POSTGRADUATE PROGRAMME
IN
MATHEMATICS

(M.Sc. Mathematics)

Courses of Study
Schemes of Examinations
&
Syllabi

Applicable to candidates admitted from the
Academic Year 2023-24 onwards

PG & RESEARCH DEPARTMENT OF MATHEMATICS
THANTHAI PERIYAR GOVERNMENT
ARTS & SCIENCE COLLEGE (Autonomous)
(Nationally Reaccredited at 'A' Level by NAAC)
TIRUCHIRAPPALLI – 620 023.

POST GRADUATE PROGRAMME

Programme Outcomes:

PS1 To provide comprehensive curriculum to groom the students into qualitative scientific manpower

PS2 Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.

PS3 To provide qualitative education through effective teaching learning processes by introducing projects, participative learning and latest software tools.

PS4 To inculcate innovative skills, team work, ethical practices among students so as to meet societal expectations.

PS5 To encourage collaborative learning and application of mathematics to real life situations.

M.Sc. Mathematics

Programme Specific Outcomes:

PSO1 Apply the knowledge of mathematical concepts in interdisciplinary fields. Effectively communicate and explore ideas of mathematics for propagation of knowledge and popularization of mathematics in society.

PSO2 Understand the nature of abstract mathematics and applied Mathematics to explore the concepts in further details. Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and scientific investigations.

PSO3 Model the real-world problems in to mathematical equations and draw the inferences by finding appropriate solutions. Continue to acquire mathematical knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematics.

PSO4 Identify challenging problems in mathematics and find appropriate solutions. Comprehend and write effective reports and design documentation related to mathematical research and literature, make effective presentations.

PSO5 Pursue research in challenging areas of pure/applied mathematics and qualify national level tests like NET/GATE etc.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1										
CO2										
CO3										
CO4										
CO5										

THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-23.										
GENERAL COURSE PATTERN FOR PG - MATHEMATICS- 2023-2024 ONWARDS										
SL. NO.	**PART**	**COURSE**		**Sub-Code**	**COURSE TITLE**	**Hrs.**	**Credits**	**CIA**	**Sem. Exam**	**Total**
I SEMESTER										
1	-	Core	I		ALGEBRAIC STRUCTURES	6	5	25	75	100
2	-	Core	II		REAL ANALYSIS I	6	5	25	75	100
3	-	Core	III		ORDINARY DIFFERENTIAL EQUATIONS	5	4	25	75	100
4	-	Core	IV		GRAPH THEORY AND ITS APPLICATIONS	5	4	25	75	100
5	-	Core	V		DISCRETE MATHEMATICS	6	4	40	60	100
6		SEC	I		Skill Enhancement Course - I Practical NUMERICAL METHODS WITH SCILAB	2	2	25	75	100
					TOTAL	**30**	**24**	**165**	**435**	**600**
II SEMESTER										
7	-	Core	VI		ADVANCED ALGEBRA	5	5	25	75	100
8	-	Core	VII		REAL ANALYSIS II	5	5	25	75	100
9	-	Core	VIII		PARTIAL DIFFERENTIAL EQUATIONS	5	4	25	75	100
10	-	Core	IX-P		R PROGRAMMING LAB	5	4	40	60	100
11		CBE	I		Discipline Specific Elective – I: MECHANICS	5	3	25	75	100
12	-	NME	I		Non-Major Elective - I :	3	2	25	75	100
13		SEC	II		Skill Enhancement Course - II Practical DIFFERENTIAL EQUATIONS WITH SCILAB	2	2	25	75	100
					TOTAL	**30**	**25**	**190**	**510**	**700**
III SEMESTER										
14	-	Core	X		COMPLEX ANALYSIS	6	5	25	75	100
15	-	Core	XI		PROBABILITY THEORY	5	4	25	75	100
16	-	Core	XII-P		PROGRAMMING IN PYTHON PRACTICALS	5	4	40	60	100
17	-	CBE	II		Discipline Specific Elective – II: TOPOLOGY	4	3	25	75	100
18	-	CBE	III		Discipline Specific Elective – III MATHEMATICS OF FINANCE AND INSURANCE	5	3	25	75	100
19		NME	II		Non-Major Elective - II :	3	2	25	75	100
20		SEC	III		Skill Enhancement Course - III Practical LATEX PRACTICALS	2	2	25	75	100
					TOTAL	**30**	**23**	**190**	**510**	**700**
IV SEMESTER										
21	-	Core	XIII		FUNCTIONAL ANALYSIS	6	4	25	75	100
22	-	Core	XIV		DIFFERENTIAL GEOMETRY	5	4	40	60	100
23	-	CBE	IV		Discipline Specific Elective – IV RESOURCE MANAGEMENT TECHNIQUES	5	3	25	75	100
24	-	SEC	IV		Skill Enhancement Course - IV: RESEARCH TOOLS AND TECHNIQUES	2	2	25	75	100
25		EA			Extension Activity	-	1	25	75	100
26		Project				12	4	25	75	100
					TOTAL	**30**	**18**	**165**	**435**	**600**
					GRAND TOTAL	**120**	**90**	**710**	**1890**	**2600**

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE I: ALGEBRAIC STRUCTURES

Semester : I **Course Code :**
Hours : 6 (5 L + 1T) **Credits : 5**

Pre-requisite: UG Level Modern Algebra

Course Objectives:

1. To introduce the concepts of class equation.
2. To develop working knowledge on class equation, solvability of groups,
3. To learn about finite abelian groups and modules.
4. To apply the techniques of Linear transformations to other branch of mathematics and practical problems.
5. To understand different canonical forms, and real quadratic forms.

Course Outcomes: Students will be able to

CO1: Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.

CO2: Define Solvable groups, direct products, modules and examine the properties of finite abelian groups.

CO3: Define similar Transformations, invariant subspace, and explore the properties of triangular matrix and nilpotent transformation relating nilpotence with invariants.

CO4: Define Jordan canonical form, Jordan blocks, rational canonical form, and companion matrix of polynomial, find the elementary devices of transformation, and apply the concepts to find characteristic polynomial of linear transformation.

CO5: Explain the properties of trace and transpose, to prove Jacobson lemma using the triangular form, and to verify whether the transformation is Hermitian, unitary and normal.

UNIT I

Group Theory: Another Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).

UNIT II

Direct products - Finite abelian groups- Modules - Solvable by Radicals.

UNIT III

Linear Transformations: Canonical forms – Triangular form - Nilpotent transformations.

UNIT IV

Canonical Forms: Jordan form - Rational canonical form.

UNIT V

Trace and transpose - Hermitian, unitary and normal transformations - Real quadratic forms.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (Is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. I. N. Herstein, "Topics in Algebra", Second Edition, John Wiley & Sons. Reprint 2016.

Unit I : Chapter 2: § 2.11 and 2.12 (Omit Lemma 2.12.5)
Unit II : Chapter 2: § 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: § 4.5
Chapter 5: § 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Unit III : Chapter 6: § 6.4 and 6.5
Unit IV : Chapter 6 : § 6.6 and 6.7
Unit V : Chapter 6 : § 6.8, 6.10 and 6.11 (Omit 6.9)

Reference Book(s):

1. M.Artin, "Algebra", Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, "Basic Abstract Algebra (II Edition)", Cambridge University Press, 1997 (Indian Edition).
3. I.S.Luther and I.B.S.Passi, "Algebra, Vol. I – Groups" (1996); "Vol. II Rings", Narosa Publishing House, New Delhi, 1999.
4. D.S.Malik, J.N. Mordeson and M.K.Sen, "Fundamental of Abstract Algebra", McGraw Hill (International Edition), New York, 1997.
5. N.Jacobson, "Basic Algebra, Vol. I & II", W.H.Freeman; also published by Hindustan Publishing Company, New Delhi, 1980.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/topics-in-algebra-inherstein-e34321263.html
2. https://algebra.com
3. https://nptel.ac.in.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	2	3	1
CO3	3	2	3	1	3	3	2	3	2	1
CO4	1	2	3	2	3	3	2	2	3	2
CO5	3	1	2	3	3	3	2	2	3	1

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE II: REAL ANALYSIS I

Semester : I **Course Code :**

Hours : 6 (5 L + 1 T) **Credits : 5**

Pre-requisite: UG Level Real Analysis Concepts

Course Objectives:

1. To work comfortably with functions of bounded variation.
2. To develop the understanding of uniform convergence and Riemann Stieltjes integral and its properties.
3. To develop the concept of convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.
4. To acquire knowledge on the basic concepts in sequences of functions.
5. To develop problem solving skills.

Course Outcomes: Students will be able to

CO1: Analyze and evaluate functions of bounded variation and Rectifiable Curves.

CO2: Describe the concept of Riemann-Stieltjes integral and its properties.

CO3: Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.

CO4: Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.

CO5: Formulate the concept and properties of inner products, norms and measurable functions.

UNIT I

Functions of bounded variation: Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

UNIT II

The Riemann-Stieltjes Integral: Introduction - Notation - The definition of the Riemann-Stieltjes integral - Linear Properties - Integration by parts - Change of variable in a Riemann-Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula.

UNIT III

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 - Mean value theorems - integrals as a function of the interval – Second fundamental theorem of integral calculus - Change of variable - Second Mean Value Theorem for Riemann integrals.

UNIT IV

Infinite Series and infinite Products: Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products.

Sequence of Functions: Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem.

UNIT V

Sequences of Functions: Pointwise convergence of sequences of functions - Examples of sequences of real-valued functions – Definition of Uniform Convergence - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions – Uniform Convergence and Riemann-Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. Tom M.Apostol, "Mathematical Analysis", Second Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
   - Unit I : Chapter 6 : § 6.1 to 6.8
     Chapter 8 : § 8.8, 8.15, 8.17, 8.18
   - Unit II : Chapter 7 : § 7.1 to 7.10
   - Unit III : Chapter 7 : § 7.11 to 7.14, 7.18 to 7.22
   - Unit IV : Chapter 8 : § 8.20, 8.21 to 8.26
     Chapter 9 : § 9.14 9.15, 9.19, 9.20, 9.22, 9.23
   - Unit V : Chapter 9 : § 9.1 to 9.6, 9.8, 9.10, 9.11, 9.13

Reference Book(s):

1. Bartle, R.G. "Real Analysis", John Wiley and Sons Inc., 1976.
2. Rudin,W. "Principles of Mathematical Analysis", 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik,S.C. and Savita Arora, "Mathematical Analysis", Wiley Eastern Limited. New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, "Introduction to Real Analysis", Satya Prakashan, New Delhi, 1991.
5. A.L.Gupta and N.R.Gupta, "Principles of Real Analysis", Pearson Education, (Indian print) 2003.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/real-analysis-4th-edition-e188037088.html
2. https://www.pdfdrive.com/introduction-to-real-analysis-fourth-edition-e20632872.html
3. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	1	3	2
CO2	2	1	3	1	3	3	2	1	3	2
CO3	3	2	3	1	3	3	2	1	3	2
CO4	1	2	3	2	3	3	2	1	3	2
CO5	3	1	2	3	3	3	2	1	3	2

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE III: ORDINARY DIFFERENTIAL EQUATIONS

Semester : I **Course Code :**
Hours : 5 (4 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Calculus and Differential Equations

Course Objectives:

1. To develop strong background on finding solutions to linear differential equations with constant and variable coefficients.
2. To find the solution of linear differential equations with singular points.
3. To study existence and uniqueness of the solutions of first order differential equations.
4. To model some physical problems and apply knowledge thus earned in other areas of mathematics.
5. To solve the problems using multiple approaches and will learn to classify ODEs.

Course Outcomes: Students will be able to

CO1: Establish the qualitative behaviour of solutions of systems of differential equations.

CO2: Recognize the physical phenomena modelled by differential equations and dynamical systems.

CO3: Analyse solutions using appropriate methods and give examples.

CO4: Formulate Green's function for boundary value problems.

CO5: Understand and use various theoretical ideas and results that underlie the mathematics in this course.

UNIT I

Linear equations with constant coefficients: Introduction - Second order homogeneous equations - Initial value problems - Linear dependence and independence - A formula for Wronskian – The Non-homogeneous equation of order two.

UNIT II

Linear equations with constant coefficients: The Homogeneous equation of order n - Initial value problems for nth order equations – A special method for solving non-homogeneous equation - Algebra of constant coefficient operators.

UNIT III

Linear equation with variable coefficients: Introduction **-** Initial value problems for the homogeneous equation – Solutions of the homogeneous equation – The Wronskian and linear dependence - Reduction of the order of a homogeneous equation – The non-homogeneous equation - Homogeneous equations with analytic coefficients - The Legendre equation.

UNIT IV

Linear equation with regular singular points: Introduction – The Euler equation – Second order equations with regular singular points – an example, the general case - Bessel equation.

UNIT V

Existence and uniqueness of solutions to first order equations: Introduction - Equation with variables separated – Exact equations – The method of successive approximations – The Lipschitz condition – Convergence of the successive approximations.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. Earl. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall of India Private Limited, New Delhi, 1987.

   Unit I : Chapter 2 - § 2.1 to 2.6

   Unit II : Chapter 2 - § 2.7 to 2.12

   Unit III: Chapter 3 - § 3.1 to 3.8 (omit 3.9)

   Unit IV: Chapter 4 - § 4.1 to 4.4 and 4.6 to 4.8 (omit 4.5 and 4.9)

   Unit V : Chapter 5 - § 5.1 to 5.6 (omit 5.7 to 5.9).

Reference Book(s):

1. Williams E. Boyce and Richard C. DI Prima, "Elementary differential equations and boundary value problems", John Wiley and sons, New York, 1967.
2. George F Simmons, "Differential equations with applications and historical notes", Tata McGraw Hill, New Delhi, 1974.
3. W.T. Reid. "Ordinary Differential Equations", John Wiley and Sons, New York, 1971
4. M.D.Raisinghania, "Advanced Differential Equations", S.Chand & Company Ltd. New Delhi, 2001.
5. B.Rai, D.P.Choudary and H.I. Freedman, "A Course in Ordinary Differential Equations", Narosa Publishing House, New Delhi, 2002.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/ordinary-differential-equations-e31554207.html
2. https://www.pdfdrive.com/ordinary-differential-equations-student-solution-manual-e1120649.html
3. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	3	2	3	1	2	3	3	2
CO2	3	1	3	2	3	3	2	1	3	2
CO3	2	1	3	1	3	3	2	1	3	2
CO4	3	2	3	1	3	3	2	1	3	2
CO5	1	2	3	2	3	3	2	1	3	2

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE IV: GRAPH THEORY AND ITS APPLICATIONS

Semester : I **Subject Code :**
Hours : 5 (4L + 1T) **Credits : 4**

Pre-requisite: UG Level Graph Theory

Course Objectives:

1. To understand and apply the fundamental concepts in graph theory.
2. To apply graph theory based tools in solving practical problems.
3. To improve the proof writing skills.
4. To have an idea of matching in graphs and study some applications of matching in day to day life problems.
5. To introduce the idea of colouring in graphs.

Course Outcomes: Students will be able

CO1: To recognize the graphs, subgraphs and trees.

CO2: To understand the connectivity, Euler tours and Hamilton cycles.

CO3: To study the concept of matchings and edge colourings.

CO4: To apply chromatic number, brooks' theorem and Euler's formula in models.

CO5: To learn about directed graphs and apply the theorems in real life situations.

UNIT I

Graphs and Subgraphs: Paths and connection – cycles – The shortest path Problem - **Trees:** Trees – Cut Edges and Bonds – Cut vertices – Cayley's Formula.

UNIT II

Connectivity: Connectivity – Blocks - **Euler Tours and Hamilton Cycles:** Euler tours – Hamilton cycles.

UNIT III

Matchings: Matchings – Matchings and Coverings in Bipartite Graphs – Perfect Matchings - **Edge Colourings:** Edge Chromatic Number – Vizing's Theorem.

UNIT IV

Vertex Colourings: Chromatic Number – Brooks' Theorem – Hajos' Conjecture – Chromatic Polynomials - **Planar Graphs**: Plane and Planar Graphs – Euler's Formula.

UNIT V

Planar Graphs (Ctd.): Kuratowski's Theorem – The Five Colour Theorem and Four Colour Conjecture - **Directed Graphs:** Directed graphs – Directed Paths – Directed Cycles.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part

of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. J.A. Bondy and U.S.R. Murty, "Graph Theory with Applications", The MacMillan Press Ltd., 1976.

   Unit I : Chapter 1 - § 1.6 - 1.8, Chapter 2 - § 2.1 - 2.4
   Unit II : Chapter 3 - § 3.1 - 3.2, Chapter 4 - § 4.1 - 4.2
   Unit III: Chapter 5 - § 5.1 - 5.3, Chapter 6 - § 6.1 - 6.2
   Unit IV: Chapter 8 - § 8.1 - 8.4, Chapter 9 - § 9.1 & 9.3
   Unit V: Chapter 9 - § 9.5 & 9.6, Chapter 10 - § 10.1 - 10.3.

Reference Book(s):

1. R. Balakrishnan and K. Ranganathan, "A Text Book of Graph Theory", Springer International Edition, New Delhi, 2008.
2. F. Harary, "Graph Theory", Narosa Publishing House, New Delhi, 1988.
3. R.J. Wilson, "Introduction to Graph Theory", Pearson Education, 4th Edition, 2004, Indian Print.
4. A.Gibbons, "Algorithmic Graph Theory", Cambridge University Press, Cambridge, 1989.

Website and e-Learning Source:

1. https://www.pdfdrive.com/graph-theory-with-applications-e10372178.html
2. https://nptel.ac.in
3. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	3	2	3	3	2	1	3	2
CO2	2	1	3	1	3	3	2	1	3	2
CO3	3	2	3	2	3	3	2	1	3	2
CO4	1	2	3	2	3	3	2	1	3	2
CO5	3	2	2	3	3	3	2	1	3	2

(For the candidates admitted from the academic year 2023 -2024 onwards)

CORE V: DISCRETE MATHEMATICS

Semester : I **Course Code :**
Hours : 6 (5L + 1T) **Credits : 4**

Pre-requisite: UG Level Set Theory, Algebra and Graph theory

Course Objectives:

1. To identify different formal language classes and their relationships.
2. Use finite-state machines to model computer operations
3. To gain knowledge about application in expert systems and database.
4. Solve problems using recurrence relations and recursion to analyze algorithms and programs.
5. Evaluate Boolean functions and simplify expression using the properties of Boolean algebra; apply Boolean algebra to circuits and gating networks.

Course Outcomes: Students will be able

CO1: To understand the concepts of grammars and its types.

CO2: To gain knowledge about finite state machine and machines, finite state machine as language recognizers.

CO3: To understand numeric functions and generating functions.

CO4: To learn about recurrence relations and apply recursive algorithm in the computing languages.

CO5: To study the concept of Boolean Algebras and Boolean Lattices.

UNIT I

Computability and Formal Languages: Russell's Paradox and Non-computability - Ordered Sets – Languages - Phrase Structure Grammars - Types of Grammars and Languages.

UNIT II

Finite State Machines: Finite State Machine - Finite State Machine as Models of Physical Systems – Equivalent Machines - Finite State Machines as Language Recognizers – Finite State Languages and Type–3 Languages.

UNIT III

Discrete Numeric Functions and Generating Functions: Introduction - Manipulation of Numeric Functions - Asymptotic Behaviour of Numeric Functions – Generating Functions.

UNIT IV

Recurrence Relations and Recursive Algorithms: Introduction – Recurrence Relations – Linear Recurrence Relations with Constant Coefficients – Homogeneous Solutions – Particular Solutions – Total Solutions – Solutions by the Method of Generating Functions.

UNIT V

Boolean Algebras: Lattices and Algebraic Systems – Principle of Duality – Basic Properties of Algebraic Systems defined by Lattices-Distributive and Complemented Lattices – Boolean Lattices and Boolean Algebras.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. C.L.Liu, "Elements of Discrete Mathematics", Second Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2000.

   Unit I : Chapter 2 - § 2.2 to 2.6
   Unit II : Chapter 7 - § 7.2 to 7.6
   Unit III : Chapter 9 - § 9.1 to 9.4
   Unit IV : Chapter 10 - §10.1 to 10.7
   Unit V : Chapter 12 - § 12.1 to 12.5

Reference Book(s):

1. T.Veerarajan, "Discrete Mathematics", McGraw Hill Education (India) Pvt. Ltd, New Delhi, 2014.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Seventh Edition, McGraw Hill Education, New York, 2012.
3. Rakesh Dube, Adesh Pandey and Ritu Gupta, Discrete Structures and Automata Theory, Narosa Publishing House, 2000.
4. John E. Hopcroft, Jeffery D. Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1995.

Website and e-Learning Source:

1. https://www.pdfdrive.com/mathemat1.ical-structures-for-computer-science-discrete-mathematics-and-its-applications-e158202395.html
2. https://nptel.ac.in
3. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	3	2	3	3	2	3	2	1
CO2	2	2	3	2	3	3	2	2	2	1
CO3	3	2	3	2	3	3	2	2	2	1
CO4	2	2	3	2	3	3	2	3	2	1
CO5	3	2	2	3	3	3	2	2	2	1

(For the candidates from the academic year 2023 – 2024 onwards)

Skill Enhancement Course- I: Practical
NUMERICAL METHODS WITH SCILAB

Semester : I **Course Code :**

Hours : 2 **Credits : 2**

Pre-requisite: UG Level Numerical Methods Concepts

Course Objectives:

1. To apply computer theory and algorithmic aspects in various situations.
2. To design and debug the programs in numerical methods.
3. To develop independent program skills.
4. To write a program to find the solution of algebraic equation and system of linear equations.
5. To write a program to evaluate the given integral.

Course Outcomes: The students will be able

CO1: To understand the basic concepts of scilab software.

CO2: To acquire the knowledge to solve the equations using numerical methods.

CO3: To obtain the ability to code and execute program for the given problem.

CO4: To apply scilab theory for designing the programs in various methods in numerical analysis.

CO5: To develop programming skill and debugging skills.

LIST OF PRACTICALS

1. Solution of an algebraic equation using Bisection Method, Newton-Raphson method.
2. Solution of a system of linear equations using Gauss-Elimination Method and Gauss-Seidel method.
3. Evaluation of an integral using Trapezoidal Rule, Simpson's 1/3 rule.
4. Solving Initial Value Problems by using Euler's modified method
5. Solving Initial Value Problems by using Runge-Kutta's Fourth order method.

Text Book(s):

1. Dr. Akhilesh Kumar, "Programming using scilab – Theory and practicals for B.Sc. Course of Pondicherry University, 2022, http://www.aagasc.edu.in/Scilab-Book-Akhilesh.pdf
2. B.S.Grewal, "Scilab Textbook Companion for Higher Engineering Mathematics", Khanna Publishers, New Delhi, 2007,

   https://www.academia.edu/34512645/Scilab_textbook_companion_for_Higher Engineering_Mathematics_B_S_Grewal_pdf.

Reference Book(s):

1. Er. Hema Ramachandran and Dr. Achuthsankar S. Nair. "SCILAB- A Free software to MATLAB" S. Chand and Company Ltd., 2008.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical methods for scientific and Engineering computation", Wiley Eastern, 1993.
3. Michael Baudin, "Introduction to Scilab", Consortium Scilab – Digiteo, 2010.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/scilab-textbook-companion-for-engineering-physics-by-hk-malik-a-singh-e51524347.html
2. https://www.pdfdrive.com/scilab-textbook-companion-for-numerical-methods-by-e-balaguruswamy-e46808275.html
3. https://www.pdfdrive.com/introduction-to-scilab-for-engineers-and-scientists-e183169568.html.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	2	3	2	2
CO2	2	2	3	3	3	3	2	2	2	2
CO3	3	2	3	2	3	2	2	2	2	2
CO4	2	3	3	2	2	3	2	3	2	1
CO5	3	2	2	3	2	2	2	2	2	1

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE VI: ADVANCED ALGEBRA

Semester: II **Course Code:**

Hours : 5 (4 L + 1 T) **Credits: 5**

Pre-requisite: UG Level Modern Algebra

Course Objectives:

1. To study field extension.
2. To learn about roots of polynomials.
3. To introduce the theory of Galois.
4. To learn about the finite fields, division rings, solvability by radicals.
5. To develop computational skill in abstract algebra.

Course Outcomes: Students will be able to

CO1: Prove theorems applying algebraic ways of thinking.

CO2: Connect groups with graphs and understanding about Hamiltonian graphs.

CO3: Compose clear and accurate proofs using the concepts of Galois Theory.

CO4: Bring out insight into Abstract Algebra with focus on axiomatic theories.

CO5: Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.

UNIT I

Extension fields – Transcendence of e.

UNIT II

Roots or Polynomials- More about roots

UNIT III

Elements of Galois Theory.

UNIT IV

Finite fields - Wedderburn's theorem on finite division rings.

UNIT V

Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Textbook(s):

1. I.N. Herstein," Topics in Algebra (II Edition)" Wiley Eastern Limited, New Delhi, 1975.

Unit I : Chapter 5: § 5.1 and 5.2
Unit II : Chapter 5: § 5.3 and 5.5
Unit III : Chapter 5: § 5.6
Unit IV : Chapter 7: § 7.1 and 7.2 (Theorem 7.2.1 only)
Unit V : Chapter 5: § 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
Chapter 7: § 7.3 and 7.4

Reference Book(s):

1. M.Artin, "Algebra", Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, "Basic Abstract Algebra (II Edition)" Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, "Algebra, Vol. I –Groups(1996)"; "Vol. II Rings",Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, "Fundamental of Abstract Algebra", McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, "Basic Algebra, Vol. I & II" Hindustan Publishing Company, New Delhi.

Website and e-Learning Source(s):

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics
3. http://www.opensource.org
4. www.algebra.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	2	3	1
CO3	3	2	3	1	3	3	2	3	2	1
CO4	1	2	3	2	3	3	2	2	3	2
CO5	3	1	2	3	3	3	2	2	3	1

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE VII: REAL ANALYSIS II

Semester: II **Course Code:**

Hours : 5 (4 L + 1 T) **Credit: 5**

Pre-requisite: UG Level Real Analysis Concepts

Course Objectives:

1. To introduce measure on the real line, Lebesgue measurability and integrability.
2. To introduce Lebesgue measurability and integrability.
3. Apply domain knowledge for Riemann - Stieltjes integral.
4. Thorough study of multivariable calculus to represent Fourier series and integrals.
5. Inverse function theorem and Implicit function theorem.

Course Outcomes: Students will be able to

CO1: Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.

CO2: Analyze the representation and convergence problems of Fourier series.

CO3: Analyze and evaluate the difference between transforms of various functions.

CO4: Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

CO5: Apply the Cauchy integral theorem in its various versions to compute contour integration.

UNIT I

Measure on the Real line - Lebesgue Outer Measure - Measurable sets – Regularity - Measurable Functions - Borel and Lebesgue Measurability.

UNIT II

Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals.

UNIT III

Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series - The Riemann – Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series.

UNIT IV

Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A

sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of Rn to R1.

UNIT V

Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of one & severable variables.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Textbook(s):

1. G. de Barra, "Measure Theory and Integration", Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)

   Unit I : Chapter 2 : § 2.1 - 2.5

   Unit II : Chapter 3 : § 3.1,3.2 and 3.4.

2. Tom M.Apostol, "Mathematical Analysis", 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

   Unit III: Chapter 11: § 11.1 -11.10

   Unit IV: Chapter 12: § 12.1 -12.14

   Unit V : Chapter 13: § 13.1 -13.6.

Reference Book(s):

1. Burkill,J.C. "The Lebesgue Integral", Cambridge University Press, 1951.
2. Munroe, M.E."Measure and Integration". Addison-Wesley, Mass.1971.
3. Roydon,H.L."Real Analysis", Macmillan Pub. Company, New York, 1988.
4. Rudin, W. "Principles of Mathematical Analysis", McGraw Hill Company, New York, 1979.
5. Malik, S.C. and Savita Arora. "Mathematical Analysis", Wiley Eastern Limited. New Delhi, 1991.
6. Sanjay Arora and Bansi Lal, "Introduction to Real Analysis", Satya Prakashan, New Delhi, 1991.

Website and e-Learning Source(s):

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics
3. http://www.opensource.org.

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	1	3	2
CO2	2	1	3	1	3	3	2	1	3	2
CO3	3	2	3	1	3	3	2	1	3	2
CO4	1	2	3	2	3	3	2	1	3	2
CO5	3	1	2	3	3	3	2	1	3	2

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE VIII: PARTIAL DIFFERENTIAL EQUATIONS

Semester: II **Course Code:**

Hours : 5 (4 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Calculus and Differential Equations

Course Objectives:

1. To classify the second order partial differential equations.
2. To study Cauchy problem.
3. Understand how partial differential equations arise in the mathematical description of heat flow and vibration.
4. Demonstrate the ability to solve boundary value problems.
5. Be acquainted with applications of partial differential equations in various disciplines of study.

Course Outcome: Students will be able to

CO1: To understand and classify second order equations and find general solutions.

CO2: To analyse and solve wave equations in different polar coordinates.

CO3: To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations.

CO4: To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions.

CO5: To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem.

UNIT I

Mathematical Models and Classification of second order equation: Classical Equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order Equations in two independent variables – canonical forms – equations with Constant coefficients – general solution

UNIT II

Cauchy Problem: The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – Spherical wave equation – cylindrical wave equation.

UNIT III

Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem- Heat conduction problem – Existence and uniqueness of solution of heat Conduction n problem – Laplace and beam equations.

UNIT IV

Boundary Value Problems: Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a

circle, a circular annulus, a rectangle – Dirichlet problem Involving Poisson equation – Neumann problem for a circle and a rectangle.

UNIT V

Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz Operators – Method of images and eigen functions – Higher dimensional Problem – Neumann Problem.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Textbook(s):

1. TynMyint-U and Lokenath Debnath, "Linear Partial Differential Equations for Scientists and Engineers" (Third Edition), North Hollan, New York, 1987.
   https://www.academia.edu/38607271/Tyn_Myint_U_Lokenath_Debnath_Linear_Partial_Differential_Equations_for_Scientists_and_Engineers_Fourth_Edition
   Unit I : Chapter 3: §3.1 - 3.6, Chapter 4: §4.1 - 4.4
   Unit II : Chapter 5: § 5.1- 5.11
   Unit III : Chapter 7: §7.2 – 7.7
   Unit IV : Chapter 9: §9.1 – 9.9
   Unit V : Chapter 11: §11.2 – 11.10

Reference Book(s):

1. M.M.Smirnov, "Second Order partial Differential Equations", Leningrad, 1964.
2. I.N.Sneddon, "Elements of Partial Differential Equations", McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, "Introduction to Partial Differential Equations and Boundary Value Problems", McGraw Hill, New York, 1968.
4. M.D.Raisinghania, "Advanced Differential Equations", S.Chand& Company Ltd., New Delhi, 2001.
5. S. Sankar Rao, "Partial Differential Equations", 2nd Edition, Prentice Hall of India, New Delhi. 2004

Website and e-Learning Source(s):

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics
3. http://www.opensource.org
4. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	1	2	3	4	5	1	2	3	3	2
CO2	3	1	3	2	3	3	2	1	3	2
CO3	2	1	3	1	3	3	2	1	3	2
CO4	3	2	3	1	3	3	2	1	3	2
CO5	1	2	3	2	3	3	2	1	3	2

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE-IX-P: R PROGRAMMING LAB

Semester: II **Course code:**

Hours : 5 (4 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Programming

Course Objectives:

1. To understand the problem solving approaches
2. To learn the basic programming constructs in R Programming
3. To practice various computing strategies for R Programming –based solutions to real world problems
4. To use R Programming data structures - lists, tuples, and dictionaries.
5. To do input/output with files in R Programming.

Course Outcomes:

On completion of this course, students will

1. Acquire programming skills in core R Programming
2. Acquire Object-oriented programming skills in R Programming
3. Develop the skill of designing graphical-user interfaces (GUI) in R Programming
4. Acquire R Programming skills to move into specific branches.

List of Practicals:

1. Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
3. Write a program to find list of even numbers from 1 to n using R-Loops.
4. Create a function to print squares of numbers in sequence.
5. Write a program to join columns and rows in a data frame using cbind() and rbind() in R.
6. Implement different String Manipulation functions in R.
7. Implement different data structures in R (Vectors, Lists, Data Frames)
8. Write a program to read a csv file and analyze the data in the file in R.
9. Create pie chart and bar chart using R.
10. Create a data set and do statistical analysis on the data using R.
11. Program to find factorial of the given number using recursive function
12. Write an R program to count the number of even and odd numbers from array of N numbers.

Text Book(s):

1. Roger D. Peng," R Programming for Data Science ", 2012

2. Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011

Reference Book(s):

1. Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014
2. Venables, W.N.,and Ripley, "S programming", Springer, 2000.

Website and e-Learning Source(s):

1. https://www.simplilearn.com

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	2	3	2	2
CO2	2	2	3	3	3	3	2	2	2	2
CO3	3	2	3	2	3	2	2	2	2	2
CO4	2	3	3	2	2	3	2	3	2	1
CO5	3	2	2	3	2	2	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

Discipline Specific Elective – I: MECHANICS

Semester : II **Course Code :**

Hours : 5 (4 L + 1 T) **Credits : 3**

Pre-requisites: UG level Calculus and Differential equations

Course Objectives:

1. To study mechanical systems under generalized coordinate systems
2. To study virtual work, energy and momentum
3. To study mechanics developed by Newton, Langrange and Hamilton Jacobi
4. To learn about Lagrangian and Hamiltonian formulation of Classical Mechanics.
5. To study the Theory of Relativity due to Einstein.

Course Outcomes: Students will be able to

CO1: Demonstrate the knowledge of core principles in mechanics.

CO2: Interpret and consider complex problems of classical dynamics in a systematic way.

CO3: Apply the variation principle for real physical situations.

CO4: Explore different applications of these concepts in the mechanical and electromagnetic fields.

CO5: Describe and apply the concept of Angular momentum, Kinetic energy and Moment of inertia of a particle.

UNIT I

Mechanical Systems: The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum.

UNIT II

Lagrange's Equations: Derivation of Lagrange's equations- Examples- Integrals of motion.

UNIT III

Hamilton's Equations: Hamilton's Principle - Hamilton's Equation - Other variational principle.

UNIT IV

Hamilton-Jacobi Theory: Hamilton Principle function – Hamilton-Jacobi Equation – Separability.

UNIT V

Canonical Transformation: Differential forms and generating functions – Special Transformations.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part

of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. Donald T. Greenwood, "Classical Dynamics" Dover Publications, Inc. New York, 1997.

   Unit I : Chapter 1 - § 1.1 - 1.5

   Unit II : Chapter 2 - § 2.1 - 2.3

   Unit III : Chapter 4 - § 4.1 - 4.3

   Unit IV : Chapter 5 - § 5.1 - 5.3

   Unit V : Chapter 6 - § 6.1 - 6.2

Reference Book(s):

1. H. Goldstein, Classical Mechanics, (2nd Edition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition), McGraw Hill Book Co., New York, 1970.

Website and e-Learning Source(s):

1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

2. http://www.opensource.org, www.physicsforum.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	1	2	1
CO2	2	1	3	1	3	3	2	1	3	2
CO3	3	2	3	1	3	3	2	1	2	1
CO4	1	2	3	2	3	3	2	1	3	2
CO5	3	1	2	3	3	3	2	1	3	1

(For the candidates from the academic year 2023 – 2024 onwards)

Skill Enhancement Course- II: Practical

DIFFERENTIAL EQUATIONS WITH SCILAB

Semester : II **Course Code :**
Hours : 2 **Credits : 2**

Pre-requisite: UG Level Differential Equation Concepts

Course Objectives:

1. To apply computer theory and algorithmic aspects in various situations.
2. To design and debug the programs in differential equations.
3. To develop independent program skills.
4. Understand the basis of Scilab software and code development.
5. To write a program to find the solution of linear equations.

Course Outcomes: The students will be able

CO1: To understand the basic concepts of scilab software.

CO2: To acquire the knowledge to solve the equations using scilab

CO3: To obtain the ability to code and execute program for the given problem.

CO4: To apply scilab theory for designing the programs in various methods in numerical analysis.

CO5: To develop programming skill and debugging skills.

LIST OF PRACTICALS

1. Write a program to Solve the first order differential equation.
2. Write a program to Solve the second order differential equation.
3. Write a program to Solve and Plot the graph for ordinary differential equation.
4. Write a program to find particular integral.
5. Write a Program to solve the given linear differential equation.

Text Book(s):

1. Dr.Akhilesh Kumar, "Programming using scilab – Theory and practicals for B.Sc. Course of Pondicherry University, 2022, http://www.aagasc.edu.in/Scilab-Book-Akhilesh.pdf
2. B.S.Grewal, "Scilab Textbook Companion for Higher Engineering Mathematics", Khanna Publishers, New Delhi, 2007,https://www.academia.edu/ 34512645/ Scilab_textbook_companion_for_Higher_Engineering_Mathematics_B_S_Grewal _pdf

Reference Book(s):

1. Er. Hema Ramachandran and Dr.Achuthsankar S. Nair. "SCILAB- A Free software to MATLAB" S. Chand and Company Ltd., 2008.

Website and e-Learning Source(s):

1. https://www.math.utah.edu/~gustafso/s2014/3150/pdeNotes/urroz-ode-scilab.pdf
2. https://ashirbadmohanty.in/scilab-ode/.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	2	3	2	2
CO2	2	2	3	3	3	3	2	2	2	2
CO3	3	2	3	2	3	2	2	2	2	2
CO4	2	3	3	2	2	3	2	3	2	1
CO5	3	2	2	3	2	2	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE X: COMPLEX ANALYSIS

Semester : III **Course Code :**
Hours : 6 (5 L + 1 T) **Credits : 5**

Pre-requisite: UG Level Complex Analysis

Course Objectives:

1. To introduce the concepts of Cauchy integral formula
2. To study the local properties of analytic functions
3. To learn about general form of Cauchy's theorem
4. To apply the techniques of evaluation of definite integral
5. To understand harmonic functions.

Course Outcomes: Students will be able to

CO1: Analyze and evaluate local properties of analytical functions and definite integrals.

CO2: Describe the concept of definite integral and harmonic functions.

CO3: Demonstrate the concept of the general form of Cauchy's theorem.

CO4: Develop Taylor and Laurent series.

CO5: Explain the infinite products, canonical products and Jensen's formula.

UNIT I

Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. **Local Properties of analytical Functions:** Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

UNIT II

The general form of Cauchy's Theorem: Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.

UNIT III

Evaluation of Definite Integrals and Harmonic Functions: Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

UNIT IV

Harmonic Functions and Power Series Expansions: Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series.

UNIT V

Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem.

Extended Professional Component.

Questions related to above topics, from varies competitive examinations UPSC/TRB/NET/UGC-CSIR/GATE/TNPSC/others to be solved. (is a part of internal component only, not to be included in the external examination question paper)

Text Book(s):

1. Lars V. Ahlfors, "Complex Analysis", 3rd edition, McGraw Hill Co., New York, 1979.

Unit I : Chapter 4 :§ 2 : 2.1 to 2.3, Chapter 4 :§ 3 : 3.1 to 3.4
Unit II : Chapter 4 : § 4 : 4.1 to 4.7,Chapter 4 :§ 5: 5.1 and 5.2
Unit III : Chapter 4 : § 5 : 5.3, Chapter 4 :§ 6 : 6.1 to 6.3
Unit IV : Chapter 4 : § 6.4 and 6.5, Chapter 5 :§ 1.1 to 1.3
Unit V : Chapter 5 : § 2.1 to 2.4, Chapter 5 :§ 3.1 and 3.2

Reference Book(s):

1. H. A. Priestley,"Introduction to complex Analysis", Clarendon Press, Oxford, 1990.
2. J.B. Conway, "Functions of one complex variables", Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, "Analytic function Theory" (2 vols.), Gonm & Co, 1959.
4. M.Heins, "Complex function Theory", Academic Press, New York,1968.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/complex-analysis-an-introduction-to-the-theory-of-analytic-functions-of-one-complex-variable-e184225966.html
2. https://www.pdfdrive.com/schaums-complex-variables-e18720112.html.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE XI: PROBABILITY THEORY

Semester : III **Course Code :**
Hours : 5 (4 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Probability Theory

Course Objectives:

1. To introduce axiomatic approach to probability theory
2. To study some statistical characteristics
3. To study the discrete and continuous distribution functions and their properties
4. To learn about characteristic function
5. To understand the basic limit theorems of probability.

Course Outcomes: Students will be able to

CO1: To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.

CO2: To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.

CO3: To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions.

CO4: To define One point, two-point, Binomial distributions, to solve problems of Hypergeometric and Poisson distributions.

CO5: To discuss Stochastic convergence, Bernoulli law of large numbers, to elaborate convergence of sequence of distribution functions, to prove Levy-Cramer Theorems.

UNIT I

Random Events and Random Variables: Random events – Probability axioms– Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

UNIT II

Parameters of the Distribution: Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

UNIT III

Characteristic functions: Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution

function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

UNIT IV

Some Probability distributions: One point, two point, Binomial – Polya – Hypergeometric – Poisson (discrete) distributions.

UNIT V

Limit Theorems: Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. M.Fisz, "Probability Theory and Mathematical Statistics", John Wiley and Sons, New York, 1963.
   Unit I : Chapter 1: § 1.1 to 1.7, Chapter 2: § 2.1 to 2.9
   Unit II : Chapter 3: § 3.1 to 3.8
   Unit III : Chapter 4: § 4.1 to 4.7
   Unit IV : Chapter 5: § 5.1 to 5.5
   Unit V : Chapter 6: § 6.2 to 6.6 (omit §6.5).

Reference Book(s):

1. R.B. Ash, "Real Analysis and Probability", Academic Press, New York, 1972.
2. K.L.Chung, "A course in Probability", Academic Press, New York, 1974.
3. R.Durrett, "Probability: Theory and Examples", (2nd Edition) Duxbury Press, New York, 1996.
4. V.K.Rohatgi, "An Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
5. B.R.Bhat, "Modern Probability Theory", (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/probability-theory-and-mathematical-statistics-third-edition-e195373074.html.

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

CORE XII-P: PROGRAMMING IN PYTHON PRACTICALS

Semester: III **Course Code :**
Hours : 4 **Credits: 3**

Pre-requisite: UG Level Programming

Course Objectives: The main objectives of this course are

1. To know the basis of algorithmic problem solving.
2. To read and write simple Python programs.
3. To develop Python programs with conditionals, loops and Python functions.
4. To use Python data structures – lists, tuples.
5. To do input/output with files in Python.

Course Outcomes: On the successful completion of the course, student will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Read, write, execute by hand simple python programs.

CO3: Structure simple Python programs for solving problems.

CO4: Decompose a Python program into functions.

CO5: Read and write data from/to files in Python programs.

List of Programs

1. Create a list and perform the following methods
   1) Insert () 2) remove () 3) append () 4) len () 5) pop () 6) clear()
2. Write a python program to add two numbers.
3. Write a program to create a menu with the following options
   i). TO PERFORM ADDITITON ii).TO PERFORM SUBSTRACTION
   iii)TO PERFORM MULTIPICATION iv).TO PERFORM DIVISION

   Accepts users input and perform the operation accordingly. Use functions with arguments.
4. Write a program to double a given number and add two numbers using lambda ()?
5. Demonstrate a python code to implement abnormal termination?
6. Write a python program to get python version.
7. Write a python program to print date, time for today and now.
8. Write a python program to create a package (college), sub- package (all dept), modules (it, cse)

9. Write a python Program to display welcome to TPGASC by using classes and objects.
10. Using a numpy module create an array and check the following:

    i). Type of array ii). Axes of array iii). Shape of array
    iv) Type of elements in array
11. Write a python program to concatenate the data frames with two different objects.
12. Write a python code to set background color and pic and draw a circle using turtle module.

Reference Book(s):

1. "Core Python Programming", Wesley J. Chun, Prentice Hall India - Second Edition.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

Discipline Specific Elective – II: TOPOLOGY

Semester : III **Course Code :**
Hours : 5 (4 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Analysis

Course Objectives:

1. To study the generalization of the concepts of continuity in metric spaces and Euclidean spaces in to more general spaces called topological spaces, in which no concept of distance makes sense.
2. To study the properties that is invariant of mathematical objects under continuous deformations.
3. To study the in-depth idea of continuous function on the connected and compact spaces and the limiting process on the topological spaces.
4. To introduce the deeper study of the embedding of topological space in a metric space or in a compact Harsdorff space for which the solutions involving the countability and separation axioms.
5. To study topological spaces, continuous functions, connectedness, compactness.

Course Outcomes: Students will be able to

CO1: Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.

CO2: Understand continuity, compactness, connectedness, homeomorphism and topological properties.

CO3: Analyze and apply the topological concepts in Functional Analysis.

CO4: Ability to determine that a given point in a topological space is either a limit point or not for a given subset of a topological space.

CO5: Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent (homeomorphic).

UNIT I

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

UNIT II

Continuous functions: Continuous functions – the product topology – The metric topology.

UNIT III

Connectedness: Connected spaces - connected subspaces of the Real line – Components and local connectedness.

UNIT IV

Compactness: Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.

UNIT V

Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (is a part of internal component only, Not to be included in the External Examination question paper).

Text Book(s):

1. James R. Munkres, "Topology",Second Edition, Pearson Education Private Ltd., Delhi, 2002.

   Unit I : Chapter 2 :§ 12 to 17
   Unit II : Chapter 2 : § 18 to 21 (Omit § 22)
   Unit III : Chapter 3 : § 23 to 25
   Unit IV : Chapter 3 : § 26 to 29
   Unit V : Chapter 4 : § 30 to 35

Reference Book(s):

1. J. Dugundji,"Topology", Prentice Hall of India, New Delhi, 1975.
2. George F.Simmons, "Introduction to Topology and Modern Analysis", McGraw Hill Book Co., 1963
3. J.L. Kelly, "General Topology", Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, "Counter Examples in Topology", Holt, Rinehart and Winston, New York, 1970.

Website and e-Learning Source(s):

1. https://www.pdfdrive.com/munkres-topologypdf-e62274918.html
2. https://www.pdfdrive.com/topology-notes-e51858074.html

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023 – 2024 onwards)

Discipline Specific Elective – III:

MATHEMATICS OF FINANCE AND INSURANCE

Semester: III **Course Code :**

Hours : 2 **Credits : 2**

Pre-requisite: UG Level Mathematics

Course Objectives:

1. To develop strong background on Mathematical tools and techniques for banks and insurance companies.
2. To study finance and insurance for a successful career in banks and insurance companies.
3. To gain knowledge in handling tools with professional competency.
4. To acquire professional communication.
5. To obtain technique Skill to solve financial and insurance problems Mathematically.

Course Outcomes: The students will be able to

CO 1: Establish the qualitative behaviour of Financial Mathematical tools.

CO 2: Recognize the physical phenomena modelled by Mathematical techniques

CO 3: Analyse using appropriate methods and give examples.

CO 4: Formulate insurance methodology problems.

CO 5: Understand and use various Mathematical ideas and results that underlie the financial and insurance problems.

UNIT I

Present value and Annuities: Present Value – Annuities.

UNIT II

Mortality: Survival Time - Actuarial functions of Mortality.

UNIT III

Life Insurances and Pure Endowments: Stochastic Cash Flows – Pure Endowments.

UNIT IV

Life Insurances and Endowments: Life Insurances – Endowments.

UNIT V

Life Insurances and Annuities: Life Insurances and Annuities Continued - Life Annuities.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, Not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. An Introduction to Actuarial Mathematics by A.K. Gupta and T. Varga, Springer-Science + Business Media, B.V 2002.

Unit I : Chapter 5 – All sections

Unit II: Chapter 9,10 – All sections

Unit III: Chapter 11,12 - All sections

Unit IV: Chapter 13- All sections

Unit V : Chapter 14 - All sections.

Reference Book(s) :

1. McCutcheon, John J; Scott, William F. London: An introduction to the mathematics of finance. Heinemann, 1986. 463 pages. ISBN: 0 434 91228 x.
2. Butcher, M V; Nesbitt, Cecil J. Mathematics of compound interest. Ulrich's Books, 1971. 324 pages.
3. Ingersoll, Jonathan E. Rowman & Littlefield, Theory of financial decision making. 1987. 474 pages. ISBN: 0 8476 7359 6.
4. Kellison, Stephen G.The theory of interest. 2nd ed. Irwin, 1991. 446 pages. ISBN: 0 256 09150 1. Available from the publication's unit.

Website and e-Learning Source(s):

1. https://pdfcoffee.com/a-k-gupta-t-varga-auth-an-introduction-to-actuarial-mathematicspdf-pdf-free.html.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	3	2	1	3
CO2	2	1	3	1	3	3	3	2	1	2
CO3	3	2	3	1	3	3	3	2	1	3
CO4	1	2	3	2	3	3	3	2	1	1
CO5	3	1	2	3	3	3	3	2	1	3

Skill Enhancement Course- III: Practical

LATEX PRACTICALS

Semester: III **Course code :**

Hours : 2 **Credits : 2**

Pre-requisite: UG Level Programming

Course Objectives:

The course aims are

1. To apply theory and algorithmic aspects in various situations.
2. To make all writing tasks simpler, more visually appealing, more consistent, and more reproducible and transparent.
3. To include figures and tables in a Latex document.
4. To acquire practical knowledge about left, right, centre and justify.
5. To write latex programs like typing a given article, question paper. Mathematical expressions, own Bio data etc

Course Outcomes:

After completion of the course, the students will be able to

CO 1: Make different Alignments in a document and an application for a job.

CO 2: Generate Bio-Data, and Table Structures.

CO 3: Create Mathematical Statements using LaTeX.

CO 4: Prepare Articles and Inserting Pictures.

CO 5: Prepare Question paper and PowerPoint presentation in LaTeX format.

LIST OF PRACTICALS

Write Latex program for the following

1. Type a Document in different alignments (Left, Right, Centre and Justify).
2. Type a Letter for applying a job.
3. Type your own Bio – Data.
4. Draw a Table structure.
5. Type a given Mathematical expression using Differentiation, Integration and Trigonometry.
6. Type a given Mathematical expression using all expression.
7. Type a given expression using all inequalities.
8. Type of given Article.
9. Draw any picture and insert in LaTeX file.
10. Type a given Question paper

11. Convert one LaTeX file into power point presentation.

Text Book(s):

1. David F Griffiths and Desmond J. Higham, “Learning LaTex”, SIAM (Society for Industrial and Applied Mathematics) Publishers, Phidel Phia, 1996.

Reference Book(s):

1. Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice,and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.
2. L. Lamport. LATEX: A Document Preparation System, User's Guide and Reference Manual. Addison-Wesley, New York, second edition, 1994

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE XIII: FUNCTIONAL ANALYSIS

Semester: IV **Course Code :**

Hours: 6 (5 L + 1 T) **Credits : 4**

Pre-requisite: UG Level Analysis

Course Objectives:

1. To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems.
2. To develop student's skills and confidence in mathematical analysis and proof techniques.
3. To understand the basic concept and theorems in functional analysis.
4. To know the concepts of Banach Spaces, Hilbert Spaces and bounded linear spaces.
5. To develop right approach towards research in Functional Analysis.

Course Outcomes:

Students will be able to

CO1: Understand the Banach spaces and Transformations on Banach Spaces.

CO2: Prove Hahn Banach theorem and open mapping theorem.

CO3: Describe operators and fundamental theorems.

CO4: Validate orthogonal and orthonormal sets.

CO5: Analyze and establish the regular and singular elements.

UNIT I

Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.

UNIT II

Hilbert Spaces: The definition and some simple properties–Orthogonal complements–Ortho normal sets–The conjugate space H^*-The adjoint of an operator–self-adjoint operators-Normal and unitary operators – Projections.

UNIT –III

Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.

UNIT –IV

General Preliminaries on Banach Algebras**:** The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity.

UNIT –V

The Structure of Commutative Banach Algebras: The Gelfand mapping –

Application of the formula $r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand-Neumark theorem.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, Not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. G.F.Simmons, "Introduction to Topology and Modern Analysis", McGraw Hill Education (India) Private Limited, New Delhi, 1963.

Unit I : Chapter 9: § 46-51

Unit II : Chapter10: § 52-59

Unit III : Chapter 11: § 60-62

Unit IV : Chapter 12: § 64-69

Unit V : Chapter 13: § 70-73.

Reference Book(s):

1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.
2. B.V. Limaye, Functional Analysis, New Age International, 1996.
3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi, 1987.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.

Website and e-Learning Source(s):

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics
3. http://www.opensource.org, http://en.wikiepedia.org.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023-2024 onwards)

CORE XIV: DIFFERENTIAL GEOMETRY

Semester: IV **Course Code:**

Hours: 5 (4L +1T) **Credits : 4**

Pre-requisite: UG Level Differential geometry

Course Objectives:

1. This course introduces space curves and their intrinsic properties of a surface and geodesics.
2. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored.
3. To help the students to understand the use of differential calculus in the field of genetics.
4. To help the students to distinguish between plane curves and space curves using differentiations.
5. To find geodesics on various surfaces.

Course Outcomes: Students will be able to

CO1: Explain space curves, Curves between surfaces, metrics on a surface, Fundamental form of a surface and Geodesics.

CO2: Evaluate these concepts with related examples.

CO3: Compose problems on geodesics.

CO4: Recognize applicability of developable.

CO5: Construct and analyse the problems on curvature and minimal surfaces.

UNIT I

Space curves: Definition of a space curve – Arc length – tangent – normal and binomial – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helices.

UNIT II

Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.

UNIT III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss-Bonnet Theorem – Gaussian curvature- surface of constant curvature.

UNIT IV

Non Intrinsic properties of a surface: The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

UNIT V

Differential Geometry of Surfaces: Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, Not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print).

   Unit I : Chapter I: § 1 - 9

   Unit II : Chapter II: § 1 to 9

   Unit III : Chapter II: § 10 to 18

   Unit IV : Chapter III: § 1 to 8

   Unit V : Chapter IV: § 1 to 8 (Omit 9 to 15).

Reference Book(s):

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Inter science Publishers, 1963.
3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe Elementary topics in Differential Geometry, Under- graduate Texts in Mathematics, Springer - Verlag 1979.

Website and e-Learning Source(s):

1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics
2. http://www.opensource.org, www.physicsforum.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	3	2	3	3	2	3	2	1
CO2	2	1	3	1	3	3	2	3	2	2
CO3	3	2	3	1	3	3	2	3	3	1
CO4	1	2	3	2	3	3	2	2	2	1
CO5	3	1	2	3	3	3	2	2	2	1

(For the candidates admitted from the academic year 2023-2024 onwards)

Discipline Specific Elective - IV:

RESOURCE MANAGEMENT TECHNIQUES

Semester: IV **Course Code:**

Hours: 5 (4L+1T) **Credits : 3**

Pre-requisite: UG Level Optimization Techniques

Course Objectives:

This course will enable the students

1. To understand the need of Operations Research.
2. To develop problem solving and decision making skill to optimum effect.
3. To make distinction between deterministic and probabilistic inventory control Models.
4. To understand various components of a queueing system and description of each of them.
5. To realize the need to study replacement and maintenance analysis Techniques.

Course Outcomes: Students will be able to

CO1 : Develop problem solving techniques needed to calculate probabilities.

CO2 : Understand basic principles of statistical inference.

CO3 : Gain knowledge in linear and dynamic programming.

CO4 : Analyse the different types of Queuing Models.

CO5 : Gain knowledge to solve the Dynamic Programming .

UNIT I

Duality and Dual Simplex Method: – Introduction - Formulation of Dual problems – Duality in LPP –Dual Simplex Method.

UNIT II

Games and Strategies : Introduction –Two person zero sum games - Some basic terms - the maximin-minimax principle - Games without saddle points - Mixed strategies - graphic solution of 2 x n and m x 2 games – Dominance property.

UNIT III

Inventory Control: Costs associated with inventories – Factors affecting inventory control - An inventory control problem – The concept of EOQ – Deterministic inventory with no shortages – Deterministic inventory problem with shortages – problems of EOQ with price breaks.

UNIT IV

Queuing Theory: Introduction- Queueing system- Elements of a queuing system – Operating Characteristics of a Queueing system- Classification of queuing models – Definition of transient and steady states – Poisson Queuing Systems – Model I { (M/M/1):(∞/FIFO)} – Model II { (M/M/1):(∞/SIRO)} -Model III {(M/M/1) : (N/FIFO)} – Model IV(Generalized Model :Birth-Death Process) - Model V {(M/M/C):(∞/$FIFO$)}.

UNIT V

Dynamic Programming: Introduction - Need of Dynamic Programming - Bellman's Principle of Optimality - Characteristics of Dynamic Programming - Problems - Applications of Dynamic Programming Problem - Solution of LPP by DPP - Solving a least cost route problem by DPP.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, Not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. Kanti Swarup, P.K. Gupta and Man Mohan, "Operations Research", sixteenth Edition, Sultan Chand and Sons, Reprint 2014.
   Unit I : Chapter 5 § 5.1 -5.4,5.7,5.9
   Unit II: Chapter 17- § 17.1 - 17.7 (pp.443 – 464)
   Unit III: Chapter 19 – § 19.6 - 19.12 (pp. 510 – 538)
   Unit IV: Chapter 21– § 21.1-21.4, 21.7-21.9
2. Prof. V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan, "Resource Management Techniques (Operations Research), A.R. Publications, 2011.
   Unit V: Chapter 10.

Reference Book(s):

1. Hamdy A. Taha Operations Research (9th Edition), Prentice Hall of India Private Limited, New Delhi, 2013.
2. S.D. Sharma, Operations Research, Kedar Nath Ram Nath and Co., Meerut, 2010.
3. F.S Hiller and J. Liberman Introduction to Operations Research (7th edition), 2010
4. G Hadley, Nonlinear and Dynamic Programming, Addison-Wesley Publishing Company, Inc.
5. Ronald L. Rardin, Optimization in Operations Research, Pearson Paperback – 2018.

Website and e-Learning Source(s):

1. https://nptel.com
2. http://mathforum.org.

For Mapping with POs and PSOs:

	POs					PSOs				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	2	1	3	2	3	3	1	3	2	2
CO2	2	1	3	1	3	3	2	3	3	1
CO3	3	1	3	1	3	2	3	3	2	1
CO4	1	2	3	2	3	3	2	2	3	2
CO5	3	1	2	3	3	3	2	3	3	1

(For the candidates admitted from the academic year 2023-2024 onwards)

Skill Enhancement Course IV: RESEARCH TOOLS AND TECHNIQUES

Semester: IV **Course Code:**

Hours: 2 **Credits : 2**

Pre-requisite: UG Level Statistical methods

Course Objectives:

This course will enable the students

1.To develop strong background on research methodology with research tools such as process, design, methods report and research techniques.

2.To formulate hypothesis using data.

3.To understand the various tools of data collection.

4.To analyse data using statistical calculations.

5.To develop ability to give research proposal.

Course Outcomes: Students will be able to

CO1: Establish the qualitative behavior of research tools.

CO2: Recognize the physical phenomena modeled by research techniques

CO3: Analyze using appropriate methods and give examples.

CO4: Formulate research methodology problems.

CO5: Understand and use various theoretical ideas and results that underlie the research methodology.

UNIT I

Research process: Formulating the Research Problem - Extensive Literature Survey - Developing the Research Hypothesis - Preparing the Research Design - Determining the Research Design - Collecting the Research Data - Execution of the Project - Analysis of Data - Hypothesis Testing - Generalization and Interpretation - Preparing of the Report or Presentation of the Result.

UNIT II

Formulation of Hypothesis: Definitions of Hypothesis – Nature of Hypothesis - Functions of Hypothesis - Importance of a Hypothesis - Forms of Hypothesis - Formulation of Testable Hypothesis - Fundamental Basis of Hypothesis.

UNIT III

Tools of Data Collection: Questionnaires – Interviews - Schedules - Observation Techniques - Rating Scales.

UNIT IV

Data Analysis: Purpose – Functions – Statistical Calculations – The inferential statistics.

UNIT V

Research Proposal: Title of the Proposal – Experimental Study – non-Experimental Study – Research Problem – Statement of Hypothesis – Procedures – Logistics.

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. Dr. Prabhat Pandey and Dr. Meenu Mishra Pandey, Research Methodology: Tools and Techniques *B*ridge Center Buzau, Al. Marghiloman 245 bis, 120082.

   Unit I : Chapter 2

   Unit II: Chapter 6

   Unit III: Chapter 8

   Unit IV: Chapter 9

   Unit V : Chapter 14.

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

Website and e-Learning Source(s):

1. https://euacademic.org/BookUpload/9.pdf.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	2	3	4	5	1	2	3	4	5
CO1	3	1	3	2	3	3	1	3	2	2
CO2	2	1	3	1	3	3	2	3	1	1
CO3	3	2	3	1	3	2	3	3	2	1
CO4	1	2	3	2	3	3	2	2	1	2
CO5	3	1	2	3	3	3	2	3	3	1

(For the candidates admitted from the academic year 2023-24 onwards)

Non-Major Elective I: NUMERICAL METHODS

(for M.Com.)

Semester : II **Course Code :**

Hours : 4 **Credits : 4**

Prerequisite: 12th Standard Mathematics

Course Objectives:

1. To learn numerical techniques to solve algebraic equations.
2. To learn numerical techniques to solve transcendental equations.
3. To find the in between values using interpolation.
4. To find the derivatives numerically.
5. To find the integration values using numerical methods.

Course Outcomes: Students will be able to

1. Use numerical techniques to solve algebraic equations.
2. Solve transcendental equations using numerical techniques.
3. Find the in between values using interpolation.
4. Find the derivatives and integration values using numerical methods.
5. Solve ordinary differential equations numerically.

UNIT I

Algebraic and Transcendental Equations: Introduction – Bisection method – Newton-Raphson method (Problems only).

UNIT II

Interpolation: Introduction – Newton's interpolation formulae – Lagrange's interpolation formula (Problems only).

UNIT III

Numerical differentiation: Introduction – Derivatives using Newton's forward difference formula – derivatives using Newton's backward difference formula (Problems only).

UNIT IV

Numerical Integration: Introduction – Trapezoidal rule – Simpson's one-third rule – Simpson's three eighth rule (Problems only).

UNIT V

Numerical solutions of ordinary differential equations: Introduction – Euler's method – Second order Runge-kutta method (Problems only).

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a

part of internal component only, Not to be included in the External Examination question paper).(To be discussed during the Tutorial hour)

Text Book(s):

1. S. Arumugam, A. Thangapandi Issac, A. Somasundaram, "Numerical methods", Second Edition, Scitech publications (India) Pvt. Ltd., Chennai, 2010.

   Unit I : Chapter 3 - § 3.0,3.3,3.5

   Unit II : Chapter 7 - § 7.0,7.1,7.3

   Unit III : Chapter 8 - § 8.0,8.1,8.2

   Unit IV : Chapter 8 - § 8.5

   Unit V : Chapter 10 - § 10.0,10.3,10.4

Reference Book(s):

1. S.S. Sastry, "Introductory methods of Numerical Analysis", Fifth edition, prentice Hall of India private Ltd, New Delhi, 2013.
2. M.K. Ventataraman, "Numerical methods in Science and Engineering", Fifth Edition, National Publisher company, 2001.

Website and e-Learning Source(s):

1. https://nptel.ac.in

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	2	3	4	5	1	2	3	4	5
CO1	1	2	3	4	5	3	2	1	1	1
CO2	3	1	3	-	-	3	2	1	1	1
CO3	2	1	3	-	-	3	2	1	1	1
CO4	3	2	3	2	-	3	2	1	1	1
CO5	3	2	3	2	1	3	2	1	1	1

(For the candidates admitted from the academic year 2023-2024 onwards)

Non-Major Elective II:

MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE

(For M.Sc. Computer Science)

Semester : III **Course Code :**
Hours : 3 **Credits : 2**

Pre-requisites: UG level Matrices and Algebra

Course Objectives:

1. To learn about Mathematical logic.
2. To have a knowledge of Inference theory.
3. To learn about Predicate calculus
4. To gain information about basic algebraic structure.
5. To study the matrix theory and develop skills in solving matrix related problems.

Course Outcomes:

1. The students will gain knowledge in the application of Mathematical logic.
2. The students will understand Predicate calculus.
3. The students will know the basic algebraic structure of Mathematics for Computer Science.
4. The students will understand the different types of matrices and their decompositions.
5. The students will be able to solve many mathematical problems in Computer Science.

UNIT I

Algebraic Systems: Semigroups and Monoids – Cyclic Monoids - Homomorphism – Isomorphism - Homomorphism and isomorphism of semigroups and monoids.

UNIT II

Mathematical logic: TF Statements– Connectives Conjunction, Disjunction, Negation, Conditional and Biconditional – Truth table – Tautology – Worked examples.

UNIT III

Theory of Inference for statement calculus – predicate calculus – Inference theory of predicate calculus.

UNIT IV

Matrices: Special Types of Matrices – Scalar multiplication of a matrix – Equality of Matrices – Addition of Matrices – Subtraction - Symmetric matrix – Skew symmetric matrix – Hermitian and skew Hermitian matrices – Multiplication of Matrices – Inverse matrix – Adjoint Matrix – Relation between adjoint and inverse matrices - Inner Product – Orthogonal matrices – Properties of orthogonal matrices - Rank of a matrix by elementary transformations – Eigen values.

UNIT V

Matrix Decomposition: Introduction – Triangular Matrices – LU Decomposition of Matrix (Problems only).

Extended Professional Component:

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved. (This a part of internal component only, Not to be included in the External Examination question paper). (To be discussed during the Tutorial hour)

Text Book(s):

1. Dr.M.K.Venkatraman, Dr.N. Sridharan and N.Chandrasekaran, "Discrete Mathematics", The National Publishing Company, Chennai, September 2000.
   Unit I : Chapter VII - § 2, 3 and 4.
   Unit II : Chapter XI - § 1,2,3,6 and 7.
   Unit III : Chapter XI - § 13 and 17.
2. T.K. Manickavachagam Pillay, T. Natarajan and K.S.Ganapathy, "Algebra Volume II", S.Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai, 2011.
   Unit IV : Chapter 2 - § 1, 1.2, 2, 3, 4, 4.1, 5, 6.1-6.3, 7, 7.1-7.5, 8, 8.1 – 8.3, 9, 9.1 – 9.2, 11, 13, 13.1, 16 (Eigen values only).
3. S.S.Sastry, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd., Delhi, 2015.
   Unit V : Chapter VII - § 7.1, 7.2 and 7.3.

Reference Book(s):

1. I. N. Herstein, Topics in algebra, Second Edition, John Wiley & Sons (Asia), 1975.
2. G.Shankar Rao, Mathematical Foundations of Computer Science, I.K. International Pvt. Ltd, 2006.
3. J. P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Education Private Limited, 1987.

Website and e-Learning Source:

1. http://mathforum.org
2. http://www.opensource.org
3. www.mathpages.com.

For Mapping with POs and PSOs:

	POs					**PSOs**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
CO1	2	1	2	2	2	2	2	1	2	1
CO2	2	1	2	1	3	2	2	1	3	2
CO3	2	2	2	1	2	2	2	1	2	1
CO4	1	2	2	2	3	2	2	1	3	2
CO5	3	1	2	3	2	2	2	1	2	1