SRI MEENAKSHI GOVERNMENT ARTS COLLEGE
FOR WOMEN (AUTONOMOUS)
MADURAI -2.

DEPARTMENT OF MATHEMATICS

CBCS course structure for M.Sc. Mathematics as directed by Tamilnadu State Council for Higher Education

From June 2021 Onwards

SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN(A)
DEPARTMENT OF MATHEMATICS

The Department of Mathematics is offering B.Sc. Mathematics since 1966 and M.Sc. Mathematics since 1980.

The department has an enterprising faculty team and provides an enriched academic ambience for the students. Seven of the faculty members have a Ph.D. Three of them are recognized research guides of Madurai Kamaraj University. Four of the faculty members are currently pursuing Ph.D.

Five of the staff members have degree in pedagogy. Four faculty members have PGDCA qualification.

Vision

The Vision of our department is to empower the Women Students to attain academic excellence.

Mission

The Mission of Mathematics department is to provide a strong foundation in Mathematics which will enable our students to excel in pedagogy and research.

Program Outcomes

The successful completion of M.Sc. program will enable the students to:

PO1 Demonstrate in depth knowledge in the relevant discipline

PO2 Master the scientific approach with critical thinking (towards) problem solving

PO3 Identify research problems with creativity and sensitivity to attain sustainable solutions

PO4 Exhibit effective communication to interact with all stakeholders

PO5 Apply/translate the acquired techniques successfully in their chosen career.

Program Specific Outcomes

On successful completion of M.Sc. Mathematics program the students will be able to:

PSO1 Acquire mastery in the core subjects of Algebra, Analysis, Geometry and Differential equations and gain in depth knowledge in applications of mathematics such as Statistics, Operations Research, Design and Analysis of Algorithms.

PSO2 Master a wide range of mathematical skills.

PSO3 Develop the ability to model real life problems using the mathematical concepts .

PSO4 Identify the appropriate problem solving technique which can be applied to any given mathematical model.

PSO5 Tackle competitive examinations like CSIR JRF/NET, TRB recruitment etc with confidence.

MAPPING PATTERN

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very Poor	Poor	Moderate	High	Very High

M.Sc. Mathematics (2021 onwards)

Semester	Subject Code	Title of the Paper	Hours	Credit
I	MA1	Groups and Rings	6	5
	MA2	Ordinary Differential Equations	6	5
	MA3	Classical Mechanics	6	4
	MA4	Numerical Analysis	6	4
	EMA	Elective - 1	6	4
		Total	**30**	**22**
II	MB1	Topology	6	5
	MB2	Real Analysis	6	5
	MB3	Fields and Lattices	6	4
	MB4	Differential Geometry	6	4
	EMB	Elective - 2	6	4
		Total	**30**	**22**
III	MC1	Number Theory	6	5
	MC2	Probability and Statistics	6	5
	MC3	Measures and Integration	5	4
	MC4	Fuzzy Set Theory	5	4
	EMC	Elective - 3	6	4
	NMPM	Non Major Elective	2	2
		Total	**30**	**24**
IV	MD1	Complex Analysis	6	5
	MD2	Functional Analysis	6	5
	MD3	Advanced Statistics	6	4
	MPW	Project	6	4
	EMD	Elective - 4	6	4
		Total	**30**	**22**

List of Elective Papers (From 2021 onwards)

1. Formal Languages and Automata Theory
2. Graph Theory
3. Integral Transforms
4. Data Structures using 'C'
   Data Structures using 'C' Lab
5. Coding Theory
6. Calculus of Variations
7. Cryptography
8. Combinatorics
9. Design and Analysis of Algorithms
10. Partial Differential Equations
11. Operations Research

List of Non Major Elective Paper

1. Mathematical Logic and Reasoning

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M.Sc. Mathematics (2021 onwards)
CORE AND ELECTIVE

EVALUATION PATTERN

Internal	:	25
External	:	75
Total	:	100

Passing Minimum	:	50 Marks
No Internal Minimum		
External Minimum	:	45% (34 Marks)
Internal and External together	:	50%

Question Paper Pattern

Time: 3 hours Max Marks : 75

Section A :

5 questions. Each question with **internal choice** between two questions from the same unit. That is every question is of 'either – or ' type.

5x 6 marks = 30 marks
(1 Question from each unit)

Section B:

3 out of 5 Questions
3x15 Marks = 45 Marks
(1 Question from each unit)

BLOOM'S TAXONOMY

REMEMBERING	**50%**
UNDERSTANDING	**30%**
APPLYING	**20%**

NON MAJOR ELECTIVE

Mathematical Logic and Reasoning **(2021 onwards)**

EVALUATION PATTERN

Internal	:	25
External	:	75
Total	:	100

Passing Minimum	:	50 Marks
No Internal Minimum		
External Minimum	:	45% (34 Marks)
Internal and External together	:	50%

Question Paper Pattern

Time: 3 hours Maximum Marks : 75

Section A : Objective

50 Questions
50x1 Mark = 50Marks

Section B: Descriptive

5 out of 8 Questions
5x5 Marks = 25 Marks

Semester: I **Hours: 6/W 90/Sem**

Course Code: MA1 **Credits: 5**

Title of the Paper: GROUPS AND RINGS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	-	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Demonstrate counting principle and Sylow's theorem	1	18
CO2. Know about direct products and finite abelian groups	2	18
CO3. Gain knowledge about Euclidean rings, Polynomial rings	3	18
CO4. Explain about dual spaces and Modules	4	18
CO5. Compute which groups are solvable, prove Jordan Holder theorem and Schrier Refinement theorem.	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	3	4	4	5	3	3	4	5	3.9
CO2	3	4	3	3	4	4	4	3	4	4	3.6
CO3	4	3	4	3	3	5	4	3	3	5	3.7
CO4	4	4	3	3	4	4	3	3	4	4	3.6
CO5	3	3	4	3	3	4	4	3	4	5	3.6

Overall Mean Score : 3.7

SEMESTER I

MA1 – GROUPS AND RINGS

Lecture hours: 6 Credit: 5

UNIT I

Another Counting Principle – Sylow's Theorem.

UNIT II

Direct Products – Finite Abelian Groups.

UNIT III

Euclidean Rings – A Particular Euclidean Ring - Polynomial Rings over Commutative Rings.

UNIT IV

Dual Spaces - Modules.

UNIT V

Solvable Groups – Jordan-Holder Theorem and Schrier Refinement Theorem.

TEXT BOOK

TB1: Topics in Algebra – I.N.Herstein, Second Edition John Wiley & Sons, Newyork, Singapore. 2016

TB2 : Modern Algebra by Surjeet Singh and Zameerudin,Eigth Edition (2014), Vikas Publishing House Pvt. Ltd.

UNIT I : TB1 : Chapter 2 : Sections 2.11, 2.12
UNIT II : TB1: Chapter 2 : Sections 2.13, 2.14
UNIT II : TB1 : Chapter 3 : Sections 3.7, 3.8, 3.11
UNIT IV : TB1 : Chapter 4 : Sections 4.3, 4.5
UNIT V : TB1 : Chapter 5 :Sections 5.7 (Upto theorem 5.7.1)and
TB2: Jordan - Holder Theorem and SchrierRefinement Theorem.

REFERENCE BOOK :

1. Linear Algebra by Sharma and Vasishtha
2. Linear Algebra by H. D. Ikramov
3. Modern Algebra by A.R.Vashishtha, 20 th Edition 1987-88, Krishna prakashan Mandir.

Semester: I **Hours: 6/W 90hrs/Sem**

Course Code: MA2 **Credits:5**

Title of the Paper: ORDINARY DIFFERENTIAL EQUATIONS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	3	1	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Acquire Knowledge about Linear differential homogeneous equations .	1	18
CO2. Solve the homogeneous equations.	2	18
CO3. Understand about Euler Equations and second order equations with Regular singular points.	3	18
CO4. Know about Bessal equations.	4	18
CO5. Apply the method of successive approximations and Lipschitz condition.	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	3	3	3	4	4	3	4	4	3.6
CO2	4	4	3	3	3	4	3	3	4	4	3.5
CO3	4	4	3	2	2	3	4	3	4	4	3.3
CO4	3	4	3	3	2	4	4	2	4	3	3.2
CO5	3	4	3	2	2	3	3	2	3	3	2.8

Overall Mean Score: 3.3

SEMESTER – I

MA2 – ORDINARY DIFFERENTIAL EQUATIONS

Lecture hours: 6 Credit:5

UNIT I

Linear Equations with Constant Coefficients - Introduction – The second order homogeneous equation – Initial value problems for second order equations – Linear dependence and independence – A formula for the Wronskian – The Non-homogeneous equation of order two - The homogeneous equation of order n.

UNITII

Linear Equations with Variable Coefficients -Introduction – Initial value problems for the homogeneous equation – Solutions of the homogeneous equation – The Wronskian and linear independence – Reduction of the order of a homogeneous equation – Homogeneous equations with analytic coefficients – The Legendre equation.

UNIT III

Linear Equations with Regular Singular Points -Introduction – The Euler equations – Second order equations with regular singular points - An example – Second order equations with regular singular points – The general case – A convergence proof – The exceptional cases.

UNIT IV

The Bessel equation – The Bessel equation (continued) – Regular singular points at infinity - Existence and uniqueness of solutions to first order equations - Introduction – Equations with variables separated – exact equations.

UNIT V

The method of successive approximations – The Lipschitz condition – convergence of the successive approximations – Approximations to and uniqueness of solutions.

TEXT BOOK

An introduction to Ordinary Differential Equations – Earl. A. Coddington, Prentice Hall of India, New Delhi, Sixteenth Indian Reprint, 2003.

UNIT I : Chapter 2 : Sections 1 to 7.
UNIT II : Chapter 3 : Sections 1 to 5 , 7 and 8.
UNIT III : Chapter 4 : Sections 1 to 6.
UNIT IV : Chapter 4 : Sections 7 to 9 Chapter 5:Sections 1 to 3.
UNIT V : Chapter 5 : Sections 4 to 6 and 8.

REFERENCE BOOKS :

1. Ordinary Differential Equations and Stability Theory by S.G.Deo, V Lakshmi Kantham, &V.Raghavendra, 2nd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Ordinary Diffrential Equations by M.Rama Mohana Rao, Affiliated East – West Press Pvt Ltd, New Delhi.
3. Ordinary Differential Equations by D.Somasundaram

Semester: I **Hours: 6/W 90hrs/Sem**

Course Code: MA3 **Credits: 4**

Title of the Paper: CLASSICAL MECHANICS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	5	1	-	-

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. A study of the machines of a particle & system of particle	1	18
CO2. Gain knowledge about simple applications of the Lagrangian formulation and some techniques of the calculus of variations	2	18
CO3. A study of derivation of Lagrange's equations & Advantages of a variational principle formulation	3	18
CO4. A study of cyclic coordinates and conservations theorems	4	18
CO5.Gather the knowledge of derivation of Hamilton's equation from a variational principle & the principle of least action	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	4	4	3	3	3	4	3	3.4
CO2	3	4	4	4	4	3	3	3	4	3	3.5
CO3	3	4	3	4	4	3	3	3	4	3	3.4
CO4	3	4	3	4	4	3	3	3	4	3	3.4
CO5	3	4	3	4	4	3	3	3	4	3	3.4

Overall Mean Score: 3.4

SEMESTER I

MA3 – CLASSICAL MECHANICS

Lecture hours : 6 Credit : 4

UNIT I

Mechanics of a particle – Mechanics of a system of particles – Constraints – D' Alembert's principle and Lagrange's equations.

UNIT II

Velocity – dependent potentials and the dissipation function. Simple applications of the Lagrangian formulation – Hamilton's principle – Some techniques of the calculus of variations.

UNIT III

Derivation of Lagrange's equations from Hamiltion's principle – Extension of Hamilton's principle to nonholonomic systems – Advantages of a variational principle formulation –Conservation theorems and symmetry properties.

UNIT IV

Legendre transformations and the Hamilton equations of motion – Cyclic coordinates and conservation theorems – Routh's procedure and oscillations about steady motion.

UNIT V

The Hamiltonian formulation of relativistic mechanics – Derivation of Hamilton's equations from a variational principle- The principle of least action.

TEXT BOOK

Classical Mechanics by Herbert Goldstein,Second edition, Narosa Publishing House, New Delhi, 2001.

UNIT I	:	Chapter1	:	Sections 1.1, 1.2, 1.3, 1.4
UNIT II	:	Chapter1	:	Sections 1.5, 1.6
		Chapter2	:	Sections 2.1, 2.2
UNIT III	:	Chapter2	:	Sections 2.3, to 2.6
UNIT IV	:	Chapter8	:	Sections 8.1 to 8.3
UNIT V	:	Chapter8	:	Sections 8.4 to 8.6

REFERENCE BOOKS :

1. Classical Mechanics by Donald T.Greenwood, Prentice Hall of India Pvt.Ltd, New Delhi, 1985.
2. Classical Mechanics by D.T.Greenwood, Prentice Hall of India Pvt. Ltd., New Delhi, 1979.
3. Classical Mechanics by D. Rutherford, Oliver and Boyd, 1987.

Semester: I **Hours: 6/W 90/Sem**

Course Code: MA4 **Credits: 4**

Title of the Paper: NUMERICAL ANALYSIS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	5	-	1	-

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1:Understand the basics of iterative methods for non linear equation	1	18
CO2. Solve linear systems	2	18
CO3. Compute interpolating polynomial and estimate its error	3	18
CO4. Gather knowledge about numerical integration and differentiation	4	18
CO5. Gain the knowledge of error estimates and convergence of Euler's method – Runge kutta method	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	4	3	3	3	3	3	3
CO2	2	3	3	3	4	3	3	3	3	3	3
CO3	2	3	3	3	4	3	3	3	3	3	3
CO4	2	3	3	3	4	3	3	3	3	3	3
CO5	2	3	3	3	4	3	3	3	3	3	3

Overall Mean Score: 3

SEMESTER- I

MA4- NUMERICAL ANALYSIS

Lecture hours : 6 hrs Credits : 4

UNIT – I The Solution of Non linear equations

A survey of Iterative methods – Fixed point Iteration – Convergence Acceleration for fixed point Iteration – convergence of the Newton and Secant methods.

UNIT – II Systems of Linear equations.

The Solution of Linear systems by elimination – The Pivoting Strategy – The Triangular Factorization

UNIT – III Interpolation by Polynomial

Polynomial Forms – Existence and Uniqueness of the Interpolating polynomial – The Divided Difference table – The Error of the Interpolating polynomial- Interpolation in a Function Table Based on equally spaced points.

UNIT -IV Differentiation and Integration

Numerical Differentiation – Numerical Integration: Some Basic rules - Numerical Integration - Gaussian Rules – Numerical Integration - Composite Rules.

UNIT – V The Solution of Differential equations

Mathematical preliminaries - Simple Difference equations – Numerical integration by Taylor series – Error estimates and Convergence of Euler's method – Runge -Kutta method.

TEXT BOOK:

Numerical Methods for scientific and Engineering Computation (Sixth Edition) by M.K.Jain, S.R.K.Iyengar, New Age International Pvt. Ltd., Publishers, 2012.

UNIT I : CHAPTER 2 SECTIONS : 2.1-2.3 & 2.5,2.6.
UNIT II : CHAPTER 3 SECTIONS : 3.1 & 3.2.
UNIT III : CHAPTER 4 SECTIONS : 4.1-4.4.
UNIT IV : CHAPTER 5 SECTIONS : 5.2,5.6,5.7,5.8 (upto page 371) & 5.9
UNIT V : CHAPTER 6 SECTIONS : 6.1 – 6.4

REFERENCE BOOK :

1) Applied Numerical Analysis (5^{th} Edition) by Curtis and Whealtey, Patrick.O .
2) Numerical Methods – P. Kandasamy, K.Thilagavathy, K.Gunavathy, Reprint 2001, S.Chand& Co. Ltd, New Delhi.
3) Elementary Numerical Analysis – An Algorithmic Approach by Samuel D Conte & Carl de Boor, Third Edition, Mc Graw Hill International editions.

Semester: II **Hours: 6/W 90/Sem**

Course Code: MB1 **Credits: 5**

Title of the Paper: TOPOLOGY **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	-	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Have a sound knowledge of some of the elementary concepts associates with topological spaces viz, open and closed sets limit points and continuous functions etc.,	1	18
CO2. Master in Product topology, Metric topology and its relation.	2	18
CO3. Have a deep knowledge connectedness	3	18
CO4. Define and briefly study in compactness	4	18
CO5. Understand the concept of countability Axioms, Seperation axioms, the Urysohn lemma and Urysohnmetrization theorem	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	3	3	4	4	4	3	4	3	3.6
CO2	3	4	3	3	3	4	4	3	3	3	3.3
CO3	4	4	3	3	4	4	4	4	4	3	3.7
CO4	3	4	3	3	3	4	4	3	4	3	3.5
CO5	4	4	3	3	4	4	4	4	4	3	3.7

Overall Mean Score: 3.28

MB1- TOPOLOGY

Lecture hours: 6 Credit: 5

UNIT I

Topological Spaces - Basis for a Topology – The Order Topology - The Product Topology on X×Y - The Subspace Topology- Closed Sets and Limit Points - Continuous Functions.

UNIT II

The Product Topology - The Metric Topology- The Metric Topology (Continued).

UNIT III

Connected Spaces – Connected subspaces of the real line.

UNIT IV

Compact Spaces - Compact subspaces of the real line - Limit Point - Compactness - The Tychonoff Theorem.

UNIT V

The Countability Axioms – The Separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn Metrization Theorem.

TEXT BOOK

Topology by James R Munkers, Second Edition, Prentice Hall of India Private Ltd., NewDelhi, 2001.

UNIT I : Chapter 2 : Sections 12 to 18
UNIT II : Chapter 2 : Sections 19 to 21
UNIT III : Chapter 3 : Sections 23 to 24
UNIT IV : Chapter 3 : Sections 26 to 28
Chapter 5 : Section 37
UNIT V : Chapter 4 : Sections 30 to 34

REFERENCE BOOKS :

1) General Topology – N.D. Goutam & Shanti Narayanan
2) General Topology – John.L.Kelly.
3) G.F.Simmons; Introduction to Topology and Modern Analysis, Tata McGraw – Hill Edition, New Delhi (2004).
4) S.T.Hu; Introduction to Topology, Tata McGraw – Hill, New Delhi 1979.

Semester: II **Hours: 6/W 90hrs/Sem**

Course Code: MB2 **Credits: 5**

Title of the Paper: REAL ANALYSIS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	1	1	-

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1 Master in derivatives of functions 1-variable & real valued function on R	1	18
CO2 Discuss functions of bounded variations, monotonic functions and functions are connected with curve having finite arc length	2	18
CO3 Master the process of integration	3	18
CO4 Understand upper and lower integrals and bounded variation, Riemann-Stieltjes integrals	4	18
CO5 Study mean value theorem for Riemann-Stieltjes and second fundamental theorem of integral calculus.	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	3	3	4	4	4	4	4	3	3.6
CO2	3	4	3	3	4	4	4	3	3	3	3.4
CO3	3	4	3	3	4	4	3	4	3	3	3.1
CO4	3	4	3	3	4	4	4	3	4	4	3.6
CO5	3	3	3	3	3	3	3	4	4	3	3.3

Overall Mean Score: 3.4

SEMESTER II

MB2 – REAL ANALYSIS

Lecture hours : 6 Credit : 5

UNIT I Derivatives

Introduction – Definition of derivative – Derivatives and Continuity – Algebra of derivatives – The Chain rule – One sided derivatives and infinite derivatives – Functions with non- Zero derivative – Zero derivatives and Local extrema – Rolle's Theorem – The Mean-value theorem for derivatives – Intermediate value theorem for derivatives – Taylor's formula with remainder

UNIT II Functions of Bounded Variation and Rectifiable Curves

Introduction – Properties of monotonic functions – Functions of bounded variation – Total variation – Addition property of total variation – Total variation on $[a, x]$ as a function of x – Functions of bounded variation expressed as the difference of increasing functions – Continuous functions of bounded variation – Curves and paths – Rectifiable paths and arc length – Additive and continuity properties of arc length

UNIT III The Riemann – Stieltjes Integral

Introduction – Notation – The definition of Riemann–Stieltjes integral – Linear properties – Integration by parts – Change of variable in a Riemann–Stieltjes integral – Reduction to a Riemann integral – Step functions as integrators – Reduction of a Riemann–Stieltjes integral to a finite sum – Euler's summation formula

UNIT IV The Riemann – Stieltjes Integral

Monotonically increasing integrators – Upper and lower integrals – Additive and linearity properties of Upper and lower integrals – Riemann's condition – Comparison Theorems – Integrators of bounded variation – Sufficient conditions for existence of Riemann–Stieltjes integrals – Necessary conditions for existence of Riemann–Stieltjes integrals

UNIT V The Riemann – Stieltjes Integral

Mean value theorems for Riemann–Stieltjes integrals – The integral as a function of the interval – Second fundamental theorem of integral calculus – Change of variable in a Riemann integral – Second mean value theorem for Riemann integrals

TEXT BOOK

Mathematical Analysis by Tom M.Apostol, Second Edition, Addison – Wesley Publishing Company, New Delhi 20th Reprint 2002.

UNIT I : Chapter 5 : Section 5.1 to 5.12
UNIT II : Chapter 6 : Section 6.1 to 6.11
UNIT III : Chapter 7 : Section 7.1 to 7.10
UNIT IV : Chapter 7 : Section 7.11 to 7.17
UNIT V : Chapter 7 : Section 7.18 to 7.22

REFERENCE BOOKS :

1) Principles of Mathematical Analysis by Walter Rudin - Third Edition, McGraw Hill Book Company, 1976, New Delhi.
2) Real Analysis by H.L.Royden, II edition – Macmillan Company.
3) Real Analysis by Sharma &Vasishtha, 17th Edition.

Semester: II **Hours: 6/W 90hrs/Sem**

Course Code: MB3 **Credits: 4**

Title of the Paper: FIELDS AND LATTICES **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	3	1	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Gain the knowledge of Extension fields, roots of polynomials	1	17
CO2. Study the concept of Galois theory and solvability by radicals, Galois groups over the rationals	2	19
CO3. Deeply analyse the finite fields	3	18
CO4. Identify the concept of partially ordered sets, Lattices	4	18
CO5. Acquire the knowledge of decomposition theory for lattices with ascending &decending chain condition	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	5	2	4	5	5	4	3	4	5	4
CO2	2	5	2	4	5	5	4	3	4	4	3.8
CO3	2	4	2	4	5	5	4	3	4	5	3.8
CO4	3	5	4	4	5	5	5	5	5	5	4.6
CO5	3	5	4	4	5	5	5	5	5	5	4.6

Overall Mean Score: 4.16

SEMESTER II

MB3–FIELDS AND LATTICES

Lecture hours: 6 Credit: 4

UNIT I

Extension fields – Roots of polynomials – More about roots.

UNIT II

The elements of Galois Theory – Solvability by radicals - Galois groups over the rationals.

UNIT III

Finite fields

UNIT IV

Partially ordered sets – Lattices – Modular lattices – Schreier's theorem.

UNIT V

Decomposition – Theory for lattices with ascending chain condition –Independence – Complemented modular lattices – Boolean algebra.

TEXT BOOK

TB1: Topics in Algebra by I.N.Herstein, Second Edition – John Wiley & Sons, New York, Singapore, 2016 .
TB2: Lectures in Abstract Algebra Volume I by I. N. Jacobson

UNIT I : TB1 : Chapter 5 -Sections 5.1, 5.3 - 5.5
UNIT II : TB1 : Chapter 5 - Sections 5.6, 5.7 (Lemma 5.7.3, Theorem 5.7.2 & 5.7.3) & 5.8.
UNIT III : TB1 : Chapter 7 - Sections 7.1
UNIT IV : TB2 : Chapter 7 - Sections 1 to 4
UNIT V : TB2 : Chapter 7 - Sections 5 to 8.

RFERENCE BOOK :

1) Linear Algebra by Serge Lang
2) Linear Algebra by Sharma &Vasishtha
3) Linear Algebra by H.D. Ikramov

Semester: II **Hours: 6/W 90hrs/Sem**

Course Code: MB4 **Credits: 4**

Title of the Paper: DIFFERENTIAL GEOMETRY **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	2	2	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Basic definitions of space curve	1	18
CO2. Understand intrinsic equation, Fundamental existence theorem for space curve and Helics	2	18
CO3. Gain the knowledge of metric, local intrinsic properties of a surface and Geodesics	3	18
CO4. Present the knowledge of Geodesic parallels, Geodesic curvature and Gauss Bonnet theorem	4	18
CO5. Get the knowledge of local non-intrinsic properties of a surface.	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	2	3	4	3	4	3	2	4	3.2
CO2	4	4	2	3	3	3	4	4	2	4	3.3
CO3	3	4	2	3	4	3	4	3	2	4	3.2
CO4	3	4	2	3	4	3	4	4	2	4	3.3
CO5	3	4	2	3	3	4	4	3	2	4	3.3

Overall Mean Score: 3.13

SEMESTER – II

MB4 –DIFFERENTIAL GEOMETRY

Lecture hours: 6 Credit: 4

UNIT I The Theory Of Space Curves:

Introductory remarks about space curves – Definitions – Arc length – Tangent, Normal and Binormal - Curvature and torsion of a curve given as the intersection of two surfaces – Contact between curves and surfaces – Tangent surface, involutes and evolutes.

UNIT II The Theory Of Space Curves

Intrinsic equations - Fundamental existence theorem for space curves – Helices.

UNIT III The Metric, Local intrinsic properties of a surface

Definition of a space – Curves on surface – surfaces of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric Correspodence – Intrinsic properties – Geodesics – Canonical geodesic equations – Normal property of geodesics.

UNIT IV The Metric, Local intrinsic properties of a surface

Geodesic parallels – Geodesic curvature – Gauss-Bonnet theorem – Gaussian curvature – surfaces of constant curvature.

UNIT V The second fundamental form : Local Non–Intrinsic Properties of a Surface

The second fundamental form – Principal curvatures – Lines of Curvature – Developablesassociated with space curves– Developables associated with curves on surfaces - minimal surfaces – ruled surfaces.

TEXT BOOK

An Introduction to Differential Geometry by T.J.Willmore published by Oxford University Press, New Delhi 2009

UNIT I	:	Chapter I	: Sections 1.1 to 1.7
UNIT II	:	Chapter I	: Sections 1.8 to 1.9
UNIT III	:	Chapter II	: Sections 2.1 to 2.12
UNIT IV	:	Chapter II	: Sections 2.14 to 2.18
UNIT V	:	Chapter III	: Sections 3.1 to 3.3 , 3.5 to 3.8

REFERENCE BOOKS :

1) Differential Geometry by S.C.Mittal&D.C.Agarwal, 9th Revised Edition, 1980.
2) Differential Geometry by D.Somasundaram, Narosa Publishing House, 2008
3) Differential Geometry by W.Heinrich&W.GuggerLeimer.
4) Differential Geometry of Three dimensions, by C.E. Weatherburn, The University Press, 1998.

Semester: III **Hours: 6/W 90/Sem**

Course Code: MC1 **Credits: 5**

Title of the Paper: NUMBER THEORY **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	-	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Examine the solution for each exercise presented in this unit	1	18
CO2. Decide which concepts and procedures need to be received from this unit	2	18
CO3. Self assess knowledge and skills acquired from this unit	3	18
CO4. Practice on linear congruence and polynomial	4	18
CO5. Find whether a given Diophantine equation has atleast one integer solution	5	18

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Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	4	3	3	3	2	3	2	2.8
CO2	3	3	3	3	2	3	4	3	4	2	3
CO3	3	4	4	3	3	3	3	3	2	3	3.1
CO4	3	3	4	4	3	2	3	4	3	3	3.2
CO5	2	3	3	3	3	3	3	3	3	3	2.9

Overall Mean Score: 3

SEMESTER-III

MC1 - NUMBER THEORY

Lecture hours : 6 Credit :5

UNIT I

Introduction – The Mobius function $\mu(n)$ – The Euler totient function $\varphi(n)$ – A relation connecting $\varphi$and μ- A product formula for $\varphi(n)$ – Th Dirichlet product of arithmetical functions – Dirichlet inverses and the Mobius inversion formula. The Mangoldt function $\Lambda(n)$-Multiplicative functions – Multiplicative functions and Dirichlet Multiplication. The inverse of a completely multiplicative function – Liouville's function $\lambda(n)$ – The divisor function $\sigma_\alpha(n)$ – Generalized convolutions – Formal power series – The Bell series of an arithmetical function – Bell series and Dirichlet multiplication – Derivatives of arithmetical functions – The Selberg identity.

UNIT II

Introduction – The big oh notation – Asymptotic equality of functions – Euler's summation formula – Some elementary asymptotic formulas – The average order of d(n) – The average order of the divisor functions $\sigma_\alpha(n)$ – The average order of $\varphi(n)$ – An application to the distribution of lattice points visible from the origin – The average order of $\mu(n)$ and $\Lambda(n)$ – The partial sums of a Dirichlet product – Applications to $\mu(n)$ and $\Lambda(n)$ – Another identity for the partial sums of a Dirichlet product.

UNIT III

Introduction – Chebyshev's functions $\psi(x)$ and $\upsilon(x)$ – Relations connecting $\upsilon(x)$ and $\pi(x)$- some equivalent forms of the prime number theorem – Inequalities for $\pi(n)$ and p_n – Shapiro's Tauberian theorem – Applications of Shapiro's theorem – An asymptotic formula for the partial sums $\sum_{p\le x}(1/p)$ - The partial sums of the Mobius function.

UNIT IV

Definition and basic properties of congruences – Residue classes and complete residue systems – Linear Congruences – Reduced residue systems and the Euler – Fermat theorem – Polynominal congruences modulo p – Lagrange's theorem – Applications of Lagrange's theorem

– Simultaneous linear congruences – The Chinese remainder theorem – Applications of the Chinese remainder theorem – Polynominal congruences with primer power moduli.

UNIT V

Quadratic residues – Legendre's symbol and its properties – Evaluation of (-1/p) and (2/p)-Gauss lemma – The quadratic reciprocity law-Applications of the reciprocity law-the Jacobi symbol – Applications to Diophantine equations.

TEXT BOOK

Introduction to Analytic Number Theory by Tom M.Apostol, Springer International Student Edition, Eighth Reprint 1998.

UNIT I	:	Chapter 2 : Sections 2.1 to 2.19
UNIT II	:	Chapter 3 : Sections 3.1 to 3.12
UNIT III	:	Chapter 4 : Sections 4.1 to 4.9
UNIT IV	:	Chapter 5 : Sections 5.1 to 5.9
UNIT V	:	Chapter 9 : Sections 9.1 to 9.8

References:

1. Elementary Number Theory by David N.Burton, Tata McGraw Hill Pvt,.Ltd., 7th Edition, 2012.
2. An introduction to the theory of Numbers by Ivan Nivan, H.S.Zuckerman and H.L.Montgomery, 5th Edition, 1991.
3. George E.Andrews – Number Theory – Hindustan Publishing Corporation of India, Delhi, 2nd Edition, Reprint 1989.
4. William J.Leveque – Fundamentals of Number Theory – Addison Wesley Publishing Company, 1977.

Semester: III **Hours: 6/W 90/Sem**

Course Code: MC2 **Credits: 5**

Title of the Paper: PROBABILITY & STATISTICS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	-	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Understand the random variables of the discrete types and continuous type	1	18
CO2. How to calculate correlation coefficient	2	18
CO3. How to derive & Calculate the Binomial, Poission, Normal, Gamma & Chi-square distribution	3	18
CO4. How to translate real world problems into probability distribution	4	18
CO5. How to read and annotate an outline of a proof and be able to write a logical proof of a statement	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	3	3	4	3	3	3	3
CO2	3	3	4	4	4	4	4	4	4	3	3.7
CO3	4	3	4	4	4	4	3	3	4	3	3.6
CO4	3	3	4	3	3	3	3	4	3	3	3.2
CO5	3	3	3	4	4	3	4	3	3	3	3.3

Overall Mean Score: 3.36

SEMESTER – III
MC2 - PROBABILITY AND STATISTICS

Lecture hours:6 Credit:5

UNIT I Random Variables

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 Multivariate distributions

Distribution of two random variables – Conditional Distributions and expectations – The correlation coefficient – Independent random variables – Extension to several Random Variables.

UNIT III Some special distributions

The Binomial and related distributions – The Poisson distribution – The Gamma and Chi-Square distributions – The Normal distribution – The Bivariate normal distribution.

UNIT IV Distributions of Functions of Random variables

Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type - The Beta, t and F distributions – Extensions of the change of the variable technique – Distributions of order statistics – The Moment Generating function Technique – The distributions of $\overline{X}$ and ns^2/σ^2 – Expectations of functions of random variables.

UNIT V Limiting Distributions

Convergence in distribution – Convergence in probability – Limiting Moment Generating functions – The Central Limit theorem – Some theorems on limiting distributions.

TEXT BOOK

Introduction to Mathematical Statistics by Robert V.Hogg and Allen T.Craig (V Edition) Pearson Education (Singapore) Pvt.Ltd, Third Reprint 2004.

UNIT I : Chapter 1 (Sections 1.5 to 1.10)
UNIT II : Chapter 2
UNIT III : Chapter 3
UNIT IV : Chapter 4 (Sections 4.1 to 4.9)
UNIT V : Chapter 5

REFERENCE BOOK

1. Fundamentals of Mathematical Statistics by S.C.Gupta and V.K.Kapoor, Sultan Chand & Sons Educational Publishers, New Delhi, 1997.
2. Mathematical Statistics with Applications by I. Miller and M.Miller; Seventh Edition, Pearson Education, 2004.
3. Mathematical Statistics by Jun Shao, Second Edition, Springer, 2003.
4. An introduction to probability and Statistics by Vijay K. Rohatgi, A.K. Md. EhsanesSaleh, Second edition, Wiley, 2008.

Semester: III **Hours: 5/W 75hrs/Sem**

Course Code: MC3 **Credits: 4**

Title of the Paper: MEASURES AND INTEGRATION **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	5	2	1	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Gain the knowledge about measure on the real line	1	15
CO2. Get the knowledge on integration of function of real variable	2	15
CO3. Present the idea of abstract measure space	3	15
CO4. Gain the idea of inequalities and L^p-spaces	4	15
CO5. Exhibit the concept of signed measures, Jordan decomposition and Radon Nikodymn theorem	5	15

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	4	2	3	3	4	4	2	4	4	3.2
CO2	4	4	3	3	4	4	4	3	2	4	3.5
CO3	4	4	3	2	3	4	4	3	3	4	3.4
CO4	4	4	3	3	3	4	4	2	3	4	3.4
CO5	4	4	3	3	3	4	4	3	3	4	3.5

Overall Mean Score: 3.4

SEMESTER III

MC3 - MEASURES AND INTEGRATION

Lecture hours:5 Credit:4

UNIT I Measure on the real line

Lebegue outer measure – measurable sets – regularity – measurable functions – Borel and Lebesgue measurability

UNIT IIIntegration of function of real variable

Integration of non negative functions – the general integral – integration of series – Riemann and Lebesgue integrals.

UNIT IIIAbstract Measure Spaces

Measure and outer measures - extension of measure – uniqueness of extension – completion of a measure – measure spaces – integration with respect to a measure.

UNIT IV Inequalities and L^p Spaces

The L^p Spaces – Convex function – Jension's inequality – the inequalities of Holder and Minkowski- completeness of $L^p(\mu)$.

UNIT V

Signed measures and Hahn decomposition – The Jordan decomposition – the Radon–Nikodym theorem

TEXT BOOK

Measure theory by G. DeBarra, New age international limited, New Delhi,Second Edition 2017.

UNIT I : Chapter 2 : Sections 1 to 5
UNIT II : Chapters 3
UNIT III : Chapters 5
UNIT IV : Chapters 6
UNIT V : Chapters 8 : Sections 1 to 3

REFERENCE BOOKS :

1) Mathematical Analysis by Tom Apostol, Second Edition,
2) Introduction to Topology and Modern Analysis by G.F. Simons, Tata Mc Graw Hill, New York, 1963.
3) An Introduction to Measure and integration by Inder K. Rana, Narosa,Publishing House, New Delhi 2007 .
4) Real Analysis by H. L. Royden, P. M. Fitzpatrick, Fourth edition, Prentice Hall of India, 2011.

Semester: III **Hours: 5/W 75hrs/Sem**

Course Code: MC4 **Credits: 4**

Title of the Paper: FUZZY SET THEORY **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	3	1	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Acquire the knowledge of Basic definition of fuzzy sets and operations for fuzzy sets	1	15
CO2. Gain the knowledge of types of fuzzy sets and operations on fuzzy sets	2	15
CO3. Study the concept of extension principle and applications	3	15
CO4. Deeply study about fuzzy relations and fuzzy graphs	4	15
CO5. Study about fuzzy logic, linguistic variables	5	15

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	5	4	5	3	3	5	3	3	3.8
CO2	3	4	4	5	5	3	3	5	3	3	3.8
CO3	3	4	4	5	5	3	3	5	3	3	3.8
CO4	3	4	4	5	5	3	3	5	3	3	3.8
CO5	3	4	4	5	5	3	3	5	3	3	3.8

Overall Mean Score: 3.8

SEMESTER III

MC4 - FUZZY SET THEORY

Lecture hours: 5 Credit : 4

UNIT I

Fuzzy sets – Basic definitions – Basic set – Theoretic Operations for Fuzzy sets.

UNIT II

Extensions – Types of Fuzzy sets – Further operations on Fuzzy sets – Algebraic operations – Set – Theoretic operations – Criteria for selecting appropriate aggregation operators.

UNIT III

The Extension Principle and Applications: The Extension principle – Operations for type-2 Fuzzy sets – Algebraic operations with Fuzzy numbers – Special extended operations – Extended Operations for L-R - Representation of Fuzzy sets.

UNIT IV

Fuzzy Relations and Fuzzy Graphs: Fuzzy Relations on sets and Fuzzy sets – Compositions of Fuzzy Relations – Properties of the Min-Max Composition – Fuzzy Graphs – Special Fuzzy Relations.

UNIT V

Fuzzy Logic and Approximate Reasoning: Linguistic Variables – Fuzzy Logic – Approximate and plausible reasoning – Fuzzy Languages.

TEXT BOOKS

Fuzzy Set Theory and its Applications Fifth Reprint, 2015 – Zimmermann.
UNIT I : Chapter 2
UNIT II : Chapter 3
UNIT III : Chapter 5
UNIT IV : Chapter 6
UNIT V : Chapter 9 : 9.1 to 9.4

REFERENCES :

1. Essentials of Fuzzy Modeling and Control by Yager R.R, Filev.D.P, 1994, New York.
2. The Role of fuzzy logic in the Management of uncertainty in expert systems by Zadeh.L.A 1983.
3. Fuzzy Programming and Linear Programming with several objective functions by Zimmermann.H.J , 1978.
4. Fuzzy sets and Fuzzy Logic Theory and Applications by George J. Klir and Bo Yuan, Prentice Hall of India Pvt. Ltd., New Delhi, 2015.

Semester: IV **Hours: 6/W 90hrs/Sem**

Course Code: MD1 **Credits: 5**

Title of the Paper: COMPLEX ANALYSIS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	5	1	-	-

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. The learner will have a strong knowledge of uniform convergence and periodic functions	1	18
CO2. Have a strong knowledge of conformal mappings and elementary Riemann surfaces	2	18
CO3. Have adequate knowledge of complex integration using Cauchy's theorem and integral formula	3	18
CO4. Have a deep knowledge of singularities, zeros and poles and maximum principle	4	18
CO5. Familiar with residues and application to evaluate the integrals	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	4	3	5	3	3	4	2	2.9
CO2	4	3	4	4	3	3	4	4	2	3	3.2
CO3	3	3	3	3	4	3	3	2	3	3	3
CO4	3	4	3	2	4	4	4	1	5	2	3.2
CO5	4	4	3	4	4	3	3	2	3	3	3.3

Overall Mean Score: 3.12

SEMESTER IV

MDI – COMPLEX ANALYSIS

Lecture hours: 6 Credit: 5

UNIT I Complex Functions

Introduction to the Concept of Analytic Function – Limits and Continuity – Analytic Functions – Polynomials – Rational Functions. Elementary Theory of Power series - Sequences – Series – Uniform Convergence – Power series – Abel's Limit Theorem - The Exponential and Trigonometric Functions - The Exponential – The Trigonometric Functions – The Periodicity – The Logarithm.

UNIT II Conformality

Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area – Linear Transformations – The Linear Group – The Cross Ratio – Symmetry – Oriented Circles – Families of Circles. Elementary Conformal Mappings - The use of level curves – A Survey of Elementary Mappings – Elementary Riemann Surfaces.

UNIT III Complex Integration

Fundamental Theorems – Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk. Cauchy's Integral Formula –The Index of a Point with Respect to a Closed Curve – The Integral Formula - Higher Derivatives.

UNIT IV Local Properties of Analytic Functions

Removable Singularities – Taylor's Theorem – Zeros and poles – The Local Mapping – The Maximum Principle.

UNIT V The General Form of Cauchy's Theorem

Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's theorem – Locally Exact Differentials – Multiply Connected Regions. The Calculus of Residues – The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals.

TEXT BOOK

Complex Analysis by Lars V. Ahlfors, Tata McGraw Hill International, Third Edition, 2013.

UNIT I : Chapter 2: Sections 1.1 to 1.4,2.1 to 2.5, 3.1 to 3.4.
UNIT II : Chapter 3: Sections 2.1 to 2.4, 3.1 to 3.5, 4.1 to 4.3.
UNIT III : Chapter 4: Sections 1.1 to 1.5, 2.1 to 2.3.
UNIT IV : Chapter 4: Sections 3.1 to 3.4.
UNIT V : Chapter 4: Sections 4.1 to 4.7, 5.1 to 5.3

REFERENCE BOOKS :

1. Real and Complex Analysis – Walter Rudin.
2. Functions of one Complex variable by Conway J. B, Springer International Student Edition, Second Edition, 2000.
3. A First course in Complex Analysis by Matthias Beck, Gerald Marchesi, Dennis Pixton, Lucas Sabalka, Orthogonal Publishing House, 2015.
4. Basic complex analysis by Jerrold E. Marsden, Michael J. Hoffman, 3rd Edition, W.H.Freeman, New York (1999), 5th reprint.

Semester: IV **Hours: 6/W 90hrs/Sem**

Course Code: MD2 **Credits: 5**

Title of the Paper: FUNCTIONAL ANALYSIS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	1	-	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Acquire basics of Banach spaces, linear transformations and Hahn Banach theorems	1	18
CO2. Master operators and imbeddings of N and its double conjugate	2	18
CO3. Have a strong knowledge of Hilbert spaces and ortho normal bases	3	18
CO4. Have a good knowledge of operators	4	18
CO5. Have a sound knowledge of spectral theory and theorem and determinants	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	3	4	4	4	3	3	3.2
CO2	3	4	5	4	3	4	4	4	3	4	3.8
CO3	4	4	5	5	3	2	3	3	2	4	3.5
CO4	4	4	2	2	4	3	3	3	3	3	3.1
CO5	2	1	3	3	4	1	5	2	3	4	2.8

Overall Mean Score: 3.28

SEMESTER IV

MD2 - FUNCTIONAL ANALYSIS

Lecture hours: 6 Credit: 5

UNIT 1

Banach spaces : The Definition and some examples - Continuous linear transformations - The Hahn-Banach theorem.

UNIT II

The natural Imbedding of N in N^{**}. The Open Mapping theorem - The Conjugate of an operator.

UNIT III

Hilbert space: Definition and properties - Orthogonal complements - Orthonormal sets- The Conjugate space H^{*}.

UNIT IV

Adjoint of an operator - Self-adjoint operator - Normal and Unitary operators.

UNIT V

Projections - Finite Dimensional Spectral theory - Determinants and the spectrum of an operator - The Spectral theorem

TEXTBOOK

'Introduction to Topology and Modern Analysis' by G.F.Simmons -McGraw-Hill Book Company, International Student Edition, Twentieth Reprint 2013.

UNIT I : Sections 46 to 48
UNIT II : Sections 49 to 51
UNIT III : Sections 52 to 55
UNIT IV : Sections 56 to 58
UNIT V : Sections 59, 61 & 62.

REFERENCES:

1. Functional Analysis by B. V. Limaye, Published by Mohinder Singh Sejwal for Wiley Eastern Ltd, New Delhi.
2. Foundations of Functional Analysis by S.Ponnusamy, Narosa Publishing House, New Delhi, 2011.
3. A Course in Functional Analysis by J.B. Conway, 2nd edition, Springer, Berlin, 1990.
4. A First course in Functional Analysis by C.Goffman and G. Pedrick, Perentice Hall of India 1974.
5. Introduction to Functional Analysis with Applications by E.Kreyzig, John Wiley & Sons, New York, 1978.

Semester: IV **Hours: 6/W 90hrs/Sem**

Course Code: MD3 **Credits: 4**

Title of the Paper: ADVANCED STATISTICS **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	1	-	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
Tackle problems regarding point and interval estimation	1	18
Analyse the properties of estimators	2	18
Understand Bayesian estimation and Rao crammer inequality	3	18
Devise powerful tests and determine best critical region	4	18
Develop suitable tests for normal models	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	4	3	3	3	3.1
CO2	3	3	3	2	3	4	4	3	3	3	3.1
CO3	3	3	3	2	3	4	4	3	3	3	3.1
CO4	3	3	3	2	3	4	4	3	3	3	3.1
CO5	3	3	3	2	3	4	4	3	3	3	3.1

Overall Mean Score: 3.1

SEMESTER IV

MD3 - ADVANCED STATISTICS

Lecture hours : 6 Credits : 4

UNIT I Introduction to Statistical inference

Point estimation – Confidence Intervals for Means – Confidence intervals for differences of means – Tests of Statistical Hypotheses – Additional comments about statistical tests – Chi-square tests.

UNIT II Sufficient Statistics

Measures of quality of estimators – A sufficient statistic for a parameter – Properties of a sufficient statistic – Completeness and uniqueness – The Exponential class of probability density functions – Functions of a parameter.

UNIT III More about Estimation

Bayesian Estimation – Fisher Information and the Rao - Cramer inequality – Limiting distributions of maximum likelihood estimators – Robust M-Estimation.

UNIT IV Theory of statistical tests

Certain best tests – Uniformly most powerful tests – Likelihood ratio tests – The sequential Probability ratio test.

UNIT V Inferences about normal models

The distributions of certain quadratic forms – A test of the equality of several means – noncentral χ^2(Chi-Square) and noncentral F – Multiple comparisons – The analysis of variance – A regression problem.

TEXT BOOK

Introduction to Mathematical Statistics by Robert V.Hogg and Allen T.Craig (V Edition) Pearson Education (Singapore) Pvt.Ltd, Third Reprint 2004.

UNIT I : Chapter 6
UNIT II : Chapter 7 (Sections 7.1 – 7.6)
UNIT III : Chapter 8
UNIT IV : Chapter 9 (Section 9.1 to 9.4)
UNIT V : Chapter 10 (Sections 10.1 and 10.6)

REFERENCE BOOKS :

1. Fundamentals of Mathematical Statistics by S.C.Gupta and V.K.Kapoor, Sultan Chand & Sons Educational Publishers, New Delhi, 1997.
2. Mathematical Statistics with Applications by I. Miller and M.Miller; Seventh Edition, Pearson Education, 2004.
3. Mathematical Statistics by Jun Shao, Second Edition, Springer, 2003.
4. An introduction to probability and Statistics by Vijay K. Rohatgi, A.K. Md. EhsanesSaleh, Second edition, Wiley, 2008.

Semester: IV **Hours: 5/W 90hrs/Sem**

Course Code: MPW **Credits: 4**

Title of the Paper: PROJECT **CORE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	5	-	-	4	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Acquire knowledge about the topic	1	15
CO2. Understand the topic	2	15
CO3. Demonstrate the topic	3	15
CO4. Develope the topic	4	15
CO5. Analyse and apply the topic	5	15

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	5	3	4	5	4	4	4	5	3	4.1
CO2	4	5	3	4	5	4	4	4	5	3	4.1
CO3	4	5	3	4	5	4	4	4	5	3	4.1
CO4	4	5	3	4	5	4	4	4	5	3	4.1
CO5	4	5	3	4	5	4	4	4	5	3	4.1

Overall Mean Score: 4.1

Semester: IV **Hours: 5/W 75hrs/Sem**

Course Code: **Credits: 4**

Title of the Paper: FORMAL LANGUAGES AND AUTOMATA THEORY **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	5	3	1	-	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Master in deterministic and-deterministic	1	18
CO2. Master regular expressions and criteria to test not to be a regular language	2	15
CO3. Have a sound knowledge on context free grammars and closure properties	3	15
CO4. Acquire mastery in parse trees and push down automata	4	13
CO5. Master in PDA & CFG's and its equivalence	5	14

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	4	2	3	5	3	4	2	3	5	3.4
CO2	3	4	3	3	2	3	4	4	3	3	3.2
CO3	4	2	3	3	3	3	4	4	3	3	3.2
CO4	3	1	4	4	3	4	3	5	4	3	3.4
CO5	3	5	2	2	4	4	3	1	2	4	3

Overall Mean Score: 3.24

ELECTIVE

FORMAL LANGUAGES AND AUTOMATA THEORY

Lecture hours : 6 Credit : 4

UNIT I

Deterministic Finite Automata, Non deterministic Finite Automata, Finite Automata with Epsilon, Transitions.

UNIT II

Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be regular.

UNIT III

Closure properties of Regular languages, Context Free Grammars.

UNIT IV

Parse Trees, Ambiguity in Grammars and Languages, Definition of the Push down Automaton.

UNIT V

The languages of a PDA, Equivalence of PDA's and CFG's, Definition of a Deterministic PDA.

TEXT BOOK

Introduction to Automata Theory, Languages and Computation by John E. Hopcroft, Rajeev &Jefferey D. Ullman, 3rd Edition, Copy right 2008, Pearson Education.

UNIT I : Chapter 2 : Sections 2.2, 2.3, 2.5

UNIT II : Chapter 3 : Sections 3.1,3.2
Chapter 4 : Sections 4.1

UNIT III : Chapter 4 : Sections 4.2
Chapter 5 : Section 5.1

UNIT IV : Chapter 5 : Sections 5.2, 5.4
Chapter 6 : Section 6.1

UNIT V : Chapter 6 : Sections 6.2, 6.3, 6.4 upto 6.4.2

References:

1. Formal Languages and Automata Theory by D.Goswamy and K.V.Krishna, 2010.

2. Introduction to Automata Theory by Shyamlendu Kandan, imprint Pearson Education, Copyright 2013.

3. Introduction to Automata theory by J.E.Hopcroft, R.Motwani and J.D. Ullman; Cambridge University press, 2007.

4. A text book on Automata theory by P.K. Srimani and S.F.B. Nasir; Cambridge University press, 2007.
5. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay and R. Manohar McGraw Hill Education (India) Pvt Ltd, 2017.

Semester: **Hours: 6/W 90hrs/Sem**

Course Code: **Credits: 4**

Title of the Paper: GRAPH THEORY **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	1	½	½

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Understand trees and spanning trees in a weighted graph	1	18
CO2. Understand fundamental circuits and cut sets, network flows – 1 – isomorphism, 2-isomorphism	2	18
CO3. Demonstrate deduction of planarity and geometric dual	3	18
CO4. Understand directed paths and connectedness	4	18
CO5. Understand graph theoretic algorithms and find shortest distance between all pairs of vertices	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	5	4	4	4	4	3	4	4	3	3.9
CO2	4	5	3	5	4	4	3	4	4	3	3.9
CO3	4	5	4	4	4	4	3	4	4	3	3.9
CO4	4	5	3	5	4	4	3	4	4	4	4
CO5	4	5	4	4	4	4	4	4	4	3	4

Overall Mean Score: 3.94

ELECTIVE

GRAPH THEORY

Lecture hours: 6 Credit: 4

UNIT I Trees and fundamental circuits

Trees – Some properties of trees – Pendant vertices in a tree – Distance and centers in a tree – Rooted and Binary trees – On counting trees – Spanning trees – Fundamental Circuits – Finding all spanning trees of a Graph – Spanning trees in a weighted Graph.

UNIT II Cut sets and Cut vertices

Cut sets – Some properties of a cut set - All cut sets in a Graph - Fundamental circuits and cut-sets – Connectivity and Separability – Network flows–1 isomorphism – 2 isomorphism.

UNIT III Planar and dual graphs

Combinatorial verses Geometric Graphs – Planar Graphs – Kuratowski's Two graphs – Different Representations of a Planar graph – Detection of Planarity – Geometric Dual.

UNIT IV Colouring, Covering and Partitioning

Chromatic Number – Chromatic Partitioning – Chromatic polynomial – Matchings – Coverings – The Four colour Problem.

Directed Graphs : Directed Graph – Some types of Digraphs – Digraphs and Binary Relations – Directed paths and connectedness – Euler digraphs – Trees with directed edges.

UNIT V Graph Theoretic Algorithms and Computer Programs

Algorithms – Input : Computer Representation of a Graph - The output – Some Basic Algorithms – Algorithm 1 : Connectedness & components, Algorithm 2: A Spanning tree, Algorithm 3 : A set of Fundamental Circuits, Algorithm 4 : Cut vertices & Separability, Algorithm 5 : Directed circuits, Algorithm 6 : Shortest path from a specified vertex to another specified vertex, Algorithm 7 : Shortest Path between all pairs of vertices.

TEXT BOOK

Graph Theory with applications to Engineering and Computer Science, by Narsingh Deo, Prentice Hall of India private Limited, New Delhi -2011.

UNIT I :Chapter 3 : Sections 1 to 10
UNIT II :Chapter 4 : Sections 1 to 8
UNIT III :Chapter 5 : Sections 1 to 6
UNIT IV :Chapter 8 : Sections 1 to 6
Chapter 9 : Sections 1 to 6
UNIT V :Chapter 11: Sections 1 to 5

REFERENCE BOOKS :

1) Introduction to Graph Theory by Garychartrand and Zhana, 2006.

2) Algorithmic Graph Theory by Allan Gibbons – Cambridge universe impress, 1994.

Semester: **Hours: 5/W 75hrs/Sem**

Course Code: **Credits: 4**

Title of the Paper: INTEGRAL TRANSFORMS **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	5	3	1	½	½

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Understand Laplace Transform and its properties	1	15
CO2. Understand the applications of Laplace transform	2	15
CO3. Know about Fourier transform	3	15
CO4. Understand applications of Fourier transform	4	15
CO5.Study the properties of Henks transform and application to PDE	5	15

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	5	4	3	4	3	4	3	4	5	3.9
CO2	4	5	5	4	5	3	4	4	5	5	4.4
CO3	4	5	3	3	5	3	4	3	4	5	3.9
CO4	4	5	5	4	4	3	4	4	5	5	4.3
CO5	3	4	5	4	5	3	4	4	5	5	4.2

Overall Mean Score: 4.14

ELECTIVE

INTEGRAL TRANSFORMS

Lecture hours: 6 Credit: 4

UNIT I Laplace Transform

Definition – Elementary properties of the Laplace transform Greens functions for initial value problems for ordinary differential equations - Inversion of Laplace transforms.

UNIT II Applications of Laplace Transform

An elementary problem for the wave equation - A signal problem for a vibrating string of finite length - The wave equation and into Greens function -Solution of the wave equation using Laplace transforms with complex variables.

UNIT III Fourier Transform

Introduction – Complex form of Fourier series - Fourier transform pair - Fourier sine and cosine transforms.

UNIT IV Applications of Fourier Transform

Fourier Transform solution of the Heat equation on an infinite interval - Heat equation on semi-infinite intervals - Solutions of the wave and Laplace equations using Fourier Transforms.

UNIT V Transforms

Introduction – Properties of Henks transform the Parseval - Relation between Fourier and Hankel transform - Application to partial differential equations.

TEXT BOOKS

1. Elementary Applied Partial Differential Equation with Fourier series and Boundary value problems(2^{nd} edition, Sep 2012) – By Richard Haberman – Prentice Hall international Editions.
2. The uses of Integral Transforms- I.N.Sneddon, Second Edition, Tata McGraw Hill, 1992.

REFERENCE BOOK :

1. Integral Transforms and their Applications by Lokenath Debrath and Dambaru Bhatta – CRC Press, New York – Third Edition.
2. Integral Transforms and their Applications by Brain Davies, Springer – Third Edition.

Semester: IV **Hours: 4/W 60hrs/Sem**

Course Code: EMC **Credits: 3**

Title of the Paper: DATA STRUCTURES USING 'C' **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	4	2	1	½	1/2

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Describe lists	1	12
CO2. Implement stacks and queues	2	12
CO3. Implement trees	3	12
CO4. Analyse sorting	4	12
CO5. Study different methods of finding shortest path	5	12

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	3	4	4	4	2	2	2	2	2.7
CO2	2	2	3	4	4	4	2	2	2	2	2.7
CO3	2	2	3	4	4	4	2	2	2	2	2.7
CO4	2	2	3	4	4	4	2	2	2	2	2.7
CO5	2	2	3	4	4	4	2	2	2	2	2.7

Overall Mean Score: 2.7

ELECTIVE

DATA STRUCTURES USING C

Lecture hours: 4 Credit : 3

UNIT I Lists

Abstract Data types(ADTs), The List ADT: Simple Array implementation of lists, Linked lists, Programming details, Common errors, Doubly linked lists, Circularly linked lists, Examples, Cursor implementation of linked lists.

UNIT II Stacks, Queues

The stack abstract data types: stack model, Implementation of stacks, application.The Queue abstract data types, Queue model, Array implementation of queues, application of queues.

UNIT III Trees

Preliminaries: Implementation of Trees, Trees traversals with an application, Binary trees, Implementation, Expression Trees. The Search Tree ADT, Binary Search Trees, Make empty, Find, FindMin and FindMax, Insert, Delete, Average Case Analysis.

UNIT IV Sorting

Preliminaries: Insertion Sort-the Algorithm, Analysis of Insertion sort. Mergesort, Analysis of Mergesort. Quick sort -Picking the Pivot - Partitioning Strategy - Small Arrays - Actual Quicksort Routines - Analysis of Quicksort - A Linear Expected Time Algorithm for Selection.

UNIT V Graph Algorithm

Shortest path Algorithm - Unweighted shortest paths -Dijkstra's Algorithm - Graphs with negative edge costs - Acyclic graphs - All Pairs Shortest Path.

TEXTBOOK

Data structures and algorithm analysis in C' by Mark Allen Weiss, Second Edition, Pearson Publications, 2014.

UNIT I : Chapter 3: Sections 3.1, 3.2
UNIT II : Chapter 3 : Sections 3.3, 3.4
UNIT III : Chapter 4 : Sections 4.1, 4.2, 4.3
UNIT IV : Chapter 7 : Sections 7.1, 7.2, 7.6, 7.7
UNIT V : Chapter 9 : Section 9.3

REFERENCE BOOK:

1. Fundamentals of Data Structures by Ellis Horrowitz, Sartaj Sahani – Galgotia Publishers, 1998.
2. C and Data Structures by P.RadhaGanessan, Scitech Publishers India Pvt Ltd, 2011.
3. Data Structures using ‘C’ by E.Balagurusamy, Tata McGraw-Hill Education, Reprint 2015.

DATA STRUCTURES USING C (LAB)

Lab hours:2 Credit:1

1. Create a Stack and do the following operations using arrays and linked lists :
   (i) Push (ii) Pop (iii) Top
2. Create a Queue and do the following operations using arrays and linked lists:
   (i) Add (ii) Remove
3. Implement the operations on singly linked list.
4. Sort the given list of numbers using following sorting techniques:
   (i) Insertion sort (ii) Merge sort
5. Find the shortest path in a given graph using Dijkstra's algorithm.

TEXT BOOK

Data structures and algorithm analysis in C' by Mark Allen Weiss, Second Edition Pearson Publications, 2014.

REFERENCE BOOK:

1. Fundamentals of Data Structures by Ellis Horrowitz, Sartaj Sahani – Galgotia Publishers, 1998.
2. C and Data Structures by P.RadhaGanessan, Scitech Publishers India Pvt Ltd, 2011.
3. Data Structures using ‘C’ by E.Balagurusamy, Tata McGraw-Hill Education, Reprint 2015.

ELECTIVE

CODING THEORY

Lecture hours: 6 Credits: 4

UNIT I

Introduction to error – Correcting codes – The main coding theory problem.

UNIT II

An introduction to finite fields – Vector spaces over finite fields –Introduction to linear codes.

UNIT III

Encoding and decoding with a linear code – The dual code, the parity check matrix and syndrome decoding.

UNIT IV

The Hamming codes – Perfect codes.

UNIT V

Codes and Latin squares – A double error – Correcting decimal code and an introduction to BHC codes – Cyclic codes.

TEXT BOOK

A first course in coding theory by Raymond Hill Charendon Press 1986

UNIT I : Chapter 1 & 2
UNIT II : Chapter 3, 4 & 5
UNIT III : Chapter 6 & 7
UNIT IV : Chapter 8 & 9
UNIT V : Chapter 10 to 12

REFERENCE BOOKS

1. Introduction to Coding Theory by J.H.Van Lint, Third Edition, Springer – Verlag Berlin, Heidelberg, 1999.
2. Introduction to Coding Theory by Jurgen Bierbrauer, Second Edition, CRC Press, Taylore and Francis Group.
3. Coding Theory a First Course by Henk C.A.VanTilborg.
4. Modern Coding Theory by Richardson Tom Et.Al.

ELECTIVE
CALCULUS OF VARIATIONS

Lecture hours : 6 Credit : 4

UNIT I Method of Variations in Problems with Fixed Boundaries

Variation and its properties – Euler's Equation – Fundamental lemma of calculus of variations – Functional of the form $\int_{x_0}^{x_1} F(x, y_1, ...y_n, y_1', ...y_n')\, dx$.

UNIT II Method of Variations in Problems with Fixed Boundaries

Functional Dependent on Higher Order Derivatives – Functional Dependent on the Functions of Several Independent Variables – Variational Problems in Parametric form.

UNIT III Variational problems with moving boundaries and Certain Other Problems

An Elementary Problem with Moving Boundaries – The Moving Boundary Problem for a Functional of the form $\int_{x_0}^{x_1} F(x, y, z, y', z')dx$ - Extremals with corne .

Field of extremals – The Function $E(x, y, p, y')$ - Transforming the Euler Equations to the Canonical form.

UNIT IV Variational Problems Involving a Conditional Extremum

Variational problems involving a conditional extremum – One sided variations.

UNIT V Sufficient conditions for an Extremum

Constraints of the Form $\phi(x, y_1, y_2, ...y_n) = 0$, Constraints of the Form $\phi(x, y_1, y_2, ...y_n, y_1', y_2', ...y_n') = 0$, Isoperimetric Problems.

TEXT BOOK

Differential Equations and the Calculus of Variations by L. Elsgolts, Mir Publications, Moscow, Second Printing, 1973.

UNIT I : Chapter 6 : Section 1 to 3
UNIT II : Chapter 6 : Section 4 to 6
UNIT III : Chapter 7
UNIT IV : Chapter 8
UNIT V : Chapter 9

REFERENCE BOOKS :

1) Advanced Calculus by LynnH.Loomis and ShlomoSterberg Jones and Barflett Publishers, London.
2) Calculus of Variations by I.M.Gelfand and S.V.Fomin, Dover Publications.
3) Calculus of Variations with Applications by A.S.Gupta.

ELECTIVE

CRYPTOGRAPHY

Lecture hours : 6 Credits : 4

UNIT I Cryptography

Classical Cryptosystems - Public Key Cryptography - RSA scheme.

UNIT II Primality Testing and Factoring

Pseudoprimes and Carmichael Numbers - Strong Pseudoprimes and Probabilistic Primality Testing – Pollard's (p-1) method - Pollard's ρ method

UNIT III Primitive Roots

The Concept of Order – The Primitive Root Theorem – The Discrete Logarithm – Primality Testing.

UNIT IV Applications

The ElGamal System - Signature Schemes –Psuedorandom Numbers Generators-I.

UNIT V Applications

Identification Schemes – Psuedorandom Numbers Generators-II.

TEXT BOOK

Number Theory with computer applications by Ramanujachary Kumanduri and Cristina Romero, Prentice Hall.

UNIT I : Chapter 5
UNIT II : Chapter 6
UNIT III : Chapter 7
UNIT IV : Chapter 8
UNIT V : Chapter 10

REFERENCE BOOKS :

1) Cryptography and Network Security, Principles and practice by William Stalling, Sixth Edition, Pearson, 2016.
2) Introduction to Analytical Number Theory, Tom M.Apostal, Narosa Publishing House Pvt Ltd, Chennai, 1998.
3) Hand Book of Applied Cryptography by Menezes A, Oorshcot P and Vaustare S, CRC Press, 1997.

ELECTIVE

COMBINATORICS

Lecture hours : 6 Credit:4

UNIT I

Two Basic Counting Principles, Simple Arrangements and Selections, Simple Arrangements and Selections with Repetition, Distributions, Binomial Identities involving Binomial Coefficients.

UNIT II

Generating Function Models, Calculating Coefficients of Generating Functions, Partitions, Exponential Generating Functions – A summation Method.

UNIT III

Recurrence Relation Models, Divide and Conquer Relations, Solution of Linear Recurrence Relations, Solution of Homogeneous Recurrence Relations, Solutions with Generating Functions.

UNIT IV

Counting with Venn Diagrams, Inclusions, Exclusion Formula, The Pigeon Hole Principle.

UNIT V

Equivalence and symmetry groups, Burnside's Lemma, The Cycle Index, Polya's Function.

TEXT BOOK

Applied Combinatorics by A.W.Tucker, John Wiley Publications, Sixth Editon, 2012.

REFERENCE BOOK

V.Krishna Murthy, Combinatorics Theory and Applications, East West Press,1993.

UNIT I : Chapter 5 : Sections 5.1 to 5.5
UNIT II : Chapter 6
UNIT III : Chapter 7 :Sections 7.1,7.2, 7.4,7.5,7.6
UNIT IV : Chapter 8 :Sections 8.1,8.2 & Appendix A(A.4)
UNIT V : Chapter 9

ELECTIVE
DESIGN AND ANALYSIS OF ALGORITHMS

Semester: I **Hours: 6/W 90hrs/Sem**

Course Code: EMA **Credits: 4**

Title of the Paper: DESIGN AND ANALYSIS OF ALGORITHMS **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	-	1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Understand basics of algorithmics	1	18
CO2. Design algorithms using brute force , divide and conquer techniques	2	18
CO3. Implement algorithms based on decrease and conquer principle, dynamic programming	3	18
CO4. Apply greedy technique to shortest path problem, minimum spanning tree problem	4	18
CO5. Analyse back tracking and branch and bound techniques	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	5	4	3	4	3	4	3	4	3	3.7
CO2	4	5	5	4	4	3	4	4	5	3	4.1
CO3	4	5	3	4	4	3	4	3	4	3	3.7
CO4	4	5	5	4	4	3	4	4	5	3	4.1
CO5	3	4	5	4	4	3	4	4	5	3	3.9

Overall Mean score: 3.9

ELECTIVE
EMA - DESIGN AND ANALYSIS OF ALGORITHMS

Lecture hours: 6 Credit: 4

UNIT I

Introduction – Definition of Algorithm – Fundamentals of algorithmic problem solving – Important problem types – Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical analysis of non recursive and recursive algorithms – Mathematical analysis of recursive algorithm – Fibonacci numbers.

UNIT II

Brute force – Selection sort – Bubble sort – Sequential search and brute force string matching – Divide and conquer – Merge sort – Quick sort – Binary tree traversal and related properties.

UNIT III

Decrease and Conquer – Insertion sort, Transform and conquer – Presorting – Heaps and Heap sort – Dynamic programming – Warshall's and Floyd's algorithm, Optimal binary search trees.

UNIT IV

Greedy technique – Prim's algorithm – Kruskal's algorithm – Dijikstra's algorithm-Huffman trees.

UNIT V

Back tracking n-queen's problem – Hamiltonian circuit problem – Subset sum problem – Branch and Bound – Assignment problems – Knapsack problem – Traveling salesman problem.

TEXTBOOK

Introduction to the Design and Analysis of algorithms by Anany Levitin Pearson education, Second edition (Copy right 2015) .

UNIT I : Chapter 1 : Sections 1 to 3
Chapter 2 : Sections 1 to 5
UNIT II : Chapter 3 : Sections 1 & 2
Chapter 4 : Sections 1, 2 & 4
UNIT III : Chapter 5 : Section 1
Chapter 6 : Sections 1&4
Chapter 8 : Sections 2&3
UNIT IV: Chapter 9 : Sections 1 to 4
UNIT V : Chapter 12 : Sections 1&2

REFERENCE BOOKS:

1. Design and Analysis of Algorithm by Sachin Dev Goyal, First Edition 2009.
2. Design and Analysis of Algorithm by Gajendra Kumar, Third Edition 2015.
3. Design and Analysis of Algorithm by Prabhakar Gupta Vineet Agarwal, Manish Varshney (2008).

Semester: II **Hours: 6/W 90hrs/Sem**

Course Code: EMB **Credits: 4**

Title of the Paper: PARTIAL DIFFERENTIAL EQUATIONS **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4		1	1

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Grasp thoroughly the fundamentals of first order partial differential equation	1	18
CO2 Solve quasi linear and non linear partial differential equation	2	18
CO3. Classify second order partial differential equation and solve the wave equation	3	18
CO4. Tackle the Laplace equation	4	18
CO5.Solve heat equation and apply Duhamel's principle	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	4	5	4	3	4	4	4	3	4	3	3.8
CO2	4	5	5	4	4	4	4	4	5	3	3.8
CO3	4	5	3	4	4	4	4	3	4	3	3.8
CO4	4	5	5	4	4	4	4	4	4	3	3.7
CO5	3	4	5	4	4	3	4	4	5	3	3.9

Overall Mean Score: 3.8

ELECTIVE
PARTIAL DIFFERENTIAL EQUATIONS

Lecture hours: 6 Credit: 4

UNIT I

First order Partial Differential Equations –Curves and Surfaces – Genesis of first order P.D.E – Classification of integrals - Linear Equations of the First Order– Pfaffian Differential Equations – Compatible Systems – Charpit's Method – Jacobi Method.

UNIT II

Integral Surfaces through a given curve – Quasi - Linear Equations – 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 – Vibrations of an infinite String – Vibrations of a Semi Infinite String – Vibrations of a String of Finite Length (Method of Seperation of variables).

UNIT IV

Laplace Equation : Boundary Value Problems – Maximum and Minimum Principles – 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 a circle – The Dirichlet problem for a Rectangle – Harnack'sTheorm – Laplace Equations – Green's Function

UNIT V

Heat conduction problem – Heat conduction – Infinite Rod Case – Heat Conduction finite Rod case – Duhamel's Principle – Wave equation – Heat Conduction Equation.

TEXT BOOK

An Elementary course in Partial Differential Equations by T.Amarnath, Narosa Publishing House, New Delhi, 1997.

UNIT I : Chapter 1 : Sections 1.1 to 1.8
UNIT II : Chapter 1 : Sections 1.9 to 1,11
UNIT III : Chapter 2 : Sections 2.1 to 2.3.5, except 2.3.4
UNIT IV : Chapter 2 : Sections 2.4 to 2.4.11
UNIT V : Chapter 2 :Sections 2.5 to 2.6.2

REFERENCE BOOK:

1. I.C.Evans, Partial Differential Equations, Graduate studies in Mathematics, Vol.19, AMS, 1998.

2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill International Book Company, London.

3. Phoolan Prasad & Renuka Ravindran, Partial Differential Equations, Second Edition, New Age International Publishers, Chennai,2012.

Semester: IV **Hours: 6/W 90hrs/Sem**

Course Code: EMD **Credits: 4**

Title of the Paper: OPERATIONS RESEARCH **ELECTIVE**

Pedagogy	Hours/W	Lecture	Peer Teaching	GD/Tutorial/Videos	ICT
	6	4	1	½	½

Course Outcomes On completing this course the student will be able to	Unit	Hrs/S
CO1. Understand network applications and apply short route algorithms, PERT & CPM	1	18
CO2. Demonstrate Parametric Linear Programming	2	18
CO3. Understand state EOQ Models, Classic EOQ Model Dynamic EOQ, Model and solve EOQ problems	3	18
CO4. Understand unconstrained problems & apply Newton Raphson Method, Solve constrained problems	4	18
CO5.Demonstrate unconstrained nonlinear algorithms and apply constrained algorithms, separate programming & quadratic programming	5	18

Course Outcomes	Programme Outcomes					Programme Specific Outcomes					Mean Score
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	5	4	4	4	4	4	3	4	4	3.9
CO2	3	5	4	4	4	4	4	4	4	4	4
CO3	3	5	4	4	4	4	4	3	4	4	3.9
CO4	3	5	4	4	4	4	4	4	4	4	4
CO5	4	5	4	4	4	4	4	3	4	4	4

Overall Mean Score: 3.96

ELECTIVE
OPERATIONS RESEARCH

Lecture hours: 6 Credit: 4

UNIT I Network Models

Scope of Network Application-Network Definitions-Minimal Spanning Tree Algorithm-Shortest-Route Problem-Examples of the Shortest-Route Applications-Shortest-Route Algorithms-CPM and PERT-Network Representation-Critical Path Computations-Construction of the Time Schedule.

UNIT II Advanced Linear Programming

Bounded Variables Algorithm-Duality-Matrix Definition of the Dual Problem-Optimal Dual Solution-Parametric Linear Programming-Parametric Changes in C-Parametric Changes in b.

UNIT III Deterministic Inventory Models

General Inventory Model-Static EOQ Models-Classic EOQ Model-EOQ Problems with Price Breaks-Multi-Item EOQ with Storage Limitation-Dynamic EOQ Models-No-Setup Model-Setup Model.

UNIT IV Classical Optimization Theory

Introduction-unconstrained Problems-Necessary and Sufficient Conditions-The Newton-Raphson Method-Constrained Problems-Equality Constraints-Inequality Constraints (Solved Problems only).

UNIT V Nonlinear Programming Algorithms

Unconstrained Nonlinear Algorithms-Direct Search Method-Gradient Method-Constrained Algorithms-Separable Programming-Quadratic Programming (Solved Problems only).

TEXT BOOK:

Operations Research An Introduction by Handy A.Taha., Seventh Print 1999.

UNIT I : Chapter 6 : 6.1 to 6.4 & 6.7
UNIT II : Chapter 7 : 7.5.2, 7.6 & 7.7
UNIT III : Chapter 11
UNIT IV : Chapter 20 : (Solved Problems only)
UNIT V : Chapter 21 : (Solved Problems only) 21.1, 21.2.1 & 21.2.2 (Solved Problems only)

References:

1. Operation Research by H.A.Taha, A.M.Natarajan, P.Balasubramani&A.Tamilarasi,– 8th edition, Prentice Hall.
2. Operation Research theory and Applications byJ.K.Sharma, Macmillan India Ltd.
3. Operation ResearchFredrick. S. Hiller & Gerald J. Liebermann, 2nd Edition, CBS Publishers Delhi.

NON MAJOR ELECTIVE
MATHEMATICAL LOGIC AND REASONING

Lecture Hours : 2 Credit: 2

Objective :

Logic and reasoning forms an important component of UGC-JRF/NET and CSIR-JRF/NET. The objective of this paper is to prepare the post graduate students to tackle the question related to logic and reasoning.

UNIT I

Series test, graphical missing number, alphabet test.

UNIT II

Analogy test, classification test, coding and decoding test.

UNIT III

Direction sense test, blood relation test, arranging in order test.

UNIT IV

Time and calendar test, Mathematical pertain test, dice and cube.

UNIT V

Venn diagram – logical diagram test.

TEXT BOOK

Trueman's Specific Series – UGC NET/SET for Lecturer ship Exam Paper I, 2011 Edition, Section V.

REFERENCE BOOK

1. R.Gupta's Popular Master Guide UGC-NET, 2013 Edition.

2. UGC NET/SET for lectureship Exam Paper I, G.K.Publications, Edition 2012.

3. Upkar's CSIR-UGC NET/JRF/SET.

4. Aggarwal – Verbal and Non-verbal Reasoning.