PG & RESERACH DEPARTMENT OF MATHEMATICS
M.Sc. MATHEMATICS PROGRAMME
SCHEME OF EXAMINATIONS (2020-2022 BATCH)

Subject Code	Subjects	Ins Hrs/week	Examinations				Credits
			Dur. Hrs	CIA	ESE	Total	
	SEMESTER I						
20PMS101	Core I: Algebra	6	3	30	70	100	4
20PMS102	Core II: Real Analysis	6	3	30	70	100	4
20PMS103	Core III: Complex Analysis	6	3	30	70	100	4
20PMS104	Core IV: Ordinary Differential Equations	6	3	30	70	100	4
20PMS1E1	ME I : Matlab	4	3	30 (Converted to 10)	70 (Converted to 40)	50	3
20PMS1E2	ME Practical II : Programming Lab in Matlab	2	3	40 (Converted to 20)	60 (Converted to 30)	50	2
TOTAL		**30**	**-**	**150**	**350**	**500**	**21**
SEMESTER II							
20PMS205	Core V: Linear Algebra	6	3	30	70	100	4
20PMS206	Core VI: Mathematical Statistics	6	3	30	70	100	4
20PMS207	Core VII: Partial Differential Equations	5	3	30	70	100	4
20PMS208	Core VIII: Mechanics	6	3	30	70	100	4
20PMS209	Core IX: Numerical Analysis	4	3	30 (Converted to 10)	70 (Converted to 40)	50	3
20PMS210	Core Practical X: Programming lab in Numerical Analysis using Matlab	2	3	40 (Converted to 20)	60 (Converted to 30)	50	2
20PMS2N1/ 20PMS2N2	NME -Mathematical Statistics and Techniques/ Mathematics in Finance	1	3	---	100	100	2
TOTAL		**30**		**150**	**450**	**600**	**23**

SEMESTER III							
20PMS311	Core XI: Topology	6	3	30	70	100	4
20PMS312	Core XII: Functional Analysis	6	3	30	70	100	4
20PMS313	Core XIII: Combinatorics	6	3	30	70	100	4
20PMS314	Core XIV: Graph Theory	6	3	30	70	100	4
20PMS3E3	ME III: Latex	4	3	30 (Converted to 10)	70 (Converted to 40)	50	3
20PMS3E4	ME Practical IV: Programming Lab in Latex	2	3	40 (Converted to 20)	60 (Converted to 30)	50	2
TOTAL		**30**		**150**	**350**	**500**	**21**
SEMESTER IV							
20PMS415	Core XV: Fluid Dynamics	6	3	30	70	100	4
20PMS416	Core XVI: Operator Theory	6	3	30	70	100	4
20PMS417	Core XVII: Control Theory	6	3	30	70	100	4
20PMS4E5	ME V: Mathematical Methods	6	3	30	70	100	5
20PMS4P1	Core XVIII: Project	4+ 2(Lab)	----	40	160	200	8
TOTAL		**30**	**----**	**160**	**440**	**600**	**25**
GRAND TOTAL		**120**		**610**	**1590**	**2200**	**90**

ME-Major Elective NME- Non Major Elective

Bloom's Taxonomy Based Assessment Pattern

K1-Remember; **K2**- Understanding; **K3**- Apply; **K4**-Analyze; **K5**- Evaluate

1. Theory: 70 Marks

TEST- I & II and ESE:

Knowledge Level	Section	Marks	Description	Total
K1/K2 Q:1-10	A(Answer all) 1-5 MCQ 6-10 Define/ Short Answers	10x1=10	MCQ/Define	70
K3 Q:11-15	B(Either or Pattern)	5x4=20	Short Answers	
K4/k5 Q:16-21	C(Answer 4 out of 6)	4x10=40	Descriptive/Detailed	

16th Question is compulsory, Q: 17-21 answer any three

2. NME - Theory: 100 Marks

Knowledge Level	Section	Marks	Description	Total
K1	A(Answer 5 out of 8)	5x5=25	Short Answers	100
K2,K3 &K4	B(Answer 5 out of 8)	5x15=75	Descriptive/Detailed	

3. Practical Examinations:

Knowledge Level	**Section**	**Marks**	**Total**
K3	Practical & Record work	30	50
K4		20	
K5			

Components of Continuous Assessment

Components		Calculation	Test 1 & 2 Total
Test 1	70	$\frac{70+70+20+20+20+10}{7}$	30
Test 2	70		
Assignment/Seminar	40		

Programme Objectives:

1. To gain sufficient knowledge in almost all branches of mathematics which can be used by the student for further applications in their respective domains of interest.

2. To import skills that are necessary for life-long learning through continuing education, research and professional development.

Programme Outcomes:

PO 1: To revisit and strengthen fundamental concepts and principles of various areas of mathematics.

PO 2: To create interest in systematic understanding of the concepts and theories of mathematics and their applications to the real world.

PO 3: To select, interpret and perceive the signification of information from sources that include books, journals, scientific reports and the internet.

PO 4: To prepare the students for competitive exams that include CSIR NET, SET etc. and to win a wide range of rewarding positions in the public and private sectors.

PO 5: To motivate research by developing problem, solving skills and apply them independently to problems in pure and applied mathematics.

OBE Rubric Mapping System:

The attainment level of the students as Low, Medium, and High is replaced by the numerals as 1, 2 and 3 respectively.

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS101	**Title**	**Batch :**	2020-2022
		ALGEBRA	**Semester**	I
Hrs/Week	6		**Credits :**	4

Course Objective

This course enable the students to learn several advanced concepts in algebra such as study of Sylow's theorems, polynomial rings, extension and finite fields and Galois theory.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	recollect the knowledge of groups, ring, homomorphism and automorphism of fields.
K2	CO2	demonstrate on polynomial rings, factorization and ideal theory in the polynomial ring, the structure of primitive polynomials and Galois theory.
K3	CO3	demonstrate on applying Sylow's theorem in subgroups and apply Gauss lemma, Einstein criterion for irreducibility of polynomials over rationals.
K4	CO4	demonstrate on applying different fields, finite fields, extension of fields, splitting field, normal extension, simple extension and fixed field.

Unit -1

Group Theory: Another counting principle - Sylow's theorem.

Chapter 2: Sections: 2.11, 2.12 [16 Hours]

Unit -2

Ring Theory: Definitions and Examples of rings - *Some special classes of rings (Self study)* - Polynomial rings - Polynomials over the rational field - Polynomial rings over commutative rings.

Chapter 3: Sections: 3.1, 3.2 and 3.9 - 3.11. [16 Hours]

Unit -3

Fields: Extension Fields.

Selected Topics: Finite Fields.

Chapter 5: Section: 5.1 Chapter 7: Section: 7.1. [15 Hours]

Unit -4

Vector Spaces and Modules: Inner product spaces, *Modules (Self study, Definitions and examples only)*

Fields: Roots of Polynomials.

Chapter 4: Sections: 4.4, 4.5. Chapter 5: Section: 5.3 [16 Hours]

Unit -5

Fields: More about roots and The Elements of Galois theory.

Chapter 5: Sections: 5.5, 5.6 [15 Hours]

Seminar, Assignment.

Text Book:

Herstein I. N. (2010), *Topics in Algebra*, 2nd Edition, Wiley India Pvt. Ltd., New Delhi.

Books for Reference:

1. Bhattarcharya P. B., Jain K, and Nagpaul S.R., (2009), *Basic Abstract Algebra*, Cambridge University Press, New York.
2. John B. Fraleigh (2003), *A First Course in Abstract Algebra*, Narosa Publishing House, New Delhi.
3. Surjeet Singh, Qazi Zameeruddin(2006), *Modern Algebra*, Vikas Publishing House Pvt. Ltd., New Delhi.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	M
CO2	M	M	M	M	L
CO3	M	M	H	M	M
CO4	M	M	M	H	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS102	**Title**	**Batch :**	2020-2022
		REAL ANALYSIS	**Semester**	I
Hrs/Week	6		**Credits :**	4

Course Objective

This course will help students to understand the basics of real analysis and to reading and writing mathematical proofs. It will lay the foundation for the subsequent study of complex analysis and functional analysis.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	attain a broad understanding of analysis techniques that are the basic stepping stones to contemporary research.
K2	CO2	classify sequences of functions which are pointwise convergent and uniform convergent.
K3	CO3	apply the basic results to classical theorems in advanced real analysis.
K4	CO4	understand the concept of Lebesgue measure which is later used in developing the theory of Lebesgue integration that gives stronger results as compared to the theory of Riemann integration.

Unit -1

Riemann-Stieltjes Integral: Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector-valued Functions - *Rectifiable Curves (Self study).*

Text Book 1:Chapter 6. [15 Hours]

Unit -2

Sequences and Series of Functions: Uniform convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration - Uniform Convergence and Differentiation - Equicontinuous Families of Functions-The Stone-Weierstrass Theorem.

Text Book 1:Chapter 7. [16 Hours]

Unit -3

Functions of Several Variables: Linear Transformations - The Contraction Principle - The Inverse Function Theorem - The Implicit Function Theorem - Determinants - *Derivatives of Higher Order (Self study).*

Text Book 1: Chapter 9 (Except Differentiation, The Rank Theorem & Differentiation of Integrals). [16 Hours]

Unit -4

Lebesgue Measure: Introduction - Lebesgue Outer Measure - The σ-Algebra of Lebesgue Measurable sets.

Lebesgue Measurable Functions: Sums, Products, and Compositions - Sequential Poinwise Limits and Simple Approximations.

Text Book 2: Sections: 2.1 - 2.3 and 3.1, 3.2. [15 Hours]

Unit -5

Lebesgue Integration: The Riemann Integral - The Lebesgue Integral of Bounded Measurable Function over a Set of Finite Measure - The Lebesgue Integral of a Measurable Nonnegative Function -The General Lebesgue Integral.

Text Book 2: Sections: 4.1 - 4.4. [16 Hours]

Seminar, Assignment

Text Books:

1. Walter Rudin, (2014), *Principles of Mathematical Analysis*, McGraw Hill, New York.
2. Royden H. L. and Fitzpatrick P. M., (2013), *Real Analysis*, Fourth Edition, Pearson Education, Inc., Publishing as Prentice Hall.

Books for Reference:

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

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	L
CO2	H	M	M	H	H
CO3	M	M	H	H	L
CO4	M	H	M	H	M

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS103	**Title**	**Batch :**	2020-2022
		COMPLEX ANALYSIS	**Semester**	I
Hrs/Week	6		**Credits :**	4

Course Objective

This paper provides a transition from undergraduate elementary results to postgraduate advanced topics and enables the learners to understand and to evaluate the definite integrals in an easy and effective way using calculus of residues. Also it gives a deeper understanding in the advanced topics such as harmonic functions, Infinite products and Normal families.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	understand the concepts and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.
K2	CO2	analyze complex contour integrals in several ways directly using parameterization and using Cauchy's theorem.
K3	CO3	represent functions as Taylor, Power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.
K4	CO4	obtain deep knowledge in advanced topics such as infinite products, canonical products and normal families.

Unit -1

Complex Integration:

The General form of Cauchy's Theorem: Chains and Cycles - Simple Connectivity - Homology - The General Statement of Cauchy's Theorem - Proof of Cauchy's Theorem - Locally Exact Differentials - Multiply Connected Regions.

Chapter 4 : Sections: 4.1 - 4.7 [16 Hours]

The Calculus of Residues: The Residue Theorem - The Argument Principle - Evaluation of Definite integrals.

Chapter 4 : Sections: 5.1 - 5.3

Unit -2

Complex Integration:

Harmonic Functions: Definition and Basic Properties of Harmonic Functions - The Mean Value Property.

Chapter 4 : Sections : 6.1and 6.2. [15 Hours]

Harmonic Functions: Poisson's Formula - Schwarz's Theorem - The Reflection Principle .

Chapter 4 : Sections: 6.3- 6.5.

Unit -3

Series and Product Developments:

Power Series Expansions: Weierstrass's Theorem -The Taylor Series - The Laurent Series.

Chapter 5: Sections: 1.1- 1.3. [15 Hours]

Partial Fractions and Factorization: Partial Fractions - Infinite Products - Canonical Products - The Gamma Function.

Chapter 5: Sections: 2.1- 2.4.

Unit -4

Series and Product Developments:

Entire Functions: Zensen's Formula.

Chapter 5: Sections: 3.1. [16 Hours]

Normal Families: Equi-continuity - Normality and Compactness, Arzela's Theorem - Families of Analytic Functions.

Chapter 5: Sections: 5.1 - 5.4.

Unit -5

Elliptic Functions:

Simply Periodic Functions: Representation by Exponentials - The Fourier Development

Doubly Periodic Functions*: The Period Module - Unimodular Transformations (Self study)* – The Canonical basis – General properties of Elliptic functions.

Chapter 7: Sections: 1.1-1.2.

Chapter 7: Sections: 2.1- 2.4. [16 Hours]

Seminar, Assignment.

Text Book:

Lars V. Ahlfors (2013), *Complex Analysis,* McGraw-Hill International Edition, Third Edition (Indian Edition).

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Books for Reference:

1. Serge Lang (2005), *Complex Analysis*, Springer International Edition.
2. Shanti Narayan & Dr. P. K. Mittal, (2014), Theory *of Functions of a Complex Variable*, S. Chand & Company Pvt. Ltd.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	M
CO2	M	H	M	M	L
CO3	H	M	M	M	L
CO4	M	M	H	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS104	**Title**	**Batch :**	2020-2022
		ORDINARY DIFFERENTIAL EQUATIONS	**Semester**	I
Hrs/Week	6		**Credits :**	4

Course Objective

This course introduces the formulation, classification of differential equations and existence and uniqueness of solutions. It also provides skill in solving initial value and boundary value problems and developing the skill in solving first and second order linear homogeneous and non- homogeneous differential equations using power series methods.

Course Outcomes (CO)

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

K1	CO1	understand the concept of Linear differential equation, Wronskian and properties
K2	CO2	solve differential equations using power series method
K3	CO3	understand linear System ,fundamental matrix and its properties
K4	CO4	analyse existence, uniqueness, other properties of a solution of differential equations and concepts of boundary value problems

Unit -1

Linear differential equations of higher order: Introduction-Linear dependence and Wronskian - Basic theory for linear equations - Method of variation of parameters - Two useful formulae - Homogeneous linear equations with constant co-efficients.

Chapter 2: Sections : 2.1 - 2.6. [16 Hours]

Unit -2

Solutions in power series: Second order linear equations with ordinary points - Legendre equation and Legendre polynomials - Second order equations with regular singular points - Bessel equation.

Chapter 3: Sections : 3.2 - 3.5 [15 Hours]

Unit -3

Systems of Linear Differential Equations: Systems of first order equations - Existence and uniqueness theorem - Fundamental matrix - Non-homogeneous linear systems - Linear systems with constant co-efficients - *Linear systems with periodic co-efficients (Self study).*

Chapter 4: Sections : 4.2 - 4.7 [15 Hours]

Unit -4

Existence and uniqueness of solutions and Oscillations of second order equations: Introduction - Preliminaries - Successive approximations- Picard's theorem - Fundamental results - Strum's comparison theorem - Elementary linear oscillations - Comparison theorem of Hille-Wintner - Oscillations of $x'' + a(t)x=0$.

Chapter 5 and 6 : Sections : 5.1 - 5.4 and 6.1- 6.5 [16 Hours]

Unit -5

Boundary Value problems: Introduction - Strum-Liouville problem - Green's functions - Picard's theorem.

Chapter 7: Sections : 7.1 - 7.3, 7.5 [16 Hours]

Seminar, Assignment

Text Book:

Deo S. G. and Raghavendran V, (1990), *Ordinary Differential Equations and Stability Theory,* Tata McGraw Hill Publishing company Limited.

Books for Reference :

1. Coddington E. A and Levinson N.,(1955), *Theory of Ordinary Differential Equations,* McGraw Hill, New York.
2. Martin H.(1985), *Ordinary Differential Equations,* Tata McGraw Hill Publishing company Limited.

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	L
CO2	H	M	H	H	M
CO3	M	H	M	H	L
CO4	H	H	H	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS1E1	**Title**	**Batch :**	2020-2022
		MAT LAB	**Semester**	I
Hrs/Week	4		**Credits :**	3

Course Objective

This course ensures the students to learn about the basics of MATLAB programming. It also enables the students to gain knowledge about the use of loops, functions, operators and insertion of plots using MATLAB commands.

Course Outcomes (CO)

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

K1	CO1	remember the notion of loops and conditional statements and apply them by modifying the commands with respect to MATLAB.
K2	CO2	get deep knowledge about the basics of MATLAB and can able to create arrays and plots using MATLAB.
K3	CO3	apply the concepts of polynomials, curve fitting and interpolation in MATLAB.
K4	CO4	implement the mathematical operations via arrays using MATLAB.

Unit -1

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

Chapter 1: Sections 1.1-1.9.

Chapter 2: Sections 2.1-2.11.

Chapter 3: Sections 3.1-3.9. [11 Hours]

Unit -2

Scripts files - Functions and function files - *Global variables (Self study)*

Chapter 4: Sections 4.1-4.8.

Chapter 6: Sections 6.1-6.11. [11 Hours]

Unit -3

Two-dimensional plots - Three dimensional plots - *Polar plots (Self study).*

Chapter 5: Sections 5.1-5.11.

Chapter 9: Sections 9.1-9.6. [10 Hours]

Unit -4

Programming in MATLAB.

Chapter 7: Sections 7.1-7.8. [10 Hours]

Unit -5

Polynomial - Curve fitting and interpolation.

Chapter 8: Sections 8.1-8.6. [10 Hours]

Seminar, Assignment.

Text Book:

Amos Gilat (2004), *MATLAB - An Introduction with Application*, John Wiley & Sons, Singapore.

Books for Reference:

1. Etter D. M., Kuncicky D. C. and Moore H. (2004), *Introduction to MATLAB 7*, Prentice Hall, New Jersy.
2. Palm W. J. (2005), *Introduction to MATLAB 7 for Engineers*, McGraw-Hill Education, New York.
3. Prata R. P (2006), *Getting Started with MATLAB - A Quick Introduction for Scientist and Engineers*, Oxford University Press, New Delhi.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	M
CO2	M	H	M	H	L
CO3	M	M	H	H	L
CO4	M	M	M	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	20PMS1E2	**Title**	**Batch :**	2020-2022
		PROGRAMMING LAB IN MATLAB	**Semester**	I
Hrs/Week	2		**Credits :**	2

Course Objective

This course ensures a practical knowledge for creating the various types of 2D and 3D plots and computing the sub matrices from the existing matrix.

Course Outcomes (CO)

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

K3	CO1	gain knowledge about the creation of matrices and graphics.
K4	CO2	access the plotting commands in creating and editing 2D and 3D plots.
K5	CO3	evaluate the roots of the polynomial and the best fit of the function.

List of Programs

1. Program to solve geometry and trigonometry problem.
2. Program to illustrate the row vector operations in a given matrix.
3. Program to illustrate the column vector operations in a given matrix.
4. Program to illustrate the creation of sub matrix form a given matrix.
5. Program for friction experiment.
6. Program to analyze the electrical resistive network.
7. Program to calculate distance of projectile by, element by element calculation.
8. Program to create vertical bar, horizontal bar, stairs, stem plots of a function.
9. Program to formatting a plot using commands.
10. Program to create plot of a function using the given data and fplot function.
11. Program to create mesh and surface plots for a given function.
12. Program to create various views of 3D plots.

13. Program for creating a matrix.
14. Program to plot a function and curve corresponds to the interpolation method.
15. Program to calculate value and finding roots of a polynomial.
16. Program to determine a function that best fits the given data.

Seminar, Assignment.

Text Book:

Amos Gilat (2004), *MATLAB - An Introduction with Application,* John Wiley & Sons, Singapore.

Books for Reference :

1. Etter D. M., Kuncicky D. C. and Moore H. (2004), *Introduction to MATLAB 7*, Prentice Hall, New Jersy.
2. Palm W. J. (2005), *Introduction to MATLAB 7 for Engineers*, McGraw-Hill Education, New York.
3. Prata R. P (2006), *Getting Started with MATLAB - A Quick Introduction for Scientist and Engineers*, Oxford University Press, New Delhi.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	H
CO2	M	H	M	M	L
CO3	M	H	M	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M.Sc.	**Programme Title:**	Mathematics	
Course Code:	20PMS205	**Title**	**Batch :**	2020-2022
		LINEAR ALGEBRA	**Semester**	II
Hrs/Week	6		**Credits :**	4

Course Objective

To make the student understand the concept of linear algebra in detail and by this student can crack the linear algebra part in competitive examination and CSIR/NET examination.

Course Outcomes (CO)

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

K1	CO1	remember the concept which are basic to analysis of a single linear transformation on a finite dimensional vector space.
K2	CO2	understand and get the idea of diagonalizable and nilpotent part of a more general transformation, the rational and Jordan Canonical formula.
K3	CO3	arrive the primary and cyclic decomposition theorems and study of admissible subspaces.
K4	CO4	analyze the concepts of matrices over a polynomial domain and a concept of bilinear forms.

Unit -1

Elementary Canonical Forms: Introduction - Characteristic Values - Annihilating Polynomials, Invariant Subspaces.

Chapter 6: Sections: 6.1 - 6.4. [16 Hours]

Unit -2

Elementary Canonical Forms: Direct Sum Decompositions - Invariant Direct Sums - The Primary Decomposition Theorem.

Chapter 6: Sections: 6.6 - 6.8. [16 Hours]

Unit -3

The Rational and Jordan Forms: Cyclic Subspaces and Annihilators - Cyclic Decompositions and the Rational Form.

Chapter 7: Sections: 7.1, 7.2. [15 Hours]

Unit -4

The Rational and Jordan Forms: The Jordan Form - Computations of Invariant Factors.

Chapter 7: Sections: 7.3, 7.4. [15 Hours]

Unit -5
Bilinear Forms: Bilinear Forms - Symmetric Bilinear Forms
Chapter 10: Sections: 10.1, 10.2. [16 Hours]

Seminar, Assignment.

Text Book:

Kenneth Hoffman and Ray Kunze (2010), *Linear Algebra*, Second Edition, PHI learning Private Ltd., New Delhi.

Books for Reference:

1. Herstein I. N. (2010), *Topics in Algebra*, Wiley India pvt. Ltd., New Delhi.
2. Kumaresan S. (2001), *Linear Algebra*, Prentice-Hall of India.
3. Serge Lang. (2005), *Introduction to linear algebra*, Springer.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	M	M	H
CO2	M	M	M	H	L
CO3	H	M	M	H	H
CO4	H	H	M	H	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS206	**Title**	**Batch :**	2020-2022
		MATHEMATICAL STATISTICS	**Semester**	II
Hrs/Week	6		**Credits :**	4

Course Objective

The objective of this syllabus is to give a systematic introduction to modern probability theory and mathematical statistics.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	construct the probability distribution of a random variable based on a real world situation and use it to compute expectation and variance.
K2	CO2	compute probabilities based on practical situations using the binomial, normal, F and t distributions.
K3	CO3	understand the limiting process of distributions and solve related problems.
K4	CO4	master the syllabus and will be able to read research reports , to do research in this field. It will help the students to face SLET, NET and CSIR examinations.

Unit -1

Random events: Preliminary remarks - Random events and operations performed on them -The system of axioms of the theory of probability - Conditional probability - Bayes theorem - Independent events.

Random variables: The concept of a random variable - The distribution function- Random variables of the discrete type and the continuous type - Functions of random variables - Multidimensional random variables - Marginal distributions - Conditional distributions - Independent random variables.

Parameters of the distribution of a random variable:

Expected values-Moments - The Chebyshev inequality - absolute moments.

Chapter 1: Sections : 1.1 - 1.3, 1.5 - 1.7.

Chapter 2 : Sections : 2.1 - 2.8

Chapter 3: Sections : 3.1 - 3.4. [15 Hours]

Unit -2

Characteristic functions: Properties of characteristic functions - The characteristic function and moments - Semi invariants - The characteristic function of the sum of independent random variables - Determination of the distribution function by the characteristic function - The characteristic function of multidimensional random vectors - Probability generating functions.

Some probability distributions: The Poisson distribution – The uniform distribution.

Chapter 4: Sections: 4.1 - 4.7.

Chapter 5:Sections: 5.5, 5.6 [16 Hours]

Unit -3

Some probability distributions: The normal distribution - The gamma distribution - *The beta distribution (Self study)*- The Cauchy and Laplace distributions.

Limit theorems: Preliminary remarks - Stochastic convergence - Bernoulli's law of large numbers - The Levy-Cramer theorem - The De Moivre - Laplace theorem.

Chapter 5: Sections: 5.7 - 5.10.

Chapter 6 :Sections: 6.1 - 6.3, 6.6, 6.7. [15 Hours]

Unit -4

Sample moments and their functions: The notion of a sample - The notion of a Statistic- the distribution of the arithmetic mean of independent normally distributed random variables - The χ^2 distribution - The distribution of the statistics($\bar{X}$,S) - Student's t-distribution -Fisher's Z-distribution.

Significance tests: The concept of a statistical test - Parametric tests for small samples - Parametric tests for large samples.

Chapter 9 : Sections : 9.1 - 9.7.

Chapter 12 : Sections : 12.1 - 12.3. [16 Hours]

Unit -5

The theory of estimation: Preliminary notions - Consistent estimates - Unbiased estimates - The sufficiency of an estimate - The efficiency of an estimate - Method of finding estimates - Confidence intervals.

Chapter13: Sections :13.1 - 13.8. [16 Hours]

Seminar, Assignment

Text Book:

Marek Fisz (1980), *Probability theory and Mathematical Statistics*, Third Edition, John Wiley & sons, Inc.

Books for Reference :

1. Gupta S. C. Kapoor V. K. (2000), *Fundamentals of Mathematical Statistics a Modern Approach*, 10th Edition, Sultan Chand & Sons.
2. Irwin Miller, Marylees Miller (2011), *Mathematical Statistics*, 7th Edition, Pearson Prentice Hall Pvt Ltd.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	M	H	H
CO2	M	H	M	M	L
CO3	H	M	M	M	L
CO4	H	M	H	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS207	**Title**	**Batch :**	2020-2022
		PARTIAL DIFFERENTIAL EQUATIONS	**Semester**	II
Hrs/Week	5		**Credits :**	4

Course Objective

This course helps the students to understand linear and non linear partial equations and solving them using Charpit's and Jacobi's methods, methods of separation of variables and by method integral transforms. This course includes the study of Laplace equation, wave equation and diffusion equation and their classifications.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	recollect the first order and second order partial differential equations and their solution.
K2	CO2	understand the linear partial differential equations with constant and variable coefficients, Boundary value problems and application of calculus of variations.
K3	CO3	gain good knowledge in applying Charpit's and Jacobi's methods, method of separation of variables and the method of integral transforms obtain solutions of partial differential equations.
K4	CO4	demonstrate on the canonical forms of second order PDEs and bounded value problems by Dirichlet and Neumann.

Unit -1

Partial Differential Equations of the First Order: Partial Differential Equations - *Origins of First-order Partial Differential Equations (Self study)* - Nonlinear Partial Differential Equations of the First Order - Compatible Systems of First-order Equations - Charpit's Method - Special Types of First-order Equations - Jacobi's Method.

Chapter 2: Sections: 1, 2, 7, 9, 10, 11 and 13. [15 Hours]

Unit -2

Partial Differential Equations of the Second Order: The Origin of Second-order Equations - Linear Partial Differential Equations with Constant Coefficients - Equations with Variable Coefficients.

Chapter 3: Sections: 1, 4 and 5. [16 Hours]

Unit -3

Partial Differential Equations of the Second Order: Separation of variables - The Method of Integral Transforms - Nonlinear Equations of Second Order.

Chapter 3: Sections: 9, 10 and 11. [15 Hours]

Unit -4

Laplace's Equation: Elementary Solutions of Laplace's Equations - Families of Equipotential Surfaces - *Boundary Value Problems(Self study)* - Separation of Variables - Problems with Axial Symmetry.

Chapter 4 : Sections: 2 - 6. [16 Hours]

Unit -5

The Wave Equation: Elementary Solutions of the One-dimensional Wave Equation - Vibrating Membranes: Application of the Calculus of Variations.

The Diffusion Equation: Elementary Solutions of Diffusion Equation - Separation of Variables.

Chapter 5: Sections: 2 and 4

Chapter 6: Sections: 3 and 4. [16 Hours]

Seminar, Assignment.

Text Book:

Ian N. Sneddon, (2006), *Elements of Partial Differential Equation, Dover Publication,* New York.

Books for Reference:

1. Michael Renardy and Robert C. Rogers. (2004), *An Introduction to Partial Differential Equations.* Second Edition. Springer.
2. Robert C. Mc Owen. (2004), *Partial Differential Equations, Methods and Applications,* Second Edition. Pearson Education, Inc.
3. Sankara Rao . K (2009), Introduction *to Partial Differential Equations, Second Edition,* PHI Learning Pvt.Ltd, New Delhi

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	M	M
CO2	H	M	M	M	L
CO3	M	M	M	H	M
CO4	M	H	M	M	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS208	**Title**	**Batch :**	2020-2022
		MECHANICS	**Semester**	II
Hrs/Week	6		**Credits :**	4

Course Objective

This course deals with some of the key ideas of classical mechanics. The concepts covered in the course include generalized coordinates, Lagrange's equations, Hamilton's equations and Hamilton - Jacobi theory.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	understand the 3N-coordinate system made up of N-spacial coordinates, N-velocity coordinates and N-acceleration coordinates.
K2	CO2	analyse the motion of mechanical systems with constraints using Lagrangian description.
K3	CO3	apply hamilton's principle and gain proficiency in solving equations of motions.
K4	CO4	use the Hamilton-Jacobi theory in solving equations of motions

Unit -1

Introductory concepts: Mechanical system - *Generalized Coordinates(Self study)* - Constraints - Virtual Work - Energy and Momentum.

Chapter 1: Sections: 1.1 - 1.5. [16 Hours]

Unit -2

Lagrange's equations: Derivations of Lagrange's Equations - *Examples (Self study)* - Integrals of Motion.

Chapter 2: Sections 2.1 - 2.3. [15 Hours]

Unit -3

Hamilton's equations: Hamilton's Principle - Hamilton's Equations.

Chapter 4: Sections: 4.1 - 4.2. [16 Hours]

Unit -4

Hamilton - Jacobi theory: Hamilton's Principle function - Hamilton-Jacobi Equation.

Chapter 5: Sections: 5.1 - 5.2. [15 Hours]

Unit -5

Canonical transformations: Differential forms and Generating Functions - Lagrange and Poisson Brackets.

Chapter 6: Sections: 6.1, 6.3. [16 Hours]

Seminar, Assignment.

Text Book:

Donald T. Greenwood, (2014) Cl*assical Dynamics, Dover Publication*, New York.

Books for Reference :

1. Goldstein, H. (1950), *Classical Mechanics*. Addison Wesley Press, Inc.
2. Synge, J.L. and Griffith, B.A.(1959), *Principles of Mechanics*. Third Edition. McGraw-Hill company.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	H	H	M	H	L
CO3	H	M	M	H	M
CO4	H	M	H	H	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS209	**Title:**	**Batch :**	2020-2022
		NUMERICAL ANALYSIS	**Semester**	II
Hrs/Week	4		**Credits :**	3

Course Objective

This course enables the students to gain knowledge in solving Non-linear equations, Boundary value problems and characteristic value problems using MATLAB functions. It also provides the techniques to find the numerical solutions for ordinary differential equations using MATLAB.

Course Outcomes (CO)

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

K1	CO1	understand the use of MATLAB to solve the set of equations and find the numerical solutions for differentiation and integration.
K2	CO2	apply iterative methods to compute the solutions of non-linear equations using MATLAB within a specified tolerance.
K3	CO3	estimate the solutions of ordinary differential equations using various methods numerically.
K4	CO4	analyze the concept of Boundary value problems and Characteristic value problems.

Unit -1

Solving Nonlinear Equations: Linear interpolation methods - Newton's method - Muller's method - Newton's method for polynomials (excluding Horner's methods, Parallel processing) - Bairstow's method for quadratic factors - *Internal halving (Self study)*.

Chapter 1: Sections: 1.3 - 1.5, 1.7, 1.8, 1.11. [11 Hours]

Unit -2

Solving Sets of Equations : The Elimination method - Gaussian Elimination and Gauss-Jordan methods - LU decomposition method - Matrix inversion by Gauss-Jordan method -Methods of iteration - Gauss Jacobi and Gauss Seidal iteration - Relaxation method - Systems of nonlinear equations- *Relaxation method(Self study)*.

Chapter 2: Sections: 2.3 - 2.5, 2.7, 2.10 - 2.12. [10 Hours]

Unit -3

Numerical Differentiation And Integration: Derivatives from differences tables - Higher-order derivatives - Divided difference, Central difference formulas - The trapezoidal rule - A composite formula - Romberg integration - Simpson's rules.

Chapter 5: Sections: 5.2, 5.3, 5.6 and 5.7. [11 Hours]

Unit -4

Numerical Solution of Ordinary Differential Equations : Taylor-series method - Euler and modified Euler methods - Runge-Kutta methods - Multistep methods - Milne's method - Adams-Moulton method.

Chapter 6: Sections: 6.2 - 6.7. [10 Hours]

Unit -5

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.

Chapter 7: Sections: 7.2 - 7.5. [10 Hours]

Seminar, Assignment.

Text Book:

Gerald C.F. and Wheatley P.O. (2005), Applied *Numerical Analysis,* Sixth Edition, Addison- Wesley, Reading.

Books for Reference :

1. R.L. Burden and J. Douglas Faires, *Numerical Analysis*, 9th ed., Boston: Cengage Learning, 2011.
2. S.S. Sastry, *Introductory Methods of Numerical Analysis*, 4th ed., New Delhi: Prentice-Hall of India, 2006.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	L
CO2	M	H	M	H	H
CO3	H	M	M	H	L
CO4	M	M	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS210	**Title**	**Batch :**	2020-2022
		PROGRAMMING LAB IN NUMERICAL ANALYSIS USING MATLAB	**Semester**	II
Hrs/Week	2		**Credits :**	2

Course Objective

This course enables a practical knowledge for finding the numerical solutions of a system of non-linear equations and first order ordinary differential equations using MATLAB.

Course Outcomes (CO)

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

K3	CO1	gain knowledge about the intimate relationship between computers and numerical analysis by employing MATLAB to perform the steps of numerical analysis.
K4	CO2	access the various methods to solve a system of linear equations and implement them in finding numerical solutions using MATLAB.
K5	CO3	evaluate the solutions of first order ordinary differential equations numerically using MATLAB.

List of Programs

1. Newton Raphson Method to find the roots.
2. Gauss elimination Method for solving a system of linear equations.
3. Matrix inverse by Gauss Jordan Method.
4. Gauss Jacobi's Method for solving a system of linear equations.
5. Gauss Seidal Method for solving a system of linear equations.
6. Numerical integration by Trapezoidal rule.
7. Numerical integration by Simpon's 1/3 rule.
8. Euler's Method for solving first order ODE.

9. Second order Runge-Kutta Method for solving first order ODE.
10. Fourth order Runge-Kutta Method for solving first order ODE.
11. Milne's Predictor-Corrector Method for solving first order ODE.
12. Eigen values and Eigen vectors by Power Method.

Seminar, Assignment.

Text Book:

Gerald C.F. and Wheatley P.O. (2005), *Applied Numerical Analysis*, Sixth Edition, Addison- Wesley, Reading.

Books for Reference :

1. R.L. Burden and J. Douglas Faires, *Numerical Analysis*, 9th ed., Boston: Cengage Learning, 2011.
2. S.S. Sastry, *Introductory Methods of Numerical Analysis*, 4th ed., New Delhi: Prentice-Hall of India, 2006.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	M
CO2	M	M	M	H	L
CO3	M	H	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS2N1	**Title**	**Batch :**	2020-2022
		NME - MATHEMATICAL STATISTICS AND TECHNIQUES	**Semester**	II
Hrs/Week	1		**Credits :**	2

Course Objective

The aim of this paper is to train the students to improve the basic knowledge relevant to their major subjects. This syllabus enables students to learn about the concept of Analysis and Testing of Hypothesis**.**

Course Outcomes (CO)

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

K1	CO1	remember the concepts of Mean, Median and Standard deviation.
K2	CO2	understand the concept of simple and rank correlation.
K3	CO3	acquire the knowledge of Regression Analysis.
K4	CO4	apply the testing of hypothesis to Z test, t-test, chi square and F test.

Unit -1

Measures of central value: Mean- Median- Standard deviation-Coefficient of variation.

Volume I: Chapter 7. [3 Hours]

Unit -2

Correlation Analysis: Simple and Rank Correlation.

Volume I: Chapter 10. [2 Hours]

Unit -3

Regression Analysis: Simple Linear Regression.

Volume I: Chapter 11. [2 Hours]

Unit -4

Testing of Hypothesis: Z Test - t Test.

Volume II: Chapter 3. [3 Hours]

Unit -5

Testing of Hypothesis: Chi square Test - F Test.

Volume II: Chapter 4, 5. [3 Hours]

Seminar, Assignment.

Text Book:

Gupta S. P. (2006), *Statistical Methods,* Sultan chand & sons, New Delhi.

Books for Reference :

1. Gupta S. C. and Kapoor V. K, *Fundamentals of Mathematical Statistics,* S. Chand & Sons, 2009.
2. Vital P. R, *Mathematical Statistics*, Margham publications, 2004.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	H	M
CO2	M	H	M	H	L
CO3	H	M	M	M	L
CO4	M	H	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M.Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS2N2	**Title**	**Batch :**	2020-2022
		MATHEMATICS IN FINANCE	**Semester**	II
Hrs/Week	1		**Credits :**	2

Course Objective

The objective of this paper is to introduce the concepts of financial statement analysis, which help the students to develop their financial skills.

Course Outcomes (CO)

On successful completion of the course, the students should be able to

K1	CO1	get the idea of ratio analysis
K2	CO2	implement the concepts of return on investments.
K3	CO3	analyze the basic concepts of financial statement analysis.
K4	CO4	gain the basic knowledge of meaning of capital budgeting.

Unit -1

Financial statement analysis: Introduction-Ratio analysis-Meaning and Rationale-Basis of comparison.

Chapter 4: Sections: 4.1, 4.2. [3 Hours]

Unit -2

Types of ratios - Liquidity ratio - Net working capital - Current ratios - Acid test/Quick ratios.

Chapter 4: Sections: 4.3 - 4.5. [3 Hours]

Unit -3

Turnover ratio-Defensive-Interval ratio-Leverage/Capital structure ratio-Debt-Equity Ratios-Debt to total capital ratio.

Chapter 4: Section: 4.6. [3 Hours]

Unit -4

Coverage ratios-Profitability ratios- profitability ratios related to sales-Profit margin-Expenses ratio.

Chapter 4: Sections: 4.9, 4.10. [2 Hours]

Unit -5

Profitability ratios related to investments: Return on investment-Importance of ratio analysis.

Chapter 5: Sections: 5.1 - 5.3. [2 Hours]

Seminar, Assignment.

Text Book:

Khan M.Y and Jain P.K (1990), *Financial Management* Tata McGraw- Hill Publishing Company Ltd, New Delhi.

Books for Reference :

1. Aswath Damodaran (2007), *Corporate Finance*, Theory and Practice, John Wiley and Sons, Inc.
2. Prasanna Chandra (1998), *Managing Investment*,Tata McGraw- Hill Publishing Company Ltd, New Delhi.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	L
CO2	M	H	M	M	M
CO3	H	M	M	M	H
CO4	M	H	M	M	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS311	**Title**	**Batch :**	2020-2022
		TOPOLOGY	**Semester**	III
Hrs/Week	6		**Credits :**	4

Course Objective

This course deals with the essentials of topological spaces and their properties in terms of continuity, connectedness, compactness etc.

Course Outcomes (CO)

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

K1	CO1	develop their abstract thinking skills.
K2	CO2	provide precise definitions and appropriate examples and counter examples of fundamental concepts in general topology.
K3	CO3	acquire knowledge about various types of topological spaces and their properties.
K4	CO4	appreciate the beauty of the mathematical results like Uryzohn's Lemma and understand the dynamics of the proof techniques.

Unit -1

Topological Spaces and Continuous Functions: Topological Spaces- Basis for a topology - The order topology - *The Product topology on $X \times Y$ (Self study)* - The Subspace topology - Closed sets and Limit points.

Chapter 2: Sections : 12 - 17. [16 Hours]

Unit -2

Topological Spaces and Continuous Functions: Continuous functions - The metric topology - The metric topology (Continued) .

Chapter 2 : Sections : 18, 20, 21. [15 Hours]

Unit -3

Connectedness and Compactness: Connected spaces - Connected subspaces of the real line - Components and Local Connectedness - Compact spaces.

Chapter 3 : Sections : 23 - 26. [15 Hours]

Unit -4

Countability and Separation Axioms: The Separation axioms - Normal spaces - The Urysohn lemma - The Urysohn Metrization Theorem - The Tietze Extension theorem.

Chapter 4 : Sections : 31 - 35. [16 Hours]

Unit -5

The Tychonoff Theorem: The Tychonoff theorem - The Stone-Cech Compactification.

Metrization Theorems and Paracompactness: The Nagata-Smirnov Metrization theorem - The Smirnov Metrization Theorem.

Chapter 5:Sections: 37, 38,

Chapter 6 : Sections: 40, 42. [15 Hours]

Seminar, Assignment.

Text Book :

Munkres J. R, *Topology*, Second Edition, Pearson Education, Inc, 2000.

Books for Reference :

1. Dugundji J, *Topology*, Prentice Hall of India, 1975.
2. John Kelly L, *General Topology*, Dover Publications, Inc., New York, 2017.
3. Simmons G. F, *Introduction to topology and modern analysis*, Tata McGraw Hill book company, Inc, Ninth reprint, 2004.
4. Sundaram P., A Text Book of Topology, Kedar Nath Ram Nath Publishers, 2017.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	M	H
CO2	M	H	H	H	L
CO3	M	H	H	M	L
CO4	M	H	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS312	**Title**	**Batch :**	2020-2022
		FUNCTIONAL ANALYSIS	**Semester**	III
Hrs/Week	6		**Credits :**	4

Course Objective

This course will enable the students to learn about the essentials of functional analysis. The course imparts an in depth analysis of normed linear spaces, Banach spaces, Hilbert spaces etc. Further the course analyzes various properties of continuous linear functional, continuous linear operators and closed linear operators.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	have a clear understanding of Normed linear spaces, Banach spaces, Hilbert spaces and B(X,Y).
K2	CO2	understand some important, but simple to follow theorems such as the best approximation theorems, projection theorem and Riesz representation theorem.
K3	CO3	have full grasp of the three important theorems of functional analysis namely Hahn-Banach theorem, the uniform boundedness principle and the closed graph theorem.
K4	CO4	apply the concepts and results covered in the course to numerical analysis and operator equations.

Unit -1

Normed Linear Spaces: Norm on a Linear Space - Examples of Normed Linear Spaces - Seminorms and Quotient Spaces - Product Space and Graph Norm - Semi-inner Product and Sesquilinear Form - Banach Spaces.

Chapter 2: Sections: 2.1, 2.1.1, 2.1.2, 2.1.4, 2.1.6, 2.2. [15 Hours]

Unit -2

Normed Linear spaces: Completion of Normed Linear Spaces - Some Properties of Banach Spaces - Baire Category Theorem (Statement only) - Schauder Basis and Separability - Heine-Borel Theorem and Riesz Lemma - Best Approximation Theorems - Projection Theorem.

Chapter 2: Sections: 2.2.2, 2.2.3, 2.3 - 2.6. [16 Hours]

Unit -3

Operators on Normed Linear Spaces: Bounded Operators - Some Basic Results and Examples - *The Space ß(X, Y) (Self study)* - Norm on ß(X,Y) - Riesz Representation Theorem - Convergence of Sequence of Operators - *Completeness of ß(X, Y) (Self Study).*

More about Hilbert Spaces: Bessel's Inequality - Fourier Expansion and Parseval's Formula - Riesz-Fischer Theorem.

Chapter 3: Sections: 3.1, 3.1.1, 3.2, 3.2.1, 3.3, 3.4, 3.4.1.

Chapter 4: Sections: 4.2 - 4.4. [16 Hours]

Unit -4

Hahn-Banach Theorem and Its Consequences: The Extension Theorem - Consequences - On Uniqueness of Extension - Separation Theorem.

Chapter 5: Sections: 5.1 - 5.4. [15 Hours]

Unit -5

Uniform Boundedness Principle: The Theorem and Its Consequences

Closed Graph Theorem and Its Consequences: Closed Graph Theorem - Bounded Inverse Theorem - Open Mapping Theorem - A Stability Result for Operator Equations.

Chapter 6: Section: 6.1.

Chapter 7: Sections: 7.1 - 7.3, 7.3.1. [16 Hours]

Seminar, Assignment.

Text Book:

Thamban Nair M, *Functional Analysis - A First Course,* Prentice Hall of India Pvt. Ltd, New Delhi, 2010.

Books for Reference :

1. Limaye B. V, *Functional Analysis,* Wiley Eastern, New Delhi, 1981.
2. Simmons G. F, *Introduction to Topology and Modern Analysis,* McGraw Hill Kogakusha, Tokyo, 1963.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	M
CO2	M	M	H	M	H
CO3	M	H	M	M	L
CO4	H	M	H	M	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS313	**Title**	**Batch :**	2020-2022
		COMBINATORICS	**Semester**	III
Hrs/Week	6		**Credits :**	4

Course Objective

Combinatorial mathematics is concerned with counting the number of ways of arranging given objects in a particular way. Generating functions are used to solve a variety of Combinatorial problems.

Course Outcomes (CO)

On successful completion of the course student will be able to

K1	CO1	gain a working knowledge of the basic ideas and techniques of the subject
K2	CO2	handle various aspects of assignment problems, beginning with the famous result of Philip Hall, and its various applications.
K3	CO3	understand the Steiner system S(5, 8, 24) and the construction of Leech Lattice in 24 dimensions..
K4	CO4	have a sound knowledge of block designs and its applications to error correcting codes

Unit -1

Introduction to basic ideas and Selections and Binomial coefficients:
Permutations - Ordered selections - Unordered selections - Further remarks on the binomial theorem - Miscellaneous.

Chapter 1, Chapter 2 : Sections: 2.1 - 2.5. [16 Hours]

Unit -2

Pairings problems: Pairings within a set - Pairings between sets - An optimal assignment problem - Gale's optimal assignment problem.

Chapter 3 : Sections : 3.1 - 3.4. [15 Hours]

Unit -3

Recurrence: Some miscellaneous problems - Fibonacci type relations - Using Generating Functions - Miscellaneous methods - Counting simple electrical networks.

Chapter 4 : Sections: 4.1 - 4.5. [16 Hours]

Unit -4

The Inclusion-Exclusion Principle: The Principle - *The Rook Polynomials (Self study)*

Block Designs and Error correcting codes: *Block designs (Self study)* - Square block designs - Hadamard configurations - Error correcting codes.

Chapter 5 : Sections: 5.1, 5.2

Chapter 6 : Sections: 6.1 - 6.4. [16 Hours]

Unit -5

Steiner Systems and Sphere Packings - Introductory remarks - Steiner Systems - S(5,8,24) .

Chapter 7 : Sections : 7.1 - 7.3 [15 Hours]

Seminar, Assignment.

Text Book:

Ian Anderson, *A first course in Combinatorial Mathematics,* Oxford University press, 1974.

Books for Reference:

1. Balakrishnan V. K and Balakrishnan V, *Schaum's outline of Combinatorics,* McGraw Hill Publishers, 1984.
2. Krishnamurthy V, *Combinatorics,* Affiliated East West Press Pvt Ltd, New Delhi, 1986.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	L
CO2	M	H	M	H	H
CO3	H	M	M	M	L
CO4	M	H	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS314	**Title**	**Batch :**	2020-2022
		GRAPH THEORY	**Semester**	III
Hrs/Week	6		**Credits :**	4

Course Objective

Graph theory is major area of Combinatorics. In this course we introduce basic concept of graph theory and analyze some important concepts and make them to crack CSIR / NET examination graph theory which comes in discrete mathematics.

Course Outcomes (CO)

On successful completion of the course student will be able to

K1	CO1	Understand the preliminaries of both undirected graphs and directed graphs.
K2	CO2	visualize the concept of planar graph and connectivity.
K3	CO3	Apply the concept of Eulerian graph and Hamiltonian graph.
K4	CO4	analyze both vertex colouring and edge colouring as well as matchings in graphs.

Unit -1

Graphs and Subgraphs: Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency matrices - Subgraphs - Vertex degrees - Path and Connection and Cycles.

Trees: Trees - Cut edges and bonds - Cut vertices and Cayley's formula.

Chapter 1: Sections : 1.1 - 1.7

Chapter 2: Sections : 2.1 - 2.4. [16 Hours]

Unit -2

Connectivity: Connectivity and Blocks.

Euler Tours and Hamilton cycles: Euler tours and Hamilton cycles.

Chapter 3: Sections: 3.1, 3.2

Chapter 4: Sections : 4.1, 4.2. [16 Hours]

Unit -3

Matchings: Matchings - Matchings and coverings in bipartite graphs and perfect matchings.

Independent sets and Cliques: Independent sets.

Chapter 5: Sections : 5.1 - 5.3

Chapter 7: Sections : 7.1. [16 Hours]

Unit -4

Edge Colorings: Edge chromatic number and Vizing's theorem.

Vertex Colorings: Chromatic number - Brooks' theorem - Dirac's Theorem, Chromatic polynomials- Girth and chromatic number.

Chapter 6: Sections : 6.1, 6.2

Chapter 8: Sections : 8.1, 8.2, 8.4, 8.5 [15 Hours]

Unit -5

Planar Graphs: Plane and planar graphs, Dual graphs - Euler's formula and Kuratowski's theorem.

Directed Graphs: Directed graphs - Directed paths - Directed cycles.

Chapter 9: Sections : 9.1 - 9.3, 9.5

Chapter 10: Sections : 10.1 - 10.3. [15 Hours]

Seminar, Assignment.

Text Book:

Bondy J. A and Murty U. S. R, *Graph Theory with Applications*, Macmillan Company, 1976.

Books for Reference :

1. Balakrishnan R and Ranganathan K (2000), *A Text Book on Graph Theory*, Springer Verlog, New York.
2. Gould R (1988), *Graph Theory*, The Benjamin/Cummings Publishing Company, Inc, California.
3. Hartsfield N and Ringel G (1990), *Pearls in Graph Theory*, Academic Press.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	M
CO2	M	M	H	M	L
CO3	M	H	M	H	H
CO4	H	M	H	M	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS3E3	**Title:**	**Batch :**	2020-2022
		LATEX	**Semester**	III
Hrs/Week	4		**Credits :**	

Course Objective

This course provides students with an introduction to technical writing and computer presentation with LATEX, which is the de-facto standard in computer science, mathematics and many of sciences**.**

Course Outcomes (CO)

On successful completion of the course the students will be able to

K1	CO1	know the basic features of LATEX system.
K2	CO2	prepare their own document in different environments**.**
K3	CO3	understand how to type set mathematics symbols such as roots, arrows, Greek letters and complex math structures such as functions, stacked expressions, matrices, lists of figures and tables.
K4	CO4	become a self-learner and begin investigating and learning new LATEX packages on their own.

Unit -1

Introduction: Text formatting - TEX and its offspring - what's new in LATEX 2ε? - How to use this book - Basics of LATEX file.

Chapter 1: Sections: 1.1 - 1.5. [11 Hours]

Unit -2

Commands and Environments: Command names and arguments - Environments - Declarations - *Lengths (Self study)* - Special characters - Fragile Commands.

Chapter 2: Sections: 2.1 - 2.6. [11 Hours]

Unit -3

Document layout and Organization: Document class - Page style - Parts of the document - Table of contents - Fine-tuning text - Word division.

Chapter 3: Sections: 3.1 - 3.6 [10 Hours]

Unit -4

Displayed Text: Changing font - *Centering and indenting* (*Self study*)- Lists - Generalized lists - Theorem like declarations - Tabulator stops - Boxes - Tables - Printing source text - Footnotes and marginal notes - Comments within Latex.

Chapter 4: Sections: 4.1 - 4.11. [10 Hours]

Unit -5

Mathematical Formulas: Mathematical environments - Main elements of math mode - Mathematical symbols - Additional elements - Fine-tuning mathematics.
Chapter 5: Sections: 5.1 - 5.5. [10 Hours]

Seminar, Assignment.

Text Book :

Kopka H and Daly P. W(1999), *A Guide to Latex*, Third Edition, Addison Wesley, London.

Books for Reference :

1. George Gratzer (2007), *More Math into Latex*, Fourth Edition, Springer.
2. www.tug.org.in/tutorials.html, *A Latex primer*.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	H
CO2	M	H	M	H	L
CO3	H	M	M	M	L
CO4	M	H	M	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M.Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS3E4	**Title**	**Batch :**	2020-2022
		PROGRAMMING LAB IN LATEX	**Semester**	III
Hrs/Week	2		**Credits :**	2

Course Objective

This course is designed to provide a practical exposure to the students on LATEX.

Course Outcomes (CO)

On successful completion of the course the students will be able to

K3	CO1	build their confidence to work in Latex.
K4	CO2	understand section hierarchy and cross reference of book environment in Latex.
K5	CO3	draw various types of pictures by accessing Latex draw.

List of Programs

1. To illustrate different font sizes in Latex.
2. To prepare a title page in Latex document.
3. To understand the section hierarchy of book environment in Latex.
4. To prepare a list using itemize environment in Latex.
5. To prepare a table in Latex.
6. To prepare a table in Latex with multiple title row.
7. To split the equations in Latex.
8. To type a equations using both left cases and right cases in Latex.
9. To type a system of equations in Latex.
10. To type a Mathematical equations using different equation format.
11. To type a Binomial equations in Latex.
12. To type a Christoffel symbol in Latex.

13. To use a cross reference in Latex article.

14. To import '.eps' picture in Latex.

15. To import a picture using Latex draw in Latex.

Seminar, Assignment.

Text Book :

Kopka H and Daly P. W (1999), *A Guide to Latex,* Third Edition, Addison Wesley, London.

Books for Reference :

1. George Gratzer (2007) , *More Math into Latex,* Fourth Edition, Springer.
2. www.tug.org.in/tutorials.html, *A Latex primer*.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	M	H
CO2	M	H	M	H	L
CO3	H	M	M	H	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS415	**Title**	**Batch :**	2020-2022
		FLUID DYNAMICS	**Semester**	IV
Hrs/Week	6		**Credits :**	4

Course Objective

This paper aims at studying the fundamentals of fluid mechanics such as kinematics of fluid, incompressible flow and boundary layer flows in one, two and three dimensions.

Course Outcomes (CO)

On completion of the course the students will be able to

K1	CO1	understand the fundamental equation of viscous compressible fluid
K2	CO2	get an idea about Bernoulli equation, Momentum theorems and their various applications
K3	CO3	analyze the motion of solid bodies in fluid
K4	CO4	create a sound knowledge of boundary layer theory

Unit -1

Kinematics of Fluids: Methods of Describing Fluid Motion: Lagrangian Method, Eulerian Method-Translation, Rotation and Rate of deformation- Streamlines, Path lines and Streak lines- The Material Derivative and Acceleration- Vorticity, Vorticity in Polar Coordinates- Vorticity in Orthogonal Curvilinear Coordinates.

Fundamental Equations of the Flow of Viscous Compressible Fluids: The Equation of Continuity - Conservation of Mass- Equations of Motion (Navier-Stokes Equations) - Conservation of Momentum.

Chapter 3: Sections: 3.1 - 3.5.

Chapter 5: Sections: 5.1 - 5.3. [16 Hours]

Unit -2

One Dimensional Invisid Incompressible Flow: Equation of continuity- Stream Tube Flow- Equation of Motion- Euler's Equation-The Bernoulli's Equation- Applications of the Bernoulli Equation(a) -Flow from a Tank Through a Small Orifice, (b)-Trajectory of a Free Jet - The Momentum Theorem- Applications of the Momentum Theorem(a)-Pressure Exerted on a Plate by a Free Jet, (b)-Jet Discharge Propulsion.

Two and Three Dimensional Invisid Incompressible Flow: Equation of Continuity - Eulerian Equation of Motion- Circulation Theorems-Velocity Potential - Irrotational Flow- Integration of the Equations of Motion - Bernoulli's Equation- the Momentum Theorem- the Moment of Momentum Theorem.

Chapter 6: Sections: 6.1 - 6.4, 6.6 - 6.7

Chapter 7: Sections: 7.1 - 7.7. [16 Hours]

Unit -3

Two and Three Dimensional Invisid Incompressible Flow: Laplace's Equation, Laplace's Equation in Cartesian Coordinates-Laplace's Equation in Cylindrical Coordinates - Laplace's Equation in Spherical Coordinates(derivations omitted) -Stream function in 2 Dimensional Motion- The Flow Net - Two Dimensional Flow Examples- Stream Function in Three Dimensional Motion - Three Dimensional Axially Symmetric Flow Examples.

Chapter 7: Sections: 7.8 - 7.13. [15 Hours]

Unit -4

Two and Three Dimensional Invisid Incompressible Flow: Motion of Solid Bodies in a Fluid, Rankine's Method of Constructing Streamlines- Superposition of Source and Rectilinear Flow- Superposition of Source and Sink with Rectilinear flow - The Rankine Body- Superposition of Rectilinear flow and Doublet- Superposition of Vortex, Rectilinear Flow and Doublet in a Two Dimensional Case.

Chapter 7: Sections: 7.14 - 7.16, 7.18- 7.19. [15 Hours]

Unit -5

Laminar Flow of Viscous Incompressible Fluids: Flow Between Parallel Flat Plates- Steady Flow in Pipes, Flow Between Two Coaxial Cylinders- Flow Between Two Concentric Rotating Cylinders.

The Laminar Boundary Layer: The Boundary Layer Equations in Two-Dimensional Flows- The Boundary Layer Along a Flat Plate- The Blasius Solution, Shearing Stress and Boundary Layer Thickness.

Chapter 8: Sections: 8.3 - 8.5.

Chapter 9: Sections: 9.2 - 9.3. . [16 Hours]

Seminar, Assignment.

Text Book:

Yuan, S.W. (1988), *Foundations of fluid mechanics.* Prentice Hall of India Pvt. Ltd.

Books for Reference:

1. Frank Chorlton (2004), *Text book on Fluid Dynamics*, CBS Publishers and Distributors, Delhi.
2. Shanthi Swarup (2000), *Fluid dynamics*, Krishna Prakasan media Pvt. Ltd., Meerut.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	H	H	M
CO2	M	H	M	M	L
CO3	M	M	H	M	L
CO4	M	M	M	H	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title:**	Mathematics	
Course Code:	20PMS416	**Title**	**Batch :**	2020-2022
		OPERATOR THEORY	**Semester**	IV
Hrs/Week	6		**Credits :**	4

Course Objective

This course will enable the students to obtain duals of certain sequence spaces and study some of the properties of such spaces namely reflexivity and weak convergence using duality consideration. Further the course enables to study about compact operators, spectral results for Banach space operators, and some operators on Hilbert spaces and various other properties of these operators.

Course Outcomes (CO)

On successful completion of this core paper, the students will be able to

K1	CO1	understand the concepts of Dual space, Reflexivity, weak convergence and compact operators and to illustrate them with examples.
K2	CO2	have a clear understanding of Spectrum, Resolvent set of an operator and Spectral mapping theorem.
K3	CO3	have well founded knowledge in adjoint of an operator, self adjoint operator, normal and unitary operator and their properties.
K4	CO4	apply the concepts and results covered in the course to operator equations.

Unit -1

Dual Space Considerations: Representation of Dual Spaces - Dual of $l^p(n)$ - Duals of Some Sequence Spaces - Duals of C[a,b] and $L^p[a,b]$ - Separability Revisited.

Chapter 8: Sections: 8.1, 8.1.1 - 8.1.4. [16 Hours]

Unit -2

Dual Space Considerations: Reflexivity and Weak Convergence - Reflexivity - Weak Convergence - Best Approximation in Reflexive Spaces.

Chapter 8: Sections: 8.2, 8.2.1 - 8.2.3. [15 Hours]

Unit -3

Compact Operators: Some Characterizations - Space of Compact Operators - Further Properties.

Chapter 9: Sections: 9.1 - 9.3. . [15 Hours]

Unit -4

Spectral Results for Banach Space Operators: Eigenspectrum and Approximate Eigenspectrum - Spectrum and Resolvent Set - Spectral Radius - Spectral Mapping Theorem - Gelfand-Mazur Theorem and Spectral Radius Formula (In 10.2.3, Theorem 10.17 only).

Chapter 10: Sections: 10.1, 10.2, 10.2.1 - 10.2.3 (In 10.2.3, Theorem 10.17 only). [16 Hours]

Unit -5

Operators on Hilbert Spaces: Adjoint of an Operator - Compactness of the Adjoint Operator - *Sesquilinear Functionals (Self study)* -Self-Adjoint, Normal and Unitary Operators - Numerical Range and Numerical Radius - *Some Characterizations (Self study).*

Chapter 11: Sections: 11.1, 11.1.1, 11.1.2, 11.2, 11.2.1, 11.2.2. [16 Hours]

Seminar, Assignment.

Text Book:

Thamban Nair M, *Functional Analysis - A First Course,* Prentice Hall of India Pvt. Ltd, New Delhi, 2010.

Books for Reference:

1. Simmons, G. F, *Introduction to Topology and Modern Analysis,* McGraw Hill Kogakusha, Tokyo, 1963.
2. Sunder V. S, *Functional Analysis: Spectral Theory,* Hindustan Book Agency, New Delhi, 1997.
3. Taylor A. E. and Lay D. C, *Introduction to Functional Analysis,* Second Edition, Wiley, New York, 1980.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	H	M	H
CO2	H	M	M	H	L
CO3	H	M	H	M	H
CO4	M	H	M	M	L

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS417	**Title**	**Batch :**	2020-2022
		CONTROL THEORY	**Semester**	IV
Hrs/Week	6		**Credits :**	4

Course Objective

Control theory is relatively a young branch of applied mathematics. The elementary concepts of differential equations and the theory of matrices are used in solving the problems.

Course Outcomes (CO)

On successful completion of this paper, the students will be able to

K1	CO1	develop their knowledge in the basic problems namely, observability, controllability, stability, stabilizability and optimal control.
K2	CO2	differentiate and solve the problems in linear systems and non-linear systems.
K3	CO3	find the rank of matrices by using the concepts of observability and controllability.
K4	CO4	easily understand the linear time varying system and linear time invariant system.

Unit -1

Observability: Linear Systems - Observability Grammian - Constant Coefficient systems - Construction kernel and Nonlinear Systems.

Chapter 2: Sections : 2.1, 2.2. [16 Hours]

Unit -2

Controllability: Linear Systems - Controllability Grammian, Adjoint Systems - Constant Coefficient systems - Steering function and Controllability of Nonlinear System.

Chapter 3: Sections : 3.1 , 3.2. [15 Hours]

Unit -3

Stability: Stability - Uniform Stability and Asymptotic Stability of Linear Systems - Perturbed linear systems and Nonlinear systems.

Chapter 4 : Sections : 4.1 - 4.3. [15 Hours]

Unit -4

Stabilizability: Stabilization via linear feedback control, Bass method - The Controllable subspace and *Stabilization with restricted feedback (Self study).*

Chapter 5 : Sections : 5.1 - 5.3. [16 Hours]

Unit -5

Optimal Control: Linear time varying systems with quadratic performance criteria - Linear time invariant systems and *nonlinear systems (Self study).*

Chapter 6 : Sections: 6.1 - 6.3. [16 Hours]

Seminar, Assignment.

Text Book:

Balachandran K and Dauer J. P, *Elements of Control Theory*, Narosa, New Delhi, Reprint 2015.

Books for Reference :

1. Conti R, *Linear Differential Equations and Control*, Academic Press, London, 1976.
2. Curtain R. F and Pitchard A. J , *Functional Analysis and Modern Applied Mathematics*, Academic Press, New York, 1977.
3. Klamka J, *Controllability of Dynamical Systems*, Klumer Academic Publisher, Dordrecht, 1991.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	H	H
CO2	M	M	H	H	L
CO3	M	H	M	H	L
CO4	M	M	M	H	M

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE

Programme Code:	M. Sc	**Programme Title :**	Mathematics	
Course Code:	20PMS4E5	**Title**	**Batch :**	2020-2022
		MATHEMATICAL METHODS	**Semester**	IV
Hrs/Week	6		**Credits :**	5

Course Objective

This course concerns the analysis and applications of calculus of variations and integral equations. Applications include areas such as classical mechanics and differential equations.

Course Outcomes (CO)

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

K1	CO1	provide a practical working knowledge of mathematics.
K2	CO2	derive some classical differential equations by using principles of calculus of variations.
K3	CO3	solve volterra integral equations and Fredholm integral equations.
K4	CO4	acquire the mathematical skills required to solve problems arising in daily life.

Unit -1

Introduction: Definition - Regularity Conditions - Special Kinds of Kernels - Eigenvalues and Eigenfunctions - Convolution Integral - The Inner or Scalar Product of Two Functions.

Integral Equations with Separable Kernels: Reduction to a System of Algebraic Equations - Examples - Fredholm Alternative - Examples - An Approximate Method.

Method of Successive Approximations: Iterative scheme - Examples - Volterra Integral equation - Examples - *Some results about the Resolvent Kernel(Self study).*

Classical Fredholm theory: The Method of Solution of Fredholm - Fredholm's first Theorem - Examples - Fredholm's second Theorem, Freholm's Third Theorem.

Text Book 1: Chapter 1: Sections: 1.1-1.6, Chapter 2: Sections: 2.1-2.5, Chapter 3: Sections: 3.1-3.5, Chapter 4: Sections: 4.1-4.5. [16 Hours]

Unit -2

Applications to Ordinary Differential Equations: Initial value problems - Boundary value problems - Examples.

Singular integral equations: The Abel integral equation - Examples.

Text Book 1: Chapter 5: Sections: 5.1, 5.2, 5.3. Chapter 8: Sections: 8.1, 8.2. [15 Hours]

Unit -3

The Method of Variations in Problems with Fixed Boundaries: Variation and its properties - Euler's Equation - Functionals of the Form $\int F(x,y1,y2,\ldots yn,y1',y2',\ldots yn')dx$ - Functionals Dependent on Higher Order Derivatives - Functional Dependent on the Functions of Several Independent Variables - Variational Problems in Parametric Form - Some Applications.

Text Book 2: Chapter 6: Sections: 6.1- 6.7. [16 Hours]

Unit -4

Sufficient Conditions for an Extremum: Field of Extremals - The Function E(x,y,p,y') - Transforming the Euler Equations to the Canonical Form.

Text Book 2: Chapter 8: Sections: 8.1 - 8.3. [15 Hours]

Unit -5

Direct Methods in Variational Problems: Direct Methods - Euler's Finite-Difference Method - The Ritz Method - Kantorovich's Method.

Text Book 2: Chapter 10: Sections: 10.1 - 10.4. [16 Hours]

Seminar, Assignment.

Text Books:

1. Kanwal R. P, *Linear Integral Equations - Theory and Technique* , Academic Press, NewYork and London, 1971.
2. Elsgolts L, *Differential Equations and the Calculus of Variations*, MIR Publishers, Moscow, 1970.

Books for Reference:

1. Corduneanu C, *Integral Equations and Applications*, Cambridge University Press, Cambridge, 1991.
2. Weinstock R, *Calculus of Variations with Applications to Physics and Engineering*, McGraw Hill Book Co, Inc, New York, 1952.

Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	M	H	L
CO2	H	M	M	H	L
CO3	M	M	M	H	M
CO4	M	H	M	M	H

H- High; M- Medium; L- Low

Course Designed by	Verified by HOD	Checked by CDC	Approved by COE