Course Name: Master of Science

Discipline : Mathematics

Rules and regulations, Course Scheme and Scheme of Examinations

(For those who join in June 2023 and later)

COURSE SCHEME:

II year M.Sc. MATHEMATICS

Semester	Part	Subject Name	Hours	Credit	Int + Ext =Total	Local	Regional	National	Global	Professional Ethics	Gender	Human Values	Environment & Sustainability	Employability	Entrepreneurship	Skill Development	Subject Code	Revised / New / No Change / Interchanged & Percentage of Revision
III	Core 10	Field Theory	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC31**	**Mark Change**
	Core 11	Complex Analysis	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC32**	**Mark Change**
	Core 12	Numerical Methods	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC33**	**Mark Change**
	Core 13	**Topology**	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC34**	**New**
	Elective 2	**a) Fuzzy Sets and Logics** b) Classical Mechanics	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAE31/** **P24MAE32**	**New** **Mark Change**
	Total		**30**	**22**														
IV	Core 14	Optimization Techniques	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC41**	**Mark Change**
	Core 15	Functional Analysis	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC42**	**Mark Change**
	Core 16	Introduction to Combinatorics	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC43**	**Mark Change**
	Core	Project work	6	4	50+50=100	✔	✔	✔	✔					✔	✔	✔	P22MA4PV/ **P24MA4PV**	No Change
	Elective 3	**a) Integral Equations** b) Advanced Topology **c) Stochastic Processes**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAE41/** **P24MAE42/** **P24MAE43**	**New** **Mark Change** **Revised 20%**
	Total		**30**	**21**														

Self-Learning Course:

Semester	Subject	Hours	Credit	Int +Ext = 100	Subject Code	Revised / New / No Change / Interchanged & Percentage of revision	Courses having focus on employability/ entrepreneurship / skill development
III	Research Topics in Mathematics	----	5	100=100	P22MASL31	No Change	employability/ entrepreneurship/ skill development

SEMESTER III
CORE: 10 - Field Theory

Contact Hours per semester : 90 **Subject Code :** P24MAC31
Contact Hours per week : 6 **Credit : 5**
Objectives:

- To enable the students to understand the concept of Field
- To enable the students to understand the concept of Galois theory
- To enable the students to understand the concept of chain conditions

Course Outcomes: After completing this course, the students are

Cos	CO Statement
CO1	Capable of finding the extension fields of a given field.
CO2	Well versed whether the regular geometrical figures can be constructed or not with straightedge and compass alone.
CO3	Able to demonstrate the concept of Galois theory.
CO4	Capable of understanding the concept of commutator subgroups and solvable groups.
CO5	Capable of finding finite fields for a given prime number p and a positive integer m.

Unit I : **(18 hours)**
Extension fields - Roots of Polynomials.
Unit II : **(18 hours)**
Construction with straightedge and compass – More about roots.
Unit III : **(18 hours)**
The elements of Galois Theory
Unit IV : **(18 hours)**
Solvability by Radicals – Galois groups over the rationals.
Unit V : **(18 hours)**
Finite fields - Wedderburns's theorem on finite division rings.

Text Book :
Topics in Algebra by I.N.HERSTEIN Second Edition.

Course Contents:

Unit I : Chapter 5: Sections 5.1 and 5.3

Unit II : Chapter 5: Sections 5.4 and 5.5

Unit III : Chapter 5: Section 5.6

Unit IV : Chapter 5: Sections 5.7 and 5.8

Unit V : Chapter 7: Sections 7.1 and 7.2

Reference Books :

1. Surjeet Singh, Qazi Zameeruddin ; Modern Algebra.
2. Vijay K.Khanna, S.K.Bhambri; A Course in Abstract Algebra

Core 11 - Complex Analysis

Contact Hours per Semester: 90 **Subject code:** P24MAC32
Contact Hours per week: 6 **Credit: 4**

Course objectives:

- To lay the foundation for this subject, to develop clear thinking and analyzing capacity for further study.
- To learn about Cauchy's Theorem which leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.
- To learn more about normal families in the context of families of analytic functions.

Course Outcomes:

On completion of the course the students can

Cos	CO Statement
CO1	Analyze the convergence of power series, understand the exponential and trigonometric functions.
CO2	Understand Cauchy theorem and Cauchy integral formula and apply these to evaluate complex contour integrals.
CO3	Identify the type of singularities and determine residues.
CO4	Analyze functions of complex variables in terms of continuity, differentiability and analyticity. Apply Cauchy-Riemann equations and harmonic functions to solve problems.
CO5	Gain knowledge about normal families in the context of families of analytic functions.

Unit–I: Polynomials – Rational functions –Elementary theory of power series: Sequences – Series – Uniform convergence – Power series – Abel's limit theorem – The exponential – The trigonometry functions.

Unit-II: Complex Integrations:Line integrals - Rectifiable arcs – Line integrals as functions of arcs - Cauchy's theorem for a rectangle - Cauchy's theorem in a circular disk - Cauchy's

integral formula: The index of a point with respect to a closed curve – The integral formula – Higher derivatives.

Unit-III: Local properties of analytical functions: Removable singularities. Taylor's theorem – Zeros and poles – The local mapping – The General form of Cauchy's theorem: Chains and Cycles - Simple connectivity – Homology – The statement and proof of General form of Cauchy's theorem.

Unit –IV: The calculus of residues: The residue theorem – The argument principle – Harmonic functions: Definition and basic properties – The mean-value property – Poisson's formula – Schwarz's theorem - The reflection principle.

Unit-V: Weierstrass theorem – The Taylor series – The Laurent series - Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The classical definition.

Text Book:

Lars V. Ahlfors - Complex Analysis - Third Edition - McGraw- Hill International Company, Singapore, 1979.

Unit I ; **Chapter 2:** Sections - 1.3, 1.4, 2.1 to 2.5, and 3.1, 3.2.
Unit II : **Chapter 4:** Sections – 1.1 to 1.5 and 2.1 to 2.3.
Unit III: **Chapter 4:** Sections – 3.1 to 3.3 and 4.1 to 4.5.
Unit IV: **Chapter 4:** Sections – 5.1, 5.2 and 6.1 to 6.5.
Unit V: **Chapter 5:** Sections: 1.1 to 1.3 and 5.1 to 5.5.

Reference Books:

1. John B.Conway, Functions of one complex variable, Second Edition, Springer 1978
2. V.Karunakaran, Complex Analysis, Second Edition, Alpha science International Limited,U.K.
3. R.Roopkumar, Complex Analysis, First Edition, Published by Pearson, Delhi.

Core 12 - Numerical Methods

Contact Hours per Semester: 90 hrs **Subject code:** P24MAC33
Contact Hours per week: 6hrs **Credit: 4**

Objectives:

- To know about the direct and indirect methods for finding the roots of transcendental and polynomial equations
- To know various methods for finding eigen values and eigen vectors.
- To discuss the single step and multistep methods for solving first order initial value problems.
- To discuss several methods of differentiation
- To discuss several methods of integration

Course Outcomes:

On completion of the course the students can

Cos	CO Statements
CO1	Able to solve the transcendental and polynomial equations.

CO2	Apply various techniques in determining the eigen values and eigen vectors.
CO3	Solve first order initial value problems.
CO4	Determine the missing terms using interpolation techniques.
CO5	Apply various numerical methods in solving real life problems involving differentiation and integration.

Unit-I: Transcendental and Polynomial Equations (18 hours)

Bisection method – Iteration Methods based on First degree Equation – Iteration Methods based on Second degree Equation – Rate of convergence

Unit – II: System of Linear Equations and Eigen value Problems (18 hours)

Introduction – Direct Methods – Iteration methods- Eigen value and Eigen vectors

Unit - III: System of Linear Equations and Eigen value Problems (contd…) (18 hours)

Jacobi method for symmetric matrices – Givens Methods for symmetric matrices – Householder's Method for symmetric matrices – Rutishauser Method for Arbitary Matrices- Power Method- Inverse Power method

Unit – IV: Interpolation (18 hours)

Introduction – Lagrange and Newton interpolation-Finite difference operator-Interpolation polynomials using finite differences-Hermite interpolations.

Unit – V: Differentiation and Integration (18 hours)

Introduction - Numerical Differentiation - Extrapolation Methods – Partial Differentiations – Numerical Integration - Methods Based on interpolation – Composite integration methods - Romberg Integration - Double Integration.

***- Students are recommended to have an industrial visit for better understanding of the course.**

Text Book:

NUMERICAL METHODS for Scientific and Engineering Computation
5th Edition –M.K.JAIN, S.R.K.IYENGAR, R.K.JAIN - 2007
UNIT 1: SECTIONS - 2.2, 2.3, 2.4, 2.5
UNIT II: SECTIONS – 3.1, 3.2, 3.4, 3.5
UNIT III: SECTIONS - 3.7 to 3.12
UNIT IV: SECTIONS – 4.1 to 4.5
UNIT V: SECTIONS - 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 5.9, 5.10, 5.11

Reference Books:

1. Hilderbrond, F-B Introduction of Numerical Analysis. McGraw-Hill New York, 1953
2. S.S. Sastry, Numerical Methods
3. S. Arumugam, Numerical methods Scitech, publications, 2001

Core 13

Course Title: Topology	**Total Hours: 90** **Contact Hours per Week: 6**
Course Code: P24MAC34	**Total Credits: 4**

Objectives :

- To enable the students to understand topological spaces.
- To enable the students to understand the concept of continuous functions .
- To enable the students to know about connected spaces.
- To enable the students to know about compact spaces .
- To study countability and separations axioms.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Understand the terms and definitions of Topological Spaces, Accumulation Points, Interior, Closure, Boundary and exterior of sets, Coarser and Finer Topologies – Subspace and theorems related to topology.
CO2:	Be motivated to unify the basics like open set, closed sets, components, continuity, completeness and so on, that are learned through one semester course on Real and complex analysis.
CO3:	Elaborate the knowledge of concepts such as connectedness and compactness.
CO4:	Recognize Bases and Subbases for topologies and write Topologies generated by classes of sets.
CO5:	Understand the importance of Metrizable topological spaces and know sufficient conditions for metrizability of a topological space.
CO6:	Use the concept of homeomorphism to identify the spaces that are having similar geometrical structures.

Unit I Topological spaces [18 Hours]

Topological spaces - Basis for a topology - The order topology - The product topology on $X \times Y$ – The sub space topology - Closed sets and limit points.

Unit II Continuous Functions [18 Hours]

Continuous functions -The product topology - The metric topology- The metric topology (continued)

Unit III Connectedness [18 Hours]

Connected spaces - Connected Subspaces of the Real line – Components – Local connectedness.

Unit IV Compactness [18 Hours]

Compact spaces - Compact subspaces of the Real line - Limit point compactness.

Unit V Separation Axioms [18 Hours]

The separation axioms – Normal spaces - The Urysohn lemma - The Urysohn metrization theorem.

Text Book :

1. James R. Munkres, Topology, Second Edition, PHI Edition Private Ltd, New Delhi (2012).

Course Contents :

Unit I : Chapter : 2 – § 12, 13, 14, 15, 16, 17.
Unit II : Chapter : 2 – § 18, 19, 20, 21.
Unit III : Chapter : 3 – § 23, 24, 25.
Unit IV : Chapter : 3 – § 26, 27, 28.
Unit V : Chapter : 4 – § 31, 32, 33, 34.

Reference Books :

1. *Dugundji, J., Topology, PHI Edition* Private Ltd., New Delhi,*1975.*
2. J. L. Kelly, General Topology, Dover Publications Inc, New York, 2017.
3. G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw-Hill Edition, India, 2004.

Elective2 (a)

Course Title: Fuzzy Sets and Logics	**Total Hours: 90** **Contact Hours per Week : 6**
Course Code: P24MAE31	**Total Credits: 5**

Objectives:

- To enable the students to know the fuzzy sets and its applications.

Course Outcomes:

On completing this course, students can/are

COs	CO Statements
CO1:	Gain the main subject of fuzzy sets.
CO2:	Learn crips and fuzzy set theory.
CO3:	Decide the difference between crips set and fuzzy set theory.
CO4:	Make calculation on fuzzy set theory.
CO5:	Gain the methods of fuzzy logic.
CO6:	Recognize fuzzy logic membership function.
CO7:	Recognize fuzzy logic fuzzy inference systems.
CO8:	Make applications on Fuzzy logic membership function and fuzzy inference systems.

Unit I **[18 Hours]**

Basic concepts on Fuzzy sets: Introduction – Fuzzy sets – Representation methods of Fuzzy set – Expansion of Fuzzy set – Certain number associated with a Fuzzy set – Certain crisp sets associated with a Fuzzy set – Standard operations of Fuzzy sets – The Magnitude of Fuzzy set Subset of Fuzzy set - Equality of Fuzzy set – Empty Fuzzy set – Largest Fuzzy set – Fuzzy point – Subsethood degree of Fuzzy set A in Fuzzy set B – Hamming distance

Unit II **[18 Hours]**

Fuzzy sets Versus Crisp sets: Additional properties of α-cuts – Significance of Theorem 3.1 –

Extension principle for Fuzzy sets – Extension principle on a Cartesian product.

Unit III **[18 Hours]**

Operations on Fuzzy sets: Introduction – Classical Fuzzy complements – Dual point – Properties of involutive complements – Fuzzy intersections: t-norms or T-norms or Triangular norms – Archimedean t-norm – Other form of intersection – Other class of t-norms – Examples of increasing generators.

Unit IV **[18 Hours]**

Operations on Fuzzy sets (contd…): Fuzzy unions: t-conorms – Archimedean t-conorm – Other form of t-conorms – Other class of t-conorms – Other operations on Fuzzy sets – Cartesian product of Fuzzy sets – Combinations of operations – Classes of averaging operations.

Unit V **[18 Hours]**

Fuzzy Logic: Introduction Basic concepts of classical logic – Algebra of propositions – Validity of arguments - Fuzzy logic – Fuzzy propositions – Types of propositions – Fuzzy quantifiers – Inference from conditional Fuzzy propositions – Inference from conditional and Qualified propositions.

Text Book:

1. A.K. Bhargava, Fuzzy set theory, Fuzzy logic and their applications, S.Chand and Company Ltd, New Delhi, 2018 (reprint).

Course Contents:

Unit I: Chapter 2 (Full)
Unit II: Chapter 3 (Full)
Unit III: Chapter 4: Sections 4.1 to 4.9
Unit IV: Chapter 4: Sections 4.10 to 4.18
Unit V: Chapter 10: Sections 10.1 to 10.4; 10.10 to 10.13 and 10.15, 10.16

Reference Book(s):

1. George J Klir and Tina A. Folger, Fuzzy sets, uncertainty and Information, 1994, Prentice-Hall of India Pvt Ltd.
2. George J.Klir/Bo Yuan, Fuzzy sets and fuzzy logic-2008 Prentice-Hall of India Pvt Ltd.
3. S.Nanda, N.R.Das, Fuzzy Mathematical Concepts, Narosa Publishing House, New Delhi, 2010.

Elective2 (b): Classical Mechanics

Contact Hours per Semester: 90 hrs **Subject code:** P24MAE32
Contact Hours per week: 6hrs **Credit: 5**

OBJECTIVES:

- To enable the students to understand the concept of generalized co-ordinates and Lagrange's equation for holonomic system.
- To enable the students to understand the different variational principles.
- To derive the equation of motion.
- To enable the students to deal with the canonical transformation.

Course Outcomes:

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

Cos	CO Statement
CO1	understand the concepts of generalized co – ordinates and De Alembert's principle.
CO2	derive Lagrange's equation for holonomic and non holonomic systems.
CO3	get familiar with variational principle and equations of motions of a rigid body.
CO4	correlate Hamiltonian and Lagrangian Equations of motions.
CO5	develop mastery over the canonical transformations.

UNIT-I **(18 hours)**

D'Alembert's principle and Lagrange's equations. (Examples 1.1, 1.2, 1.3, 1.4, 1.5 and 1.6 only).

UNIT-II **(18 hours)**

Variational Principle and Lagrange's equations. (Examples 2.1, 2.2, 2.3, 2.4 and 2.5 only).

UNIT-III **(18 hours)**

Equations of Motions of Rigid body. (Examples: 3.1, 3.2 only).

UNIT-IV **(18 hours)**

Hamilton's Equations of Motions. (Examples: 4.1, 4.2, 4.3, 4.4 and 4.5 only)

UNIT-V **(18 hours)**

Canonical Transformations. (Examples: 5.1 and 5.2 only)

TEXT BOOK:

- CLASSICAL MECHANICS (Revised Edition) by C.R.MONDAL, PHI,NEW DELHI:2011

  UNIT-I : Chapter-I UNIT-II : Chapter-II
  UNIT-III: Chapter-III UNIT-IV: Chapter-IV
  UNIT-V: Chapter-V
  (Exercise Problems are excluded)

REFERENCE BOOK :

1.CLASSICAL MECHANICS by Goldstein
2. MECHANICS by Synge and Giriffith
3. Green Wood, Classical Dynamics

SEMESTER IV

Core 14 - Optimization Techniques

Contact hours per semester: 90 **Subject Code:** P24MAC41
Contact hours per week: 6 **Credits: 4**

Objectives:

- To know the techniques of network models and classical optimizations
- To give the tools of solving non-linear programming

Course Outcomes:

After completing this course, the students are

Cos	CO Statement
CO1	Able to construct the critical path for a given network.
CO2	Able to solve a given LPP using Simplex method or Revised simplex method.
CO3	Capable of applying the techniques of game theory to solve the two person zero-sum game which arises in real life.
CO4	Capable of solving non-linear programming problems using various algorithms

Unit I: Network Models: Minimal spanning tree algorithm – Shortest route algorithms – maximal flow Problems – critical path calculations – Free and total floats. **(18 hours)**
Unit II: Advanced linear programming : simplex method using the restricted basis – bounded variables Algorithm – Revised Simplex method. **(18 hours)**
Unit III: Game Theory : Optimal solution of two person zero sum games – solution of mixed strategy games - Linear programming solution of games. **(18 hours)**
Unit IV: Classical Optimization Theory: Jocobian Method - Lagrangian Method – The Newton Raphson – Kuhn–Tucker conditions. **(18 hours)**
Unit V: Unconstrained algorithms – Non Linear Programming Algorithms: Separable Programming – Quadratic Programming. **(18 hours)**

***- Students are recommended to have an industrial visit for better understanding of the course.**

Text Book: Operations Research, H.A. Taha, 8th edition, prentice Hall, New Delhi, 2008.
UNIT 1: Chapter 6 – Sections 6.2, 6.3.2, 6.4.2, 6.5.2, 6.5.3.
UNIT 2: Chapter 7- Sections 7.1 to 7.3.
UNIT 3: Chapter 13- Sections 13.4
UNIT 4: Chapter 18 – Sections 18.1 & 18.2.
UNIT 5: Chapter 19 – Sections 19.1, 19.2.1 and 19.2.2.
Note: Computer Programming portions are excluded.

Reference Book:

1. **Operations Research, 12th Thoroughly Revised Edition** by Kanti Swarup,P.K.Gupta,Man Mohan
2. **Resource Management Techniques (Operations Research)** Prof.V.Sundaresan, K.S.Ganapathy Subramanian,K.Ganesan, -A.R.Publications.

Core 15 - Functional Analysis

Contact Hours per Semester: 90 hrs **Subject code:** P24MAC42
Contact Hours per week: 6hrs **Credit: 4**

Objectives:

To enable the students to

- Understand the basic concepts of Normed linear Spaces and continuity of linear maps
- Know the two important theorems on Banach spaces
- Understand the three fundamental theorems in functional analysis and how to use this theorems in problems

Course Outcomes:

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

Cos	CO Statement
CO1	recognize the structure and properties of normed linear spaces and linear transformations defined on them.
CO2	understand the basic properties and established theorems on Hilbert spaces.
CO3	deal with orthogonality concepts and various operators.
CO4	identify regular elements, singular elements, topological divisors of zero in a Banach algebra.
CO5	derive formula for the spectral radius.

Unit I: **(18 Hours)**

Banach spaces – Definition and examples – Continuous linear transformations – Hahn Banach theorem

Unit II: **(18 Hours)**

Open mapping theorem – The conjugate of an operator – Hilbert spaces – Definition, Examples and simple properties – Orthogonal complements.

Unit III: **(18 Hours)**

Orthonormal sets – Conjugate space H* - The adjoint operator – Self adjoint operators – Projections.

Unit IV: **(18 Hours)**

Banach algebras- Definition and some examples – Regular and singular elements – Topological divisors of zero.

Unit V: **(18 Hours)**

The spectrum – The formula for spectral radius

Text Book:

- G.F. Simmons , Introduction to Topology and Modern Analysis; Tata McGraw Hill International Company, International Student Edition, 2004.

Unit I: Chapter 9: **S**ections – 46,47,48
Unit II : Chapter 9:Sections – 50,51 ; **Chapter 10:** Sections – 52 and 53
Unit III : Chapter-10:Sections – 54 (example 4 is excluded); 55, 56, 57, 59
Unit IV : Chapter 12**:** Sections – 64, 65, 66
Unit V : Chapter 12:Sections – 67 and 68

Reference Book:

- B. V. Limaye, Functional Analysis, New age international (P)Ltd, New Delhi, 2002.

Core 16 – Introduction to Combinatorics

Contact Hours per Semester: 90 hrs **Subject code:** P24MAC43
Contact Hours per week: 6hrs **Credit: 4**

Objectives:
To enable the students to

- Understand the basic concepts of permutations and combinations
- Be familiar with generating functions and techniques
- Develop skills to obtain solutions of recurrence relations by generating functions
- Solve problems using the principle of inclusion and exclusion
- know the applications of Polya's fundamental theorem in Combinatorics

Course Outcomes:
After completing this course, the students are

Cos	CO Statement
CO1	Able to distinguish between the ordered arrangement and unordered selection of objects.
CO2	Able to solve the recurrence relation by the techniques of generating functions.
CO3	Capable of handling the principle of inclusion and exclusion for counting problems which arise in real life situations.
CO4	Able to solve combinatorics problems using Polya's algorithm.

Unit – I: PERMUTATION AND COMBINATION (18 hours)
r-permutations and r-combinations with and without Repetition- The rules of sums and products- Permutations-Combinations-Distributions of Distinct objects - Distributions of non-Distinct objects-Stirling's formula.

Unit – II: GENERATING FUNCTIONS (18 hours)
Generating functions for Combinations-Enumerators for Permutations- Distributions of Distinct objects into non distinct cells – Partitions of Integers-Elementary Relations.

Unit - III: RECURRENCE RELATIONS (18 hours)

Linear recurrence Relations with constant coefficients-Solutions by the technique of Generating Functions

Unit – IV: THE PRINCIPLE OF INCLUSION AND EXCLUSION (18 hours)

The general formula – Derangements – Permutations with restrictions on relative positions

Unit – V: POLYA'S THEORY OF COUNTING (18 hours)

Equivalence classes under a permutations group – Burnside theorem-Equivalence classes of functions- weights and inventories of functions-Polya's Fundamental Theorem

Text Book:

- Liu.C.L.., "Introduction to Combinatorial Mathematics",MCGraw Hill Book Co..New York 1968.

Contents:

Chapter 1:Sections 1.1 to 1.7
Chapter 2:Sections 2.1 to2.5 and 2.7
Chapter 3:Sections 3.1 to 3.3
Chapter 4:Sections 4.1 to 4.5
Chapter 5:Sections 5.3 to 5.6

Reference Books:

1. Bala Krishnan,V.K.,"Combinatorics",Tata McGraw Hill publishing Co., New Delhi, 2005.
2. Daniel I.A.Cohen, "Basic Techniques of Combinatorial Theory and Applications", John Wiley and Sons., New Delhi,1978.
3. Krishnamurthy.V.," Combinatorics Theory and Applications", Affiliated East West Press Pvt.Ltd.,Chennai,1985.

Elective3 (a) - Integral Equations

Contact Hours per semester : 90 **Subject Code : P24MAE41**
Contact Hours per week : 6 **Credit : 5**

Objective:

- Develop the ability to solve the problems involving integral equations.
- To know the method of converting initial and boundary value problems into integral equations.
- To understand the Classical Fredholm theory in solving problems
- To practice the application of Green's function in the conversion of initial and boundary value problems.

Course Outcomes:

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

Cos	CO Statement
CO1	Identify the types of integral equations and kernels and convert initial and boundary value problems into corresponding integral equations

CO2	Solve homogeneous Fredholm integral equations using characteristic values and characteristic functions.
CO3	Utilize iterated kernels, resolvent kernels in solving integral equations.
CO4	Apply Classical Fredholm theory as a method of solving integral equations.

Unit I: **(18 hours)**

Integral equation – Definition – types – Solution – initial value problem – converting initial value problem into a volterra integral equation – boundary value problem – converting boundary value problem into a Fredholm integral equation.

Unit II: **(18 hours)**

Characteristic values – characteristic functions - solution to homogeneous Fredholm integral equations of second kind with separable kernel – examples.

Unit III: **(18 hours)**

Iterated kernels – iterative method – solution to Fredholm integral equations of second kind – Reciprocal function – solution to Volterra integral equation of second kind – Problems.

Unit IV: **(18 hours)**

Classical Fredholm theory – Fredholm first fundamental theorem – resolvent kernel –solution of integral equations.

Unit V: **(18 hours)**

Green's function – definition – conversion and solution of boundary value problems – special case – solution based on construction of green's function – problems.

Text Book:

Integral Equations and Boundary value problemsby M.D.Raisinghania, 3rd Edition,S. Chand & Company Ltd., Ram Nagar, New Delhi

Unit I Chapter 1 : Sections 1.1 to 1.18 and Chapter 2 : Sections 2.1 to 2.6
Unit II Chapter 3 Sections 3.1 to 3.3
Unit III Chapter 5 Sections 5.1 to 5.8 (Statement only) , 5.9 to 5.13
Unit IV Chapter 6 Sections 6.1 to 6.3
Unit V Chapter 11 Sections 11.1 to 11.6

Reference Books:

1. R. P. Kanwal, *Linear Integral Equations. Theory and techniques.* Academic Press, New York, 1971.
2. I.N. Sneddon, *Mixed boundary value problems in potential theory,* North Holland, 1966.

Elective 3(b) - Advanced Topology

Contact Hours per Semester: 90 **Subject code:** P24MAE42
Contact Hours per week: 6 **Credit: 5**

Objectives:

To get deep knowledge about various compactifications and metrization and theorems on completeness.

Course Outcomes:

The successful completion of this course the student will be able to

COs	CO Statement
CO 1	Define and illustrate the concept of Stone-Cech compactification, local finiteness, para compactness
CO 2	Define complete metric spaces, compactness in metric space
CO 3	Understand theorems like the Tychonoff theorem, the Nagata-Smirnov metrization theorem, Ascoli's theorem
CO 4	Acquire the knowledge of a space of filling curves
CO 5	Understand and apply ideas from theory of Baire's spaces

Unit I: The Tychonoff theorem: **(18 hours)**

The Tychonoff theorem- The Stone-Cech compactification

Unit II: Metrization theorem: **(18 hours)**

Local finiteness – The Nagata-Smirnov Metrization theorem

Unit III: Paracompactness : **(18 hours)**

Paracompactness – The Smirnov metrization theorem

Unit IV: Complete metric spaces: **(18 hours)**

Complete metric spaces – A space filling curves – compactness in metric spaces

Unit V: Baire spaces:

Pointwise and compact convergence – Ascoli's theorem – Baire spaces

(18 hours)

Text Books:

- **James R. Munkres,** Topology, Second Edition, Pearson Education, Singapore, 2001

Unit I: Chapter 5: Sections 37, 38
Unit II: Chapter 6: Sections 39,40
Unit III: Chapter 6: Sections 41, 42
Unit IV: Chapter 7: Sections 43, 44 and 45
Unit V: Chapter 7: Sections 46, 47 and 48

Reference Book:

1. J.L. Kelley, General Topology, Springer-Verlag, New York, 1991
2. S. Willard, General Topology, Addition-Wesley publishing Company Inc., Reading, 1970

Elective 3(c) - Stochastic Processes

Contact Hours per Semester: 90 hrs **Subject code:** P22MAE43/ **P24MAE43**

Contact Hours per week: 6hrs **Credit: 5**

Objectives

- To introduce the basic concepts in stochastic process.
- To motivate preliminary definitions in Markov Chain, Markov, Process, Poisson
- Process etc.

Course outcomes:

After the completion of the course the student will able to

Cos	CO Statement
CO1	Specify the type of stochastic process and their properties.
CO2	Identify classes of states in Markov chains and characterize the classes.
CO3	Use Poisson process to model the real life problems.
CO4	Understand the theoretical structure of renewal theory and its applications.
CO5	Elaborate the steady state and transient behaviours of M/M/1 model .

Unit I: **(18 hours)**

Stochastic Process: Introduction – Specification of Stochastic Processes, Stationary processes, Martingales, Markov Chains: Definitions and Examples, Higher transition probabilities, classification of states and chains.

Unit II: **(18 hours)**

Stability of Markov chain, Markov chains with denumerable number of states, Poisson process.

Unit III: **(18 hours)**

Poisson process and related distributions – Markov chain with discrete state space.

Unit IV: **(18 hours)**

Renewal process: Renewal process-Renewal process in continuous time – Renewal equation – Stopping time: Wald's equation – Renewal theorems.

Unit V: **(18 hours)**

Stochastic processes in Queueing theory: Queueing systems: General concepts – Queueing model M/M/1: steady state behavior – Transient behavior M/M/1 model – Birth and death process in Queueing theory: Multichannel model.

Text Book:

" Stochastic Processes", Prof. J. Medhi

Unit I: Chapter2: 2.1 to 2.4; Chapter3: 3.1, 3.2, 3.4 (3.3 is not included)
Unit II: Chapter3: 3.6, 3.8, 4.1 (pages 157-169)
Unit III: Chapter4: 4.2 to 4.5 (pages 170-206)
Unit IV: Chapter6: 6.1 to 6.5 (pages 242 – 272)
Unit V: Chapter10: 10.1 to 10.4 (pages 407 – 430)

Reference Book:

"Modelling and Analysis of Stochastic Systems", V. G. Kulkarni, CRC Press (2nd Edition)
