Euler's Criterion
5.2 The LegendreSymbol and its properties
5.3 Quadratic Reciprocity
5.4 Quadratic Congruences with Composite Moduli

TEXT BOOK

1. Elementary Number Theory – David M. Burton – Tata McGraw-Hill Publishing Company Limited – NewDelhi – Sixth Edition(2007)

UNIT I:	Chapter 2 :	2.2 - 2.5	Chapter 3: 3.1, 3.2
UNIT II:	Chapter 4 :	4.2 - 4.4,	Chapter 5: 5.2 - 5.4
UNIT III:	Chapter 6 :	6.1 - 6.3,	Chapter7: 7.2 - 7.4
UNIT IV:	Chapter 8 :	8.1 - 8.4	
UNIT V:	Chapter 9 :	9.1 - 9.4	

REFERENCE BOOKS

1. An Introduction to the Theory of Numbers, Fifth Edition, Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery John Wiley & Sons Inc,2004.
2. Introduction to Analytic Number Theory, Tom M. Apostol, Springer International Student Edition, Narosa Publishing House, New Delhi, Reprinted1989

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Demonstrate and apply division algorithm in integers and definefactorization using primes	**K3**
CO2	Classify and Solve the Chinese Reminder problem using congruences	**K4**
CO3	Determine Quadratic residues	**K4**
CO4	Explain and illustrate arithmetic functions and also analyze their properties	**K5**
CO5	Recall prime factorization and solve special types of Diophantineequations	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

Self study course - II **Sub. Code : 21PMASS2**
Credit : -

THEORY OF FIELDS

Course Objectives

The objective of this programme is

CO1	To recall and construct extensions of a given field
CO2	To evaluate the degree of the splitting field of a polynomial
CO3	To develop appropriate numerical methods to solve a system of linear equations.
CO4	To compare the list and identify the extensions such as finite, algebraic, simple and normal
CO5	To construct the properties of finite fields

UNIT I

Fields

1.1 Extension Fields
1.2 The Transcendence of e
1.3 Roots of polynomials

UNIT II

Fields

2.1 Construction with straight edge and compass
2.2 More about roots

UNIT III

Fields

3.1 The elements of Galois theory
3.2 Solvability by radicals

UNIT IV

Selected Topics

4.1 Finite fields
4.2 Wedderburn's theorem on finite division rings

UNITV

Selected Topics

5.1 A theorem of Frobenius

5.2 Integral Quaternions and the Four-Square theorem

TEXT BOOK :

Topics in Algebra, Herstein. I.N., 2016, Wiley Student Edition.

UNIT I:	Chapter 5 :	5.1-5.3
UNIT II:	Chapter 5 :	5.4,5.5
UNIT III:	Chapter 5 :	5.6,5.7
UNIT IV:	Chapter 7:	7.1,7.2
UNIT V:	Chapter 7 :	7.3,7.4

REFERENCES :

1. Richard M. Foote and David S. Dummit , 2011, Abstract Algebra, John Wiley Publications
2. Joseph A Gallian, 1999, Contemporary Abstract Algebra, Narosa Publication
3. Vijay K Khanna and S.K. Bhambri , 2015, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	Constructed extensions of a given field	**K3**
CO2	Analyze the concept of degree of the splitting field of a polynomial	**K4**
CO3	Analyze the constructability of algebraic numbers	**K4**
CO4	Explain and identified the extensions such as finite, algebraic, simple and normal	**K5**
CO5	Discuss the properties of finite fields	**K6**

M.Sc., Mathematics
2021 – 2022 onwards

Self study course III **Sub. Code : 21PMASS3**
Credit : 5

MATLAB THEORY

Course Objectives

The objective of this programme is

CO1	This course provides basic fundamentals on MATLAB, primarily for numerical
CO2	To learn the characteristics of script files, functions and function files, two-dimensional
CO3	To enhance the programming skills with the help of MATLAB
CO4	To learn special kinds of differential equations such as elliptic, parabolic and
CO5	Its features which allow learning and applying specialized technologies.

UNIT I

1.1 Introduction to MATLAB
1.2 Constants, variables and Expressions

UNIT II

2.1 Vectors and Matrices

UNIT III

3.1 Polynomials

UNIT IV

4.1 Ordinary Differential Equations and Symbolic Mathematics

UNIT V

5.1 MATLAB applications in Digital Singal Processing

TEXT BOOK:

1. "MATLAB And its Applications in Engineering" by Raj Kumar Bansal, Ashok Kumar Goel, Monoj Kumar Sharma,Pearson Education, Dorling Kindersley (India) Pvt. Ltd., 2009.

UNIT I : Chapter 1, Chapter 2
UNIT II : Chapter 3
UNIT III : Chapter 4
UNIT IV: Chapter 9
UNIT V : Chapter 15

REFERENCE BOOK:

1. MATLAB – The language of Technical Computing-1984-1997 by sthe MathWorks, Inc. All Rights Reserved.
2. A Beginnner's Guide to MATLAB- Christos Xenophontos. MATLAB is a registered trade mark of the Math Works Inc. A first draft of this document appeared as Tech nical Report 98-02. – Clarkson University.

COURSE OUTCOMES (COs) & COGNITIVE LEVEL MAPPING

On the completion of the course the student will be able to

COs	CO Description	Cognitive Level
CO1	To identify the foundation for doing matrix manipulations, plotting of functions and data, implementation of algorithms, and creation of user interfaces.	**K3**
CO2	To classify an integrating computation, visualization and programming inan easy to use environment where problems and solutions are expressed in familiar mathematical notations	**K4**
CO3	To analyze a more flexible programming tool for users in order to create large and complex application programs.	**K4**
CO4	To decide the set of tools that facilitates for developing, managing, debugging and profiling M-files, and MATLAB's applications.	**K5**
CO5	To consists of set of tools that facilitates for evaluating and crating the MATLAB's applications.	**K6**