Eligibility condition for admission

For admission to Post Graduate Programmers (P.G) a candidate should have passed the 3years degree course (under 10 + 2 + 3 pattern) (B.Sc Mathematics and B.Sc Mathematics with CA) recognized by the university as equivalent there to.

Duration

Two years. Each year consists of 2 semesters. The duration of a semester is 90 working days.

Attendance

75% of the classes in each semester shortage of attendance can be condoned as per existing university rules.

Evaluation procedure :

A mark Statement with CGPA = $\frac{\sum(MarksXcredits)}{\sum(Credits)}$

Where the summations are over all paper appeared up to the current semester.

Examinations: 3 hours duration. Total marks 100 for all papers
External Internal ratio 75:25 with 2 Internal tests.

The scheme of Examination

The components for continuous internal assessment are:

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks
Total	--25 marks

Pattern of the questions paper for the continuous Internal Assessment

The components for continuous internal assessment are:

Part –A

Six multiple choice questions (answer all) 6 x01= 06 Marks

Part –B

Two questions (‘either …. or ‘type) 2 x 07=14 Marks

Part –C

One question out of two 1 x 10 =10 Marks

Total 30 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x01 = 10 Marks

(No Unit shall be omitted; not more than two questions from each unit.)

Part –B

Five Paragraph questions (‘either …. or ‘type) 5 x 07 = 35 Marks

(One question from each Unit)

Part –C

Three Essay questions out of five 3 x 10 =30 Marks

(One question from each Unit)

Total 75 Marks

Minimum Marks for a Pass

50% of the aggregate (Internal +Summative Examinations).
No separate pass minimum for the Internal Examinations.
34 marks out of 75 is the pass minimum for the Summative Examinations.

PROGRAMME SPECIFIC OUTCOMES

PSO1: To provide students with a knowledge, abilities and insight in Mathematics and computational techniques so that they are able to work as mathematical professional.

PSO2: To train students to deal with the problems faced by software industry through knowledge of mathematics and scientific computational techniques.

PSO3: To provide students with knowledge and capability in formulating and analysis of mathematical models of real life applications.

PSO4: Helps the students to acquire sufficient knowledge on computer skills so as to get placement in MNCs and to inculcate the research aptitude in various subjects in Mathematics.

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Table: 1 : Course pattern

Study component	I Sem	II Sem	III Sem	IV Sem	Total Hours	Total Credit	No. of Course	Total Marks
Core Subjects	6(5) 6(5) 6(5) 6(4)	6(5) 6(5) 6(4) 6(4)	6(5) 6(5) 6(5) 6(4)	6(5) 6(5) 6(4) 6(4)	96	74	16	1600
Major Elective	6(4)	6(4)		6(4)	18	12	03	300
Non-Major Elective			6(4)		06	04	01	100
TOTAL	**30(23)**	**30(22)**	**30(23)**	**30(22)**	**120**	**90**	**20**	**2000**

SEMESTER I

Subject Code	Subjects	No.of course	Hours / week	Credits	Maximum Marks		
					Int	Ext	Total
18PMTC11	Algebra- I	1	6	5	25	75	100
18PMTC12	Real Analysis - I	1	6	5	25	75	100
18PMTC13	Ordinary Differential Equations	1	6	5	25	75	100
18PMTC14	Graph Theory	1	6	4	25	75	100
18PMTE11 18PMTE12 18PMTE13 18PMTE14	Elective :Any one of the papers from List 1: **1.Combinatorial Mathematics** 2.DifferenceEquations 3.Mechanics 4.Analysis of Algorithms	1	6	4	25	75	100
	TOTAL	**5**	**30**	**23**	**125**	**375**	**500**

SEMESTER II

Subject Code	Subjects	No.of course	Hours / week	Credits	Maximum Marks		
					Int	Ext	Total
18PMTC21	Algebra - II	1	6	5	25	75	100
18PMTC22	Real Analysis - II	1	6	5	25	75	100
18PMTC23	Numerical Analysis	1	6	4	25	75	100
18PMTC24	Advanced Graph Theory	1	6	4	25	75	100
18PMTE21 18PMTE22 18PMTE23 18PMTE24	Elective :Any one of the papers from List 2: **1.Partial Differential Equations** 2.JAVA Programming 3.Automata Theory and Formal Language 4.Fluid Mechanics	1	6	4	25	75	100
	TOTAL	**5**	**30**	**22**	**125**	**375**	**500**

SEMESTER – III							
Subject Code	**Subjects**	**No.of course**	**Hours / week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PMTC31	Field Theory and Lattices	1	6	5	25	75	100
18PMTC32	Complex Analysis	1	6	5	25	75	100
18PMTC33	Topology	1	6	5	25	75	100
18PMTC34	Statistics	1	6	4	25	75	100
18PMTN31	**Non Major Elective:** 1.Mathematics for Competitive Examinations	1	6	4	25	75	100
	TOTAL	**5**	**30**	**23**			**500**

SEMESTER –IV							
Subject Code	**Subjects**	**No.of course**	**Hours / week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PMTC41	Measure Theory and Integration	1	6	5	25	75	100
18PMTC42	Functional Analysis	1	6	5	25	75	100
18PMTC43	Operations Research	1	6	4	25	75	100
18PMTPR1	Project & Viva-voce	1	6	4	40	60	100
18PMTE41 18PMTE42 18PMTE43 18PMTE44	**Major Elective:** Any one of the Papers from the List given below **1. Number Theory** 2.Advanced Topology 3.Stochastic Processes 4. Fuzzy Sets and Logic	**1**	**6**	**4**	**25**	**75**	**100**
	TOTAL	**5**	**30**	**22**			**500**

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTC11**	**Credits**	**: 05**

ALGEBRA - I

Course Outcomes:

CO1: To introduce the advanced ideas in Group theory.
CO2: To familiarize Abelian groups and Ring theory.
CO3: To know about PID and UFD.
CO4: To equip the students with the algebraic structure on skill development.

Unit- I: Groups (Definitions only) – Subgroups - A Counting Principle - Normal subgroups and Quotient groups - Permutation groups.

Unit -II: Another Counting Principle -Sylow's Theorems - Direct Products - Finite Abelian Groups.

Unit - III : Ideals and Quotient Rings - More Ideals and Quotient Rings, The Field of Quotients of anIntegral Domain.

Unit -IV: Euclidean Rings - A particular Euclidean Rings.

Unit -V: Polynomial rings - Polynomials over the rational field - Polynomial rings over Commutativerings.

Text Book :

1. I. N.Herstein,**Topics in Algebra**, Second Edition, John Wiley and Sons, New Delhi, Reprint 2010.

   Unit I - Chapter 2: Sections 2.1, 2.4, 2.5, 2.6, 2.10
   Unit II - Chapter 2: Sections 2.11, 2.12, 2.13, 2.14
   Unit III- Chapter 3: Sections 3.4, 3.5, 3.6,
   Unit IV - Chapter 3: Sections 3.7, 3.8
   Unit V - Chapter 3: Sections 3.9,3.10,3.11.

Reference Books :

1. Joseph A Gallian, ***Contemporary Abstract Algebra***, 8th Edition,*Cengage Learning India Private Limited, New Delhi*, 2013.
2. Thomas W.Hungerford, **Algebra**, Springer International Edition, Newyork, 2009.

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTC12**	**Credits**	**: 05**

REAL ANALYSIS - I

Course Outcomes:

CO1: To familiarize the concept of the construction of the real number system.
CO2: To introduce the convergence of sequence and series.
CO3: To explain about continuity and differentiability on real line R.
CO4: To emphasize the proofs development.

Unit - I : Basic Topology - Finite, Countable and uncountable sets – Metric Spaces – Compact Sets – Perfect sets – Connected Sets.

Unit - II : Numerical sequences - Convergent sequences – Subsequences – Cauchy sequences – Upper and lower limits – Some special sequences.

Unit - III: Series – Series of nonnegative terms – The number e – The root and ratio tests – Power series – Summation by parts – Absolute convergence – Addition and Multiplication of series – Rearrangements.

Unit - IV: Continuity - Limits of functions – Continuous functions – Continuity and Compactness – Continuity and Connectedness - Discontinuities – Monotonic functions – Infinite limits and limits at infinity.

Unit - V: Differentiation - The Derivative of a real function – Mean value theorems - The Continuity of Derivatives – L' Hospital's rule – Derivatives of Higher order – Taylor's theorem – Differentiation of Vector Valued functions.

Text Book:

1. Walter Rudin, **Principles of Mathematical Analysis**, Tata Mc Graw Hill Publications, Third Edition, New Delhi,1976.

   Unit 1 - Chapter 2 : Section 2.1 to 2.47

   Unit I1 - Chapter 3 : Section 3.1 to 3.20

   Unit 1I I - Chapter 3 : Section 3.21 to 3.55

   Unit 1V - Chapter 4 : Section 4.1 to 4.34

   Unit V - Chapter 5 : Section 5.1 to 5.19

Reference Books :

1. Walter Rudin**, Real and Complex Analysis,** Tata Mc Graw Hill Publications , 3rd Edition, New Delhi,1976.

2. V.Karunakaran, Real **Analysis,** Pearson Publications, New Delhi, 2012.

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTC13**	**Credits**	**: 05**

ORDINARY DIFFERENTIAL EQUATIONS

Course Outcomes:

CO1: To provide knowledge on ODEs.
CO2: To familiarize power series solution, special functions.
CO3: To teach about existence and uniqueness of solutions of ODEs
CO4: To formulate and solve application problems based on skill development.

Unit - I : Second order homogeneous equation, Initial Value Problem, Linear Dependence and Independence, A formula for Wronskian, Non-homogeneous equation of order two.

Unit - II : Homogeneous equation of order n, Initial value problems, Annihilator method to solve non- homogeneous equation, algebra of constant coefficient operators.

Unit -III: Introduction, Initial value problem for the homogeneous equation, Solution of the Homogeneous equation, the Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogeneous equation, Homogeneous equation with analytic coefficients, The Legendre equation.

Unit - IV: Introduction, the Euler equation, Second order equation with Regular Singular points – an example, Second order equation with Regular Singular points – the general case, A convergence proof, The exceptional cases, The Bessel equation, The Bessel equation (continued) .

Unit - V: Introduction, Equation with Variable Separated, Exact equation, The method of Successive Approximations, The Lipschitz Condition, Convergence of the Successive Approximation, Non local existence of solution, Approximation to and uniqueness of solutions.

Text Book:

1. E.A.Coddington, **An Introduction to ordinary differential equation**, PHI Learning Private Limited, New Delhi, 2010.

   Unit I - Chapter 2 : Section 1 to 6

   Unit II - Chapter 2 : Section 7 to 12

   Unit III - Chapter 3: Section 1 to 8

   Unit IV - Chapter 4: Section 1 to 8

   Unit V - Chapter 5: Section 1 to 8

Reference Books :

1. M.Rama Mohan Rao, **Ordinary Differential Equations Theory and Applications,** East West Press Publications, New Delhi, 1980.
2. Purna Chandra Biswal, **Ordinary Differential Equations**, PHI Learning Publications, New Delhi, 2012.
3. SG Deo, **Ordinary Differential Equations**, Tata Mc Graw Hill Publications, New Delhi, 2010.

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTC14**	**Credits**	**: 04**

GRAPH THEORY

Course Outcomes:

CO1: To understand and apply the fundamental concepts in graph theory.

CO2: To apply graph theory based tools in solving practical problems.

CO3: To develop mathematical maturity.

CO4: To improve the different types of proof writing skills**.**

Unit - I: Graphs and Simple Graphs, Graph Isomorphism, The Incidence and Adjacency Matrices, Sub graphs, Vertex degrees, Paths and Connection, Cycles, **Applications**: The shortestpath problem, Sperner'slemma.

Unit - II: Trees, Cut edges and Bonds, Cut vertices, Cayley's formula,

Application: The Connector problem.

Unit -III: Connectivity, Blocks, Euler tours, Hamiltonian cycles.

Applications: Construction of Reliable Communication networks, The travelling salesman problem.

Unit - IV: Matchings, Matchings and Coverings in Bipartite graphs, Perfect matchings.

Application: Thepersonnel assignment problem.

Unit -V: Edge Chromatic Number, Vizing's Theorem.

Application: The Timetabling Problem.

Text Book:

1. J.A.Bondy and U.S.R.Murty, **Graph Theory with Applications**. North Holland Publications, New york, 1976.

   Unit I - Chapter 1 : Section 1.1 to 1.9
   Unit II - Chapter 2: Section 2.1 to 2.5

   Unit III - Chapter 3: Section 3.1 to 3.3
   Chapter 4: Section 4.1,4.2 and 4.4
   Unit IV - Chapter 5: Section 5.1 to 5.4
   Unit V - Chapter 6 : Section 6.1to 6.3

Reference Books:

1. John Clark and Derek Allan Holton, **A first look at Graph Theory,** World Scientific Publications, Singapore, 1991.
2. Harary, **Graph Theory,** Narosa Publishing House, New Delhi, 1988.
3. S.K.Yadav, **Elements of Graph Theory,** Ane Books Pvt. Ltd,New Delhi, 2010.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2018-2019 and after)

Class	**: M.Sc (Mathematics)**	**PartIII**	**: Elective**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTE11**	**Credits**	**: 04**

COMBINATORIAL MATHEMATICS

Course Outcomes:

CO1: To introduce combinatorial techniques.

CO2: To introduce the application of permutation and combination.

CO3: To improve the problem solving techniques

CO4: To demonstrate the use of mathematical reasoning by justifying based on skill development.

Unit - 1 : Introduction – The rule of sum and product – permutations – Combinations – Distribution of distinct Objects – Distributions of Non-distinct objects.

Unit - II : Introduction – Generating functions for combinations – Enumerators for permutations – Distributions of distinct objects into non-distinct cells – partitions of integers – Elementary relations.

Unit - III : Introduction –linear recurrence relation with constant coefficients- solution by the technique of generating functions- recurrence relation with two indices.

Unit -IV : Introduction – The principle of inclusion and exclusion – The general formula – Dearrangements - Permutations with restrictions on relative positions.

Unit - V : Introduction – Equivalence classes under permutation group – Equivalence classes of functions - Weights and inventories of functions – Polya's fundamental theorem – Generalization of Polya's theorem.

Text Book:

1. C.T.Liu, **Introduction to Combinatorial Mathematics,** TataMcGraw Hill, New Delhi, 1968.

   Unit I - Chapter 1 : Section 1.1 to 1.6

   Unit II - Chapter 2 : Section 2.1 to 2.5 and 2.7

   Unit III - Chapter 3 : Section 3.1 to 3.3 and 3.5

   Unit IV - Chapter 4 : Section 4.1 to 4.5

   Unit V - Chapter 5 : Section 5.1, 5.3, to 5.7

Reference Books :

1. V.Krishnamurthy, **Combinatorics Theory and Applications,** East West Press, New Delhi, 2005.
2. Alan Tucker, **Applied Combinatorics,** Wiley Student edition. India, 5th Edition, New Delhi.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
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Class	**: M.Sc Mathematics**	**PartIII**	**: Elective**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTE12**	**Credits**	**: 04**

DIFFERENCE EQUATIONS

Course Outcomes:

CO1: To develop essential methods of obtaining numerical solutions.
CO2: Explore the use of differential equations as models in various applications.
CO3: To learn about the applications of statics and dynamics.
CO4: To develop skills and knowledge of standard concepts in difference equations.

Unit – I: Linear Difference Equations of Higher Order

Difference calculus – General theory of linear difference equations – Linear homogenous equations with constant coefficients – Linear non-homogenous equations – Method of undetermined coefficients.

Unit – II: System of Linear Difference Equation

Autonomous (time invariant) systems –The basic theory –The Jordan form: Autonomous (time-invariant) systems - Linear Periodic Systems.

Unit – III: The Z-Transform Method

Definitions and examples – Properties of Z-Transform – The inverse Z-Transform and solutionsof difference equations - Power series method - Partial fraction method – Inversion integralmethod.

Unit – IV: Oscillation Theory

Three-term difference equations – Self-adjoint second order equations –Nonlinear differenceequations.

Unit – V: Asymptotic Behaviour of Difference Equations

Tools of approximations - Poincare's theorem – Asymptotically diagonal systems.

Textbook:

1. Saber N.Elaydi, **An Introduction to Difference Equations**, Third Edition, Springer InternationalEdition, First Indian Reprint, New Delhi, 2008.

   Unit I - Chapter 2: Sections: 2.1 to 2.4
   Unit II - Chapter 3: Sections: 3.1 to 3.4
   Unit III -Chapter 6: Sections: 6.1,6.2
   Unit IV -Chapter 7: Sections: 7.1 to 7.3
   Unit V - Chapter 8: Sections: 8.1 to 8.3

Reference Books:

1. S.Goldberg, Introduction to Difference Equations, Dover Publications, 1986.
2. Walter G.Kelley, Allan C.Peterson, Difference Equations An Introduction with Applications,Academic Press, Indian Reprint, New Delhi, 2006.
3. V.Lakshmikantham, DonatoTrigiante, Theory of Difference Equations: Numerical Methodsand Applications, Second Edition, Marcel Dekker, Inc, New York, 2002.
4. Ronald E.Mickens, Difference Equations, Van Nostrand Reinhold Company, New York,1987.
5. SudhirK.Pundir, RimplePundir, Difference Equations (UGC Model Curriculum), PragatiPrakashan, First Edition, Meerut, 2006.

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DEPARTMENT OF MATHEMATICS
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Class : M.Sc (Mathematics) **Part III: Elective**
Semester : I **Hours : 06**
Sub code : 18PMTE13 **Credits : 04**

MECHANICS

Course Outcomes:

CO1: To introduce the basic laws, principles and postulates governing statics.
CO2: To introduce the basic laws, principles and postulates governing dynamic systems.
CO3: To learn about the applications of statics and dynamics.
CO4: To provide the basic knowledge on skill based.

Unit - I : Mechanics of a Particle, Mechanics of a System of Particles, Constraints.

Unit - II : D Alembert 's principle and Lagrange's equations, Velocity – dependent potentials and the Dissipation function, Hamilton's principle, Some techniques of the calculus of variations.

Unit - III : Derivation of Lagrange's equations from Hamilton's principle, Extension of Hamilton's principle to nonholonomic systems, Advantage of a variational principle formulation, Conservation theorems and Symmetry properties.

Unit - IV : Reduction to the equivalent one – body problem. The equations of motion and first integrals,The equivalent one –dimensional problem and Classification of orbits, The Virial theorems.

Unit - V : The Diffential equation for the orbit and integral power – law potentials, Conditions for closed orbits(Bertrand's theorem), The Kepler problem : Inverse square law of force, The Motion in time in the Kepler problome, The Laplace – Runge- Lenze vector.

Text Book:

1. H.Goldstein,**Classical Mechanics,** Second Edition, Addison Wesley, Newyork, 1980.

Unit I - Chapter 1 : Section 1.1 to 1.3

Unit II - Chapter 1 : Section 1.4, 1.5
Chapter 2 : Section 2.1, 2.2

Unit III - Chapter 2 : Section 2.3 to 2.6

Unit IV - Chapter 3 : Section 3.1 to 3.4

Unit V - Chapter 3 : Section 3.5 to 3.9

References Books :

1. Madhumangal, **A Course on Classical Mechanics,** Narosa Publishing Private Ltd, New Delhi, 2009.

2. B.D.Gupta, Satya Prakash, **Classical Mechanics**, 6th Edition, Kedar Nath Ram Nath Publications, Mearut, 1987-1988.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
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Class	**: M.Sc (Mathematics)**	**Part III**	**: Elective**
Semester	**: I**	**Hours**	**: 06**
Sub code	**: 18PMTE14**	**Credits**	**: 04**

ANALYSIS OF ALGORITHMS

Course Outcomes:

CO1: To understand the fundamental concept of sorting.

CO2: To know about different types of graph algorithms.

CO3: To brief about DFS algorithm.

CO4: To apply the Fundamental principle of algorithm for employability.

Unit - I : Analysis Basics -What is analysis? What to count and consider Mathematical Background,Rates of Growth, Recurrence Relation, Analyzing programs.

Unit - II : Searching and selection Algorithms Sequential Search, Binary search Selection, Programming exercise.

Unit - III : Sorting Algorithms : Insertion Sort, Bubble Sort, Shellsort, Quicksort.

Unit - IV : Numeric Algorithm Calculating Polynomials, Matrix Multiplication Linear equations.

Unit - V : Graph Algorithms : Graph Back ground and Terminology, Data Structure Methods for Graphs, Depth-first and Breadth- first Traversal algorithms, Minimum Spanning Tree Algorithm, Shortest- Path Algorithm.

Text Book:

1. Jeffery J.Mac Connell, **Analysis of Algorithms** (**An Active Learning Approach**), Narosa Publishing House, New Delhi, 2002.

   Unit I - Chapter 1 : Section 1.1 to 1.4, 1.6, 1.7
   Unit II - Chapter 2 : Section 2.1 to 2.4
   Unit III - Chapter 3 : Section 3.1, 3.2, 3.3, 3.7
   Unit IV - Chapter 4 : Section 4.1, 4.2, 4.3
   Unit V - Chapter 6 : Section 6.1, 6.2, 6.3, 6.4, 6.5

Reference Books:

1. I. Chandra Mohan, **Design and Analysis of Algorithms,** PHI Pvt. Ltd, New Delhi, 2008.
2. Michael T. Goodrich Roberta Tamassia**, Algorithm Design,** Wiley Student Education Publication, New Delhi, 2009.

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTC21**	**Credits**	**: 05**

ALGEBRA - II

Course Outcomes:

CO1: To familiarize various methods on solving algebraic equations.
CO2: To introduce inequalities.
CO3: To explain about metric measures
CO4: To set up and solve linear system and linear inequalities, algebraically based on skill development.

Unit - I: Elementary Basic Concepts - Dual Spaces – Inner Product Spaces.

Unit -II: The Algebra of linear transformations, Characteristic roots.

Unit -III: Canonical forms, Triangular form, Nilpotent transformations.

Unit -IV: Trace and Transpose, Determinants.

Unit- V: Hermitian, Unitary and Normal transformations.

Text Book:

1. I. N.Herstein,**Topics in Algebra**, Second Edition, John Wiley and Sons, New Delhi, Reprint 2010.

Unit I - Chapter 4: Section 4.1, 4.3 ,4.4.

Unit II - Chapter 6: Section 6.1 and 6.2

Unit III - Chapter 6: Sections 6.4 and 6.5

Unit IV - Chapter 6 : Section 6.8 and 6.9

Unit V - Chapter 6: Section 6.10

Reference Books :

1. Thomas W.Hungerford, **Algebra**, Spinger International Edition, Newyork, 2009.
2. M.L. Khanna, **Linear Algebra,** Jai PrakashNath Publications, Meerut, 1984.
3. Martin Isaacs ,**Algebra,** Library of Congress Cataloging-in-Publication Data, Edition, New Delhi, 2009.

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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTC22**	**Credits**	**: 05**

REAL ANALYSIS – II

Course Outcomes:

CO1: To introduce the Riemann-Stieltjes integral.
CO2: To familiarize the sequence and series of functions and equicontinuous families of functions.
CO3: To acquire knowledge in Exponential, Logarithmic, The Trigonometric and Gamma functions.
CO4: To formulate the problems in the sets and will be able to apply the fundamental principle on skill development.

Unit - I : The Riemann-Stielitjes integral: Definition and Existence of the Integral- Properties of the Integral - Integration and Differentiation - Integration of Vector - Valued functions- Rectifiable Curves.

Unit - II : Sequences and Series of functions: Discussion of Main problem - Uniform Convergence – Uniform Convergence and Continuity-Uniform Convergence and Integration.

Unit - III : Uniform Convergence and Differentiation- Equicontinuous families of functions- The Stone- Weierstrass theorem.

Unit - IV : Some Special Functions; Power series-The Exponential and Logarithmic Functions-The Trigonometric Functions-The Algebraic Completeness of the Complex Field-Fourier Series- The Gamma Function.

Unit - V: Functions of Several variables - Linear Transformation – Differentiation – The Inverse Function Theorem – The Implicit Function Theorem.

Text Book:

1. Walter Rudin, **Principles of Mathematical Analysis** (Third Edition), Mc.Graw Hill Book Company Publications, New Delhi, 1976.

   Unit I - Chapter 6 : Section 6.1 to 6.27

   Unit II - Chapter 7 : Section 7.1 to 7.15

   Unit III - Chapter 7 : Section 7.16 to 7.26

   Unit IV - Chapter 8 : Section 8.1 to 8.22

   Unit V - Chapter 9 : Section 9.1 to 9.29

Reference Books :

1. H.L.Royden, **Real Analysis**, Third Edition, PHI Learning Pvt Ltd., 3rd Edition, New Delhi, 2009.

2. Houshang H.Soharb**, Basic Real Analysis,** Springer International Edition, Newyork, 2009.

3. J.P.Singh, **Real Analysis,** First Edition, Ane Books Pvt Ltd, New Delhi, 2009.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
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Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTC23**	**Credits**	**: 04**

NUMERICAL ANALYSIS

Course Outcomes:

CO1: To develop Numerical computational skills.
CO2: To practice Numerical computational applications.
CO3: To introduce difference equations and recurrence equations.
CO4: To demonstrate understanding and implementation of numerical solution of algorithms based for employability

Unit - I : Introduction – Bisection method – Iteration method (approximation method) based on firstdegree equation, second degree equation, General Iteration Methods .

Unit - II : Introduction, Direct methods, Iteration methods, Eigen Values and Eigen Vectors.

Unit - III : Introduction Lagrange's and Newton Interpolation, Finite Difference Operators, Interpolating Polynomials using Finite Differences, Hermite Interpolation .

Unit - IV : Introduction, Numerical Differentiation, Extrapolation methods, Partial Differentiation,Numerical Integration, Methods based on Interpolation, Composite Integration methods.

Unit - V : Introduction, Difference equations, Numerical methods (Euler method, Backward Eulermethod, Mid-point method. .

Text Book:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, **Numerical Methods for scientific and Engineering computation** – 4th edition, New age international Pvt limited, New Delhi, 2009.

   Unit I - Chapter 2 : Section 2.1-2.4 and 2.6

   Unit II - Chapter 3 : Section 3.1, 3.2, 3.4, 3.5

   Unit III - Chapter 4 : Section 4.1 – 4.5

   Unit IV - Chapter 5 : Section 5.1, 5.2, 5.4 - 5.7, 5.9.

   Unit V - Chapter 6 : Section 6.1-6.3

Reference Books :

1. G.Shankar Rao, **Numerical Analysis,** New Age International publishers, New Delhi,1997.
2. Rainer Kress, **Numerical Analysis**, Springer international Edition, New Delhi, 2010.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2018-2019 and after)

Class	**: M.Sc (Mathematics)**	**Part III**	**: Core**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTC24**	**Credits**	**: 04**

ADVANCED GRAPH THEORY

Course Outcomes:

CO1: To introduce the graph theoretical concepts.
CO2: To explain about advanced application of Graph theory.
CO3: To introduce about graph algorithms.
CO4: To demonstrate the ability to improve the knowledge about advanced models and methods for employability.

Unit - I: Independent sets, Ramsey's theorem,Turan's theorem,

Application: Schur's theorem.

Unit - II: Chromatic number, Brook's theorem, Hajo's conjecture, Chromatic Polynomials, Girth and Chromatic number.

Application: A Storage Problem

Unit -III : Plane and Planar graphs, Dual Graphs ,Euler's formula ,Bridges , Kuratowski's Theorem, The Five-Color theorem and Four Color conjecture, Non - Hamiltonian Planar Graphs.

Application: A Planarity Algorithm.

Unit - IV: Directed Graphs, Directed Paths, Directed Cycles,Flows, Cuts, The Max-Flow Min –Cut theorem.

Applications: A job sequencing problem, Menger's theorem.

Unit -V: Circulation and Potential differences, The number of Spanning Trees,

Applications: Prefect Squares.

Text Book:

1. J.A.Bondy and U.S.R.Murty, **Graph Theory With Applications,** NorthHolland Publications, Newyork, 1976.

   Unit I - Chapter 7 : Sections 7.1 to 7.4

   Unit II - Chapter 8 : Sections 8.1 to 8.6

   Unit III - Chapter 9 : Sections 9.1. to 9.8

Unit IV - Chapter 10 : Section 10.1. to 10.5&Chapter 11 : Section 11.1 to 11.4

Unit V - Chapter 12 : Section 12.1and 12.2

Reference Books:

1. John clark and Derek Allan Holton, **A first look atGraph Theory,** World Scientific Publications, Singapore, 1991.
2. Harary, **Graph Theory**, Narosa Publishing House, New Delhi, 1988.
3. S.K.Yadav, **Elements of Graph Theory,** Ane Books Pvt. Ltd, New Delhi, 2010.
4. ReinhardDiestel, **Graph Theory**, Spinger Publications, 3rd Edition, Germany, 2006.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2018-2019 and after)

Class	**: M.Sc (Mathematics)**	**Part III**	**: Elective**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTE21**	**Credits**	**: 04**

PARTIAL DIFFERENTIAL EQUATIONS

Course Outcomes:

CO1: To expose the students to various methods of solving different kinds of Partial differential equations.

CO2: To make the students to apply their knowledge in PDE to other branches of sciences.

CO3: To classify First and Second order PDE.

CO4: To provide the capability of solving the differential equation problems on skill based.

Unit - I : First Order P.D.E –Curves and Surfaces – Genesis of First Order P.D.E – Classification of Integrals – Linear Equation of the first Order – Pfaffian Differential Equation –Compatible Systems – Charpit's Method – Jacobi's Method.

Unit - II : Integral Surfaces Through a Given Curve –Quasi-Linear Equation –Non- Linear First Order P.D.E.

Unit -III : Second Order P.D.E.: Genesis of Second Order P.D.E – Classification of Second Order P.D.E - One- Dimensional Wave Equation – Vibration of an Infinite String – Vibration of a Semi – infinite String – Vibration of a String of Finite Length (Method of Separation of Variables).

Unit-IV: Laplace's Equation Boundary Value Problems- Maximum and Minimum Principle- The Cauchy Problem – The Dirichlet Problem for the Upper Half Plane – The Neumann Problem for the Upper Half Plane – The Dirichlet Interior Problem for a Circle – The Dirichlet Exterior Problem for a Circle – The Neumann Problem for Circle – The Dirichlet Problem for a Rectangle –Harnack's Theorem.

Unit -V: Green's function, Heat Conduction Problem – Heat Conduction –Infinite Rod Case- Heat Conduction Finite Rod Case – Duhamel's Principle – Wave Equation –Heat Conduction Equation.

Text Book:

1. T.Amarnath, **An Elementary Course in Partial Differential Equation,** Narosa Publishing Company, Chennai, 1997.

   Unit I - Chapter 1 : Section 1.1 to 1.8
   Unit II - Chapter 1 : Section 1.9 to 1.11
   Unit III - Chapter 2 : Section 2.1 to 2.3 (2.3.1 to 2.3.3and 2.3.5)
   Unit IV - Chapter 2 : Section 2.4.1 to 2.4.10
   Unit V - Chapter 2 : Section 2.4 (2.4.11 to 2.4.13)
   Section 2.5 (2.5.1and 2.5.2)
   Section 2.6 (2.6.1and 2.6.2)

Reference Books :

1. E.T. Copson, **Partial differential equations,** S. Chand and Company Ltd., New Delhi , 1984.
2. Jeffrey Raich, **Partial differential equations,** Springer Publisher, Newyork, 1991.
3. Ian sneddon, **Elements of Partial Differential Equations,** Mc Graw-Hill Book Company, New Delhi, 1985.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
(For those who joined in 2018-2019 and after)

Class	**: M.Sc (Mathematics)**	**Part III**	**: Elective**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTE22**	**Credits**	**: 04**

JAVA PROGRAMMING

Course Outcomes:

CO1: To understand Java platform.
CO2: To know about HTML, tags & Applets.
CO3: To initiate the capability on creation and maintenance of websites.
CO4: To provide employability.

Unit - I : C++ Vs JAVA,JAVA and Internet and WWW,JAVA Support systems, JAVA environment.JAVA program structure, Tokens, Statements, JAVA Virtual machine, Constant &Variables, Data Types, Declaration of variables, Scope of Variables, Symbolic Constants, Type Casting.

Operators: Arithmetic, Relational, Logical Assignments, Increment and Decrement, Conditional, Bitwise, special, Expressions & its evaluation.

if Statement, if…else…Statement, Nesting of if…else… statements, else …if Ladder, Switch? Operators, Loops-While, Do, For, Jumps in Loops, Labeled loops.

Unit -II : Defining a Class, Adding Variables and Methods, Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods.

Inheritance : Extending a Class, Overriding Methods, Final Variables and Methods, Final Classes, Finalizer Methods, Abstract Methods and Classes, Visibility Control.

Unit -III : Arrays:One Dimensional & Two Dimensional, Strings, Vectors, Wrapper Classes, Defining Interface Extending Interface, Implementing Interface, Accessing Interface Variable, System Packages, Using system Package, Adding a Class to a Package, Hiding Classes.

Unit -IV : Creating Threads, Extending the Threads Class, Stopping and Blocking a Thread, Life Cycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the Runnable Interface.

Unit -V : Local and Remote Applets Vs Applications, Writing Applets, Applets Life Cycle, Creating and Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File,Running the Applet, Passing Parameters to Applets, Aligning the Display, HTML Tags & Applets, Getting input from the user.

Text Book:

1. E.Balaguruswamy, **Programming with Java**, 2nd Edition, Tata Mc Graw Hill Publishing Company, New Delhi, 2005.
   Unit I - Chapter 2 : Section 42.4,2.5 and 2.9
   Chapter 3 : Section 3.5,3.6,3.7and 3.9
   Chapter 4 : Section 4.2,4.3,4.4,4.5,4.7,4.8and 4.9
   Chapter 5 : Section 5.2 to 5.11
   Chapter 6 : Section 6.3 to 6.8
   Chapter 7 : Section 7.2 to 7.6
   Unit II - Chapter8 : Section 8.1 to 8.18
   Unit III - Chapter 9 : Section 9.1 to 9.7
   Chapter 10 : Section 10.1 to 10.5
   Chapter 11 : Section 11.3 ,11.8,11.9
   Unit IV - Chapter 12 : Section 12.1 to 12.11
   Unit V - Chapter 14 : Section 14.1 to 14.17

Reference Books:

1. Peter Norton, **Peter Norton Guide To Java Programming**, Techmedia Publications.
2. Paul Dietel, Harvey Deited,**Java How to program**, PHI learning Pvt. Ltd, 8th Edition, 2010.
3. WEBSITE **:**https://www.spoken-tutorial.org

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
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Class : M.Sc (Mathematics) **Part III : Elective**
Semester : II **Hours : 06**
Sub code : 18PMTE23 **Credits : 04**

AUTOMATA THEORY AND FORMAL LANGUAGE

Course Outcomes:

CO1: To understand the notion of effective computability.
CO2: To familiarize finite and infinite Automata, Grammars.
CO3: To introduce Push and Down Automata.
CO4: To indentify different formal language classes and their relationship for employability.

Unit- I : Why study automata theory? Introduction to formal proof, Additional forms of proof, Inductive proofs, The Central concepts of Automata theory.

Unit- II : An informal picture of finite automata, Deterministic finite automata, Non-deterministic finiteautomata, An application: Text search, Finite automata with epsilon transitions.

Unit- III : Regular expressions, Finite automata and regular expressions, Applications of regular expressions, Algebraic laws of regular expressions.

Unit -IV : Proving language are not regular, Closure properties of regular languages. Decision properties of regular languages. Equivalence and Minimization of automata .

Unit -V : Context-free grammars, parse trees, applications of context-free grammar. Ambiguity in grammars and languages. Definition of Push Down automata, Languages of PDA, Equivalence of PDA's and CFG's Deterministic PDA.

Text Book:

1. J.E. Hopcroft, R. Motwani, and J.D. Ullman, **Introduction to Automata Languages and Computation**, Pearson Edition, II Edition, New Delhi, 2001.

Unit I - Chapter 1: Sections 1.1 to 1.5,
Unit II - Chapter 2: Sections 2.1 to 2.5
Unit III - Chapter 3: Sections 3.1 to 3.4,
Unit IV - Chapter 4: Sections 4.1 to 4.4
Unit V - Chapter 5: Sections 5.1 to 5.4,
Chapter 6: Sections 6.1 to 6.4

Reference Books:

1. S.F.B. Nasir, **A Text book on Automata Theory,** Cambridge University Press India Pvt. Ltd , New Delhi, 2010.

MANNAR THIRUMALAI NAICKER COLLEGE (Autonomous)
DEPARTMENT OF MATHEMATICS
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Class	**: M.Sc (Mathematics)**	**Part III**	**: Elective**
Semester	**: II**	**Hours**	**: 06**
Sub code	**: 18PMTE24**	**Credits**	**: 04**

FLUID MECHANICS

Course Outcomes:

CO1: To understand the concept of fluids.
CO2: To explain about ideal fluids integrals.
CO3: To inculcate research attitude in diffusion.
CO4: To evaluate pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe for employability.

Unit- I : Real Fluids and Ideal Fluids – Velocity of a Fluid at a point – Streamlines and Path lines; Steady and Unsteady Flows – The Velocity potential – The Vorticity vector - Local and Particle Rates of Change – The Equation of continuity - Worked examples – Acceleration of a Fluid – Conditions at a rigid boundary – General analysis of fluid motion – Pressure at a point in a Fluid at Rest – Pressure at a point in Moving Fluid – Conditions at a Boundary of Two Inviscid Immiscible Fluids – Euler's equations of motion – Bernoulli's equation – worked examples.

Unit -II : Discussion of a case of steady motion under conservative body forces – Some potential Theorems – Some Flows Involving Axial symmetry - Some special two – Dimensional Flows – Impulsive motion. Some three-dimensional Flows:Introduction – Sources. Sinks and Doublets – Images in a Rigid Infinite plane – Axi – Symmetric Flows; stokes stream function.

Unit- III : Some Two – Dimensional Flows: Meaning of a Two – Dimensional Flow – Use of Cylindrical Polar coordinates – The Stream Function – The Complex Potential for Two – Dimensional, Irrotational,Incompressible Flow-Complex Velocity Potentials for Standard Two-Dimensional Flows-Some worked examples-The Milne Thomson circle theorem and Applications-The theorem of Blasius.

Unit - IV: The use of conformal Transformation and Hydrodynamical Aspects-Vortex rows. Viscous flow: Stress components in a Real fluid – Relations between Cartesian Components of Stress – Translational Motion of Fluid element – The Rate of Strain Quadric and Principal Stresses – Some further properties of the Rate of Strain Quadric – Stress Analysis in fluid motion – Relations between Stress and Rate of Strain – The Coefficient of Viscosity and Laminar Flow – The Navier – Stokes equations of Motion of A Viscous fluid.

Unit - V : Some Solvable problems In Viscous Flow – Steady Viscous Flow in tubes Of Uniform Cross Section – Diffusion of Vorticity – Energy Dissipation Due To Viscosity – Steady Flow Past A Fixed Sphere – Dimensional Analysis; Reynolds Number – Prandtl's Boundry Layer.

Text Book:

1. F. Chorlton, **Fluid Dynamics,** CBS Publishers and Distributors, New Delhi-110 002, 1985.

Unit I - Chapter 2: (Full)
Chapter 3: Section 3.1 to 3.6

Unit II - Chapter 3: Section 3.7 to 3.11
Chapter 4: Section 4.1, 4.2, 4.3, 4.5

Unit III - Chapter 5: Section :5.1 to5.9 except 5.7
Chapter 8: Section 8.10 to 8.16

Unit IV - Chapter 5: Section 5.10, 5.12
Chapter 8: Section 8.2 to 8.9

Unit V - Chapter 8: Section 8.10 to 8.16

Reference Book :

1. Shanti Swarup, **Fluid dynamics,** Krishna Prakashan Mandir Publication, Meerut, 1984.

Eligibility condition for admission

For admission to Post Graduate Programmers (P.G) a candidate should have passed the 3years degree course (under 10 + 2 + 3 pattern) (B.Sc Mathematics and B.Sc Mathematics with CA) recognized by the university as equivalent there to.

Duration

Two years. Each year consists of 2 semesters. The duration of a semester is 90 working days.

Attendance

75% of the classes in each semester shortage of attendance can be condoned as per existing university rules.

Evaluation procedure :

A mark Statement with CGPA = $\frac{\sum(MarksXcredits)}{\sum(Credits)}$

Where the summations are over all paper appeared up to the current semester.

Examinations: 3 hours duration. Total marks 100 for all papers
External Internal ratio 75:25 with 2 Internal tests.

The scheme of Examination

The components for continuous internal assessment are:

Two tests and their average	--15 marks
Seminar /Group discussion	--5 marks
Assignment	--5 marks
Total	--25 marks

Pattern of the questions paper for the continuous Internal Assessment

The components for continuous internal assessment are:

Part –A

Six multiple choice questions (answer all) 6 x01= 06 Marks

Part –B

Two questions (‘either …. or ‘type) 2 x 07=14 Marks

Part –C

One question out of two 1 x 10 =10 Marks

Total 30 Marks

Pattern of the question paper for the Summative Examinations:

Note: Duration- 3 hours

Part –A

Ten multiple choice questions 10 x01 = 10 Marks

(No Unit shall be omitted; not more than two questions from each unit.)

Part –B

Five Paragraph questions (‘either …. or ‘type) 5 x 07 = 35 Marks

(One question from each Unit)

Part –C

Three Essay questions out of five 3 x 10 =30 Marks

(One question from each Unit)

Total 75 Marks

Minimum Marks for a Pass

50% of the aggregate (Internal +Summative Examinations).
No separate pass minimum for the Internal Examinations.
34 marks out of 75 is the pass minimum for the Summative Examinations.

PROGRAMME SPECIFIC OUTCOMES

PSO1: To provide students with a knowledge, abilities and insight in Mathematics and computational techniques so that they are able to work as mathematical professional.

PSO2: To train students to deal with the problems faced by software industry through knowledge of mathematics and scientific computational techniques.

PSO3: To provide students with knowledge and capability in formulating and analysis of mathematical models of real life applications.

PSO4: Helps the students to acquire sufficient knowledge on computer skills so as to get placement in MNCs and to inculcate the research aptitude in various subjects in Mathematics.

MANNAR THIRUMALAI NAICKER COLLEGE(Autonomous)
DEPARTMENT OF M.Sc MATHEMATICS
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Table: 1 : Course pattern

Study component	I Sem	II Sem	III Sem	IV Sem	Total Hours	Total Credit	No. of Course	Total Marks
Core Subjects	6(5) 6(5) 6(5) 6(4)	6(5) 6(5) 6(4) 6(4)	6(5) 6(5) 6(5) 6(4)	6(5) 6(5) 6(4) 6(4)	96	74	16	1600
Major Elective	6(4)	6(4)		6(4)	18	12	03	300
Non-Major Elective			6(4)		06	04	01	100
TOTAL	**30(23)**	**30(22)**	**30(23)**	**30(22)**	**120**	**90**	**20**	**2000**

SEMESTER – III							
Subject Code	**Subjects**	**No.of course**	**Hours / week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PMTC31	Field Theory and Lattices	1	6	5	25	75	100
18PMTC32	Complex Analysis	1	6	5	25	75	100
18PMTC33	Topology	1	6	5	25	75	100
18PMTC34	Statistics	1	6	4	25	75	100
18PMTN31	**Non Major Elective:** 1.Mathematics for Competitive Examinations	1	6	4	25	75	100
	TOTAL	**5**	**30**	**23**			**500**

SEMESTER –IV							
Subject Code	**Subjects**	**No.of course**	**Hours / week**	**Credits**	**Maximum Marks**		
					Int	**Ext**	**Total**
18PMTC41	Measure Theory and Integration	1	6	5	25	75	100
18PMTC42	Functional Analysis	1	6	5	25	75	100
18PMTC43	Operations Research	1	6	4	25	75	100
18PMTPR1	Project & Viva-voce	1	6	4	40	60	100
18PMTE41 18PMTE42 18PMTE43 18PMTE44	**Major Elective:** Any one of the Papers from the List given below **1. Number Theory** 2.Advanced Topology 3.Stochastic Processes 4. Fuzzy Sets and Logic	**1**	**6**	**4**	**25**	**75**	**100**
	TOTAL	**5**	**30**	**22**			**500**

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DEPARTMENT OF MATHEMATICS
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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 06**
Sub code	**: 18PMTC31**	**Credit**	**: 05**

FIELD THEORY AND LATTICES

Course Outcomes
CO1: To make the students familiar with the concepts of Galois Theory.
CO2: To introduce its application in solvability by radicals.
CO3: To study about linear transformations and Lattices.
CO 4: To make them understand the aspects of field theory.

Unit –I

Fields, Extension fields, Roots of polynomials.

Unit –II

More about roots, The elements of Galois theory.

Unit –III

Solvability by Radicals, Galois groups over the rationals.

Unit –IV

Finite fields, Wedderburn's Theorem on finite division rings.

Unit – V

Lattices: Lattices and posets, lattices as posets. Sub lattices; direct products, distributive lattices, modular and geometric lattices, Boolean lattices.

Text book s:

1. Herstein.I.N, **Topics in Algebra**, Second Edition, John Wiley and Sons, 1999, New Delhi.
2. Garrot Birkoff and Thomas Bartee, **Modern Applied Algebra,** CBC Publishers and Distributors, 1999, New Delhi.

Unit I- Text Book 1 : Chapter 5 : Sections 5.1,5.3
Unit II -Text Book 1 : Chapter 5 : Sections 5.5,5.6
Unit III - Text Book 1 : Chapter 5 : Sections 5.7,5.8
Unit IV - Text Book 1 : Chapter 7 : Sections 7.1,7.2
Unit V- Text Book 2 : Chapter 9 : Sections 9.1 to 9.7

Reference Books:

1. Vijay K.Khanna, "**Lattices and Boolean Algebras",** Second Edition, Vikas Publishing House Pvt. Ltd, 2008.
2. John B.Fraleigh, "**A First Course in Abstract Algebra"**, Third Edition, Narosa Publishers, 2003, New Delhi.
3. Patrick Morandi , **"Field and Galois Theory"** ,Springer International Edition, 1996, New Delhi.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 06**
Sub code	**: 18PMTC32**	**Credit**	**: 05**

COMPLEX ANALYSIS

Course Outcomes

CO1: To understand the concept of analyticity, line integrals, residues.
CO2: To familiarize its applications.
CO3: To introduce Taylor and Laurent Series.
CO4: To introduce the theory of analytic function, complex integration and Riemann Zeta Function.

Unit –I

Introduction to the concept of Analytic Function – Elementary theory of Power Series.

Unit –II

The Exponential and Trigonometric Function – Conformality – Linear Transformation.

Unit –III

Fundamental Theorems – Cauchy Integral Formula – Local properties of Analytical Function.

Unit-IV

The General form of Cauchy's Theorem – The Calculus of Residues - Harmonic Functions.

Unit –V

Power Series Expansions – Partial Fractions and Factorization - Entire Functions – The Riemann Zeta Function .

Text Book:

1. Ahlfors, L.V., "**Complex Analysis"**, Third Edition, McGraw Hill International Company, 1979, New Delhi.

Unit I -	Chapter 2 : Section 1 and 2 (2.4 & 2.5)
Unit II -	Chapter 2 : Section 3
	Chapter 3 : Section 2 and 3 (3.1 to 3.3)
Unit III -	Chapter 4 : Section 1,2,3
Unit IV -	Chapter 4 : Section 4 (4.1 to 4.5) , Section 5 & Section 6
Unit V -	Chapter 5: Section 1,2(2.1 & 2.2) and Section 3 & 4.

Reference Books:

1. Churchill, R.V, J.W. Brown and R.F. Verhey, **Complex Variables and Applications**, McGraw – Hill International Company, 1974, New Delhi.

2. Conway, J.B, **Functions of one Complex Variable**, Narosa Publishing House, 2006, Chennai.

3. Karunakaran.V, Complex Analysis, Narosa Publishing House, 2005, Chennai.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 06**
Sub code	**: 18PMTC33**	**Credit**	**: 05**

TOPOLOGY

Course Outcomes

CO1: To familiarize the concepts of Topology.
CO2: To learn the various aspects of Topological spaces.
CO 3: To define and categorize the separation axioms which separate a point from another Point.
CO4: To introduce the metrization theorem.

Unit –I

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 – Continuous functions – The product topology.

Unit –II

The metric topology – connected spaces – connected subspaces of the real line.

Unit-III

Compact spaces – Compact sub spaces of the real line – Limit point compactness – Local compactness.

Unit –IV

Countability axioms - The separation axioms – Normal spaces .

Unit – V

The Urysohn Lemma – The Urysohn metrization theorem – Tietze Extension theorem.

Text Book:

1. James R.Mukres, "**Topology**" (Second Edition), Prentice –Hall of India Private Ltd, January 1987, New Delhi.

Unit I-	Chapter 2 : Sections 12 to 19
Unit II -	Chapter 2 : Sections 20 and 21 &
	Chapter 3: Sections23 and 24
Unit III -	Chapter 3 : Sections 26 to 29
Unit IV -	Chapter 4 : Sections 30 to 32
Unit V -	Chapter 4 : Sections 33 to 35

Reference Books:

1. Gupta. K.P, **Topology**, First Edition, Pragati Prakashan Educational, 1974, Meerut-250001.
2. James Dugundji, **Topology**, Universal book stall, Reprint 1990, New Delhi.
3. . Chandrasekhara Rao, "Topology", Narosa Publishing House, 2009, New Delhi.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
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Programme	**: PG**	**Part III**	**: Core**
Semester	**: III**	**Hours per week**	**: 06**
Sub code	**: 18PMTC34**	**Credit**	**: 04**

STATISTICS

Course Outcomes
CO1: To develop knowledge on various standard distributions.
CO2: To introduce Sampling Theory.
CO3: To familiarize the application through various statistical methods.
CO4: To create statistical models for real life problems.

Unit – I

Introduction : Set theory, Probability set function, Conditional probability and Independence , Random variables of the discrete type , Random Variables of the continuous type , Properties of the distribution function, Expectation of a Random variable, Some special expectations , Chebyshev's inequality.

Unit – II

Distributions of random variables, Conditional distributions and expectations , The correlation coefficient , Independent random variables, Extension to several random variables.

Unit – III

The Binomial and Related distributions, The Poisson distribution, The Gamma and Chi-square distribution, The Normal distribution, The Bivariate normal distribution.

Unit – IV

Sampling theory , Transformations of variables of the discrete type, Transformations of variables of the continuous type, The Beta , t, F distributions, Extensions of the change of variable technique, The moment generating function technique, Some Specific distributions - The distributions of $\bar{X}$ and $\frac{n s^2}{\sigma^2}$, Expectation of functions of Random Variables.

Unit –V

Convergence of distribution, Convergence of probability, Limiting moment generating functions , the Central limit theorem , Some theorems of limiting distributions.

Text Book :

1. Hogg, R.V and Craig, A.T, **Introduction to Mathematical Statistics**, Fifth Edition , Pearson Education, 2005, New Delhi.

Unit I - Chapter 1 : Sections 1.1 to 1.10

Unit II - Chapter 2 : Sections 2.1 to 2.5

Unit III - Chapter 3 : Sections 3.1 to 3.5

Unit IV - Chapter 4 : Sections 4.1 to 4.9

Unit V - Chapter 5 : Sections 5.1 to 5.5

Reference Books:

1. Irwin Miller, **Mathematical Statistics**, Pearson Publisher, 2004.
2. David Freeman, **Statistics**, Viva Book Publisher, 2010.
3. R.S.N.Pillai & Bagavathy , Statistics Theory and Practice, S.Chand Publications, 7th Revised Edition , 2008.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS
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Programme	**: PG**	**Part IV**	**: NME**
Semester	**: III**	**Hours per week**	**: 06**
Sub code	**: 18PMTN31**	**Credit**	**: 04**

MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Course Outcomes

CO1: To develop knowledge on various standard distributions.
CO2: To introduce Sampling Theory.
CO3: To familiarize the application through various statistical methods.
CO 4: To apply the concepts in Competitive Examinations.

Unit –I

H.C.F. and L.C.M. of numbers – Simplifications.

Unit – II

Percentage – Profit and loss – Ratio and proportion.

Unit – III

Time and work – Time and distance – Problems on Trains.

Unit – IV

Simple interest – Compound interest – Stocks and Shares.

Unit –V

Data interpretation: Tabulation – Bar Graphs – Pie charts.

Text Book:

1. Aggarwal. R.S, **Quantitative Aptitude**, S.Chand and Company Ltd, 2009, New Delhi.
   Unit I – Chapters 2 & 4 (Except exercises)
   Unit II – Chapters 10, 11 & 12 (Except exercises)
   Unit III – Chapters 15, 17 & 18 (Except exercises)
   Unit IV – Chapters 21, 22 & 29 (Except exercises)
   Unit V – Chapters 36, 37 & 38 (Except exercises)

Reference Books:

1. Abhigit Guha, **Quantitative Aptitude**, 4th Edition, Tata McGraw Hill Publications, 2011, New Delhi.
2. Mohan Rao.U, **Quantitative Aptitude**, Scitech Publications, Reprint 2013, Chennai.

Aggarwal. R.S, **Verbal & Non Verbal Reasoning**, S.Chand & Co, 2009, New Delhi.

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Programme	**: PG**	**Part III**	**: Core**
Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTC41**	**Credit**	**: 05**

MEASURE THEORY AND INTEGRATION

Course Outcomes

CO1: To introduce the idea connected to the concepts of measures.
CO2: To explain about measurable sets and functions.
CO3: To learn more about Riemann and Lebesgue integration.
CO4: Ability to use a wide range of references and thinking.

Unit –I

Measure on the Real line – Lebesgue outer Measure – Measurable sets-Regularity.

Unit – II

Measurable functions – Borel and Lebesgue Measurability.

Unit – III

Integration of non-negative functions – The general integral – Integration of series.

Unit – IV

Riemann and Lebesgue integrals – The four derivatives – Continuous non – differentiable functions.

Unit – V

Functions of bounded variations – Lebesgue differentiation theorem – Differentiation and Integration – The Lebesgue set.

Text book:

1. De Barra. G, **Measure Theory and Integration**, New Age International Pvt Ltd, Chennai, Reprint, 2010.
   Unit I – Chapter 2 Sections 2.1 to 2.3
   Unit II – Chapter 2 Sections 2.4 & 2.5
   Unit III – Chapter 3 Sections 3.1 to 3.3
   Unit IV – Chapter 3 Section 3.4 & Chapter 4 Sections 4.1 & 4.2
   Unit V – Chapter 4 Sections 4.3 to 4.6

Reference Books:

1. Royden, H.L., **Real Analysis**, Pretice-Hall of Indian Pvt. Ltd, 2008, New Delhi.
2. Jain, P.K and Gupta. P.K, **Lebesgue Measure and Integration**, New Age International Pvt .Ltd, Reprint 2010, Chennai.
3. Malik. A. K & S.K.Gupta, "**Measure Theory and Intregration**", I.K International Publishibg House Pvt , Ltd, Reprint 2017, New Delhi.

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
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Programme	**: PG**	**Part III**	**: Core**
Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTC42**	**Credit**	**: 05**

FUNCTIONAL ANALYSIS

Course Outcomes

CO1: To develop the skills in analyzing the basic structure of Normed spaces.
CO2: To get knowledge in using some special classes of functions.
CO3: To explain about various types of operators.
CO4: To understand Banach and Hilbert spaces and self-adjoint Operators.

Unit I

Normed Spaces, Banach Spaces – Further properties of normed spaces – finite dimensional normed spaces and Subspaces - Compactness and Finite Dimension - Linear operators.

Unit II

Bounded and Continuous linear operators-Linear functionals – linear operators and functionals on finite dimensional spaces –normed spaces of operators and dual spaces - Inner product space, Hilbert space - Further properties of inner product spaces.

Unit III:

Orthogonal complements and direct sums – Orthonormal sets and sequences –series related to orthonormal sets and sequences – Total orthonormal sets and sequences - Representation of functionals on Hilbert spaces.

Unit IV

Hilbert Adjoint operator - Self adjoint operators, unitary and normal operators - Zorn's Lemma - Hahn-Banach Theorem- Hahn-Banach theorem for complex vector spaces and normed spaces - Bounded Linear Functional on C[a, b] and its Applications.

Unit V

Adjoint operator - Reflexive spaces – Uniform boundedness theorem - Strong and weak convergence – Convergence of sequences of operators and functional - Open mapping theorem - Closed graph theorem.

Text Book:

1. Introductory Functional Analysis with Applications by Erwin Kreyszig , John Wiley & Sons Publication (2006).

Unit I -	Chapter 2:Sections 2.2 - 2.6
Unit II -	Chapter 2: Section 2.7 - 2.10
	Chapter 3: Sections 3.1 - 3.2
Unit III -	Chapter 3: Sections 3.3 - 3.6 & 3.8
Unit IV -	Chapter 3: Section 3.9 - 3.10
	Chapter 4: Sections 4.1 - 4.4
Unit V -	Chapter 4: Sections 4.5 - 4.9 & 4.12 -4.13

Reference Books:

1. Limaye. B.V, **Functional Analysis,** New age International PVT. Ltd, 2007, New Delhi.
2. PawanK.Jain & OM.P.Ahuja, **Functional Analysis**, New Age International (P) Limited, New Delhi.
3. Thamban Nair. M, "**Functional Analysis**- A First course, PHI Learning Private Limited, 2002, New Delhi.

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Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTC43**	**Credit**	**: 04**

OPERATIONS RESEARCH

Course Outcomes

CO1: To familiarize various decision– making tools.
CO2: To introduce some techniques used in OR.
CO3: To introduce the application on inventory control system and etc.
CO4: To Identify the resources required for a project and generate a plan and work schedule.

Unit – I

Network definitions- minimal spanning tree algorithm-Shortest route problem-maximal flow model-minimum cost capacitated flow problem- CPM and PERT.

Unit – II

Recursive nature of computations in DP - Forward and Backward recursion - Selected DP applications. General inventory models – Static Economic Order Quantity(EOQ) models.

Unit –III

Decision making under certainty-Analytic Hierarchy Process(AHP)-Decision making under risk- decision under uncertainty-Game theory.

Unit –IV

Queuing systems – Elements of Queuing model – Role of Exponential Distribution – Pure Birth and Death Models – Generalized Poisson Queuing Models – Specialized Poisson Queues.

Unit –V

Unconstrained Problems – Constrained Problems.

Text Book:

1. Hamdy A. Taha, **Operations Research – An introduction**, 8th Edition, PHI, New Delhi.
   Unit I - Chapter 6: sections 6.1 to 6.5
   Unit II - Chapter 10: sections 10.1 to 10.3
   Chapter 11:sections 11.1 to 11.3
   Unit III - Chapter 13:sections 13.1 to 13.4
   Unit IV - Chapter 15:sections 15.1 to 15.6
   Unit V - Chapter 18: sections 18.1 to 18.2

Reference Books:

1. Kanti Swarup , P.K. Gupta and Man Mohan, "**Operations Research"** , Sultan Chand & sons Publications, Reprint 2006, New Delhi.

2. Harvey M. Wagner, "**Principles of Operations Research", Second** Edition, Prentice Hall of Pvt Ltd, 1998, New Delhi.

3. Prem Kumar Gupta and D.S.Hira, "**Operations Research**", S.Chand Publications, 2009, New Delhi.

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Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTPR1**	**Credit**	**: 04**

PROJECT & VIVA-VOCE

Evaluation of the Project & Viva-Voce shall be made jointly by the research supervisor and the External Examiner.

Evaluation of Project & Viva-Voce

Maximum Marks : 100 Marks

Internal : 40 Marks
External : 60 Marks

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Programme	**: PG**	**Part III**	**: Elective**
Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTE41**	**Credit**	**: 04**

NUMBER THEORY

Course Outcomes

CO1: To introduce some importance tools in number theory.
CO2: To learn about number theoretical functions.
CO3: To recognise the importance of the Division Algorithm, and be able to apply it in a variety of scenarios.
CO4: To familiarize about primitive roots.

Unit – I

Preliminaries: Well – ordering principle, induction , binomial coefficients, Greatest integer function – Divisibility : Notion of divisibility, G.C.D, Euclids Algorithm , G.C.D via Euclid's Algorithm, L.C.M, Representations of integers .

Unit – II

Primes: Definition, Prime counting function , Prime number theorem ,Test of Primality, Sieve of Eratosthenes, Canonical factorization, Fundamental theorem of Arithmetic.

Unit – III

Congruences : Congruences and Equivalence relations, Linear Congruence, Linear Diophantine equations, Chinese Remainder Theorem, Polynomial Congruences, Modular Arithmetic, Fermat's Theorem, Wilson's Theorem, Pythagorean equation.

Unit – IV

Arithmetic functions: Sigma, Tau functions, Dirichlet product, Dirichlet inverse, Mobius function, Euler's function, Euler's theorem.

Unit –V

Primitive roots: Definition, properties, Existence-Quadratic Congruences : Quadratic Residues, Legendre symbols, Gauss lemma, Law of quadratic reciprocity .

Text Book:

1. Neville Robbins, **Beginning of Number Theory**, Second Edition, Narosa publications, New Delhi, 2006.
   Unit I - Chapters : 1,2
   Unit II - Chapter : 3
   Unit III - Chapter :4
   Unit IV - Chapter : 5
   Unit V - Chapter 6: sections 1,2 & 3 only.
   Chapter 7: sections 1,2 and 3 only.

Reference Book:

1. Ivan Niven**, Introduction to Theory of numbers,** Wiley Eastern, 2009.
2. Tom M. Apostal, Introduction to Analytic Number Theory, Springer International Edition,
3. Martin Erichson & Anthony Vazzana**, " Introduction to Number Theory",** Saurabh printers Private Ltd, 2010.

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Programme	**: PG**	**Part III**	**: Elective**
Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTE42**	**Credit**	**: 04**

ADVANCED TOPOLOGY

Course Outcomes

CO1: To introduce the concept of Local finiteness and Completeness.
CO2: To familiarize compactness.
CO3: To study about Baire spaces.
CO4: To define and categorize the separation axioms which separate a point from another point, a point from a set that does not contain this point and a set from another set.

Unit –I

The stone-cech Compactification- Local finiteness.

Unit – II

The Nagata- smirnov Metrization theorem – Para Compactness- The Smirnov Metrization theorem.

Unit –III

Complete metric spaces- A space filling curve.

Unit – IV

Compactness in metric spaces – point wise and compact convergence- Ascoli's theorem.

Unit – V

Barie spaces – A Nowhere differentiable function

Text Book :

1. James R.Mukres, **Topology,** Second Edition, Prentice –Hall of India Private Ltd, New Delhi, 2010.

Unit I -	Chapter 8 : section 38
	Chapter 6 : section 39
Unit II -	Chapter 6 : section 40, 41 and 42
Unit III -	Chapter 7 : section 43 and44
Unit IV -	Chapter 7 : section 45,46 and 47
Unit V -	Chapter 8 : section 48 and 49.

Reference Books:

1. Gupta. K.P, **Topology**, First Edition, Pragati Prakashan Educational, 1974, Meerut.
2. James Dugundji, **Topology,** Universal book stall, Reprint 1990, New Delhi.
3. Chandrasekhara Rao.K, "**Topology**",Narosa Publishing House, 2009, New Delhi.

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Semester	**: IV**	**Hours per week**	**: 06**
Sub code	**: 18PMTE43**	**Credit**	**: 04**

STOCHASTIC PROCESSES

Course Outcomes

CO1: To introduce the concepts of Stochastic Process.
CO2: To familiarize its applications.
CO3: To learn about real life problems.
CO4: To provide the classification and properties of, discrete and continuous time Markov chains, simple Markovian queueing models.

Unit – I

Stochastic Processes : Some notions – Specification of Stochastic processes – Stationary process – Markov Chains – Definitions and examples – Higher Transition probabilities – Generalization of Independent Bernoulli trails- Sequence of chain – Dependent trains.

Unit-II

Markov Chains : Classification of state and chains – determination of higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.

Unit –III

Markov processes with Discrete state space : Poisson processes and their extensions – Poisson process and related distribution – Generalization of Poisson process – Birth and Death process- Markov processes with discrete state space (continuous time Markov Chains)

Unit –IV

Renewal processes and theory : Renewal process – Renewal processes in continous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.

Unit-V

Stochastic processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state behaviour – transient behaviour of M/M/1 Model – Non Markovian models – the model GI/M/1.

Text Books:

1. Medhi.J, **Stochastic Processes**, Wiley Eastern, 1987, New Delhi.

   Unit I - Chapter 2 : Sections 2.1 to 2.3, Chapter 3 : Sections 3.1 to 3.3
   Unit II - Chapter 3 : Sections 3.4 to 3.6, 3.8, 3.9 and 3.11
   Unit III - Chapter 4 : sections 4.1 to 4.5
   Unit IV - Chapter 6 : sections 6.1 to 6.5
   Unit V - Chapter 10 : Sections10.1 to 10.3, 10.7 and 10.8

Reference Books:

1. Basu.A.K., **Stochastic Process**, Narosa Publisher, 2007, New Delhi.
2. Bhat. B.R, Stochastic Model, New Age International Publisher, 2010, Delhi, reprint.
3. Zdzistaw Brzezniak and Tomsz Zastawniak, Basic Stochastic process, Springer, 2009, Delhi.

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Sub code	**: 18PMTE44**	**Credit**	**: 04**

FUZZY SETS AND LOGIC

Course Outcomes:
CO1: To develop the basic knowledge of fuzzy sets and its operations.
CO2: To familiarize fuzzy numbers and fuzzy operations.
CO3: To explain about the nature and difference between crisp and fuzzy relations.
CO4: Be thorough with the concept of Logical connectives and fuzzy graphs.

Unit – I

Fuzzy sets: Basic types – Basic concepts – Additional properties of α–cuts – Representation of fuzzy sets – Extension principle for fuzzy sets – Types of operations – Fuzzy complements.

Unit – II

Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Arithmetic operation on fuzzy numbers..

Unit – III

Fuzzy relation: Crisp versus Fuzzy relation – projection and cyclinderic extensions - Binary fuzzy relation on a single set – fuzzy equivalence relations – Fuzzy compatibility relation – Fuzzy ordering relation.

Unit – IV

Fuzzy logic: Classical logic – An over view – multi-valued logic –Fuzzy propositions – Fuzzy quantifiers – Linguistic hedges.

Unit – V

Applications: Approximate Reasoning –An Overview – Fuzzy Implications – Selection of Fuzzy Implications – Multi-conditional Approximate Reasoning – The Role of Fuzzy Relation Equations – Interval-Valued Approximate Reasoning.

Text Book:

1. George J Klir and B.Yuan, Fuzzy sets and Fuzzy logic – Theory and application, Second edition, Prentice Hall, 1995, New Delhi.

Unit I -	Chapter 1: Sections 1.2 to 1.4
	Chapter 2: Sections 2.1 to 2.3
	Chapter 3: Sections 3.1 & 3.2
Unit II -	Chapter 4: Section 4.1 to 4.4
Unit III -	Chapter 5: Sections 5.1 to 5.7
Unit IV -	Chapter 8: Section 8.1 to 8.5
Unit V -	Chapter 11: Sections 11.1 to 11.6

Reference Books:

1. Zimmermann, H.J, **Fuzzy Set Theory and its Applications**, Fourth Edition, Springer Publishers, 2006, New Delhi.
2. DuBois.D and Prade.H.M, Fuzzy Sets and Systems: Theory and Applications, Academic Press, 1994.
3. Ganesh.M, Introduction to Fuzzy sets and Fuzzy logic, Prentice Hall of India, 2006), New Delhi.