C. Abdul Hakeem College (Autonomous), Melvisharam.

Syllabus for M.Sc., Mathematics effective from the year 2024-2025

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*CC*	***P24MMA101***	***ALGEBRAIC STRUCTURES***	***90***	***5***	***25***	***75***	***100***

Objectives:

To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations and real quadratic forms.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Apply Sylow's theorem to calculate the number of Sylow p - subgroups for a specific group.	**K3**
CO2	Examine whether the given group is solvable or not and express any finitely generated R – module in terms of direct product of cyclic submodules, where R is a Euclidean ring.	**K4**
CO3	For given two linear transformations, determine whether they are similar or not.	**K5**
CO4	Analyze the given linear transformation admits triangular form or Jordan form or rational canonical form or not.	**K4**
CO5	Understand the special types of linear transformations and their characteristic roots.	**K2**

Syllabus:

Unit-I: Group Theory **(18 Hours)**

Another Counting Principle - Sylow's Theorem (In theorem 2.12.1, First proof of the theorem only).

Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)

Unit-II: Fields: Solvability by Radicals **(18 Hours)**

Group Theory: Direct products - Finite Abelian Groups.

Vector Spaces and Modules: Modules.

Chapter 5: Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Sections 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5.

Unit-III: Linear Transformations: **(18 Hours)**

Canonical Forms: Triangular Form - Nilpotent Transformations.

Chapter 6: Sections 6.4 and 6.5

Unit-IV: Linear Transformations: **(18 Hours)**

Canonical Forms: A Decomposition of V: Jordan Form - Rational Canonical Form.

Chapter 6: Sections 6.6 and 6.7

Unit-V: Linear Transformations: **(18 Hours)**

Trace and Transpose - Hermitian, Unitary and Normal Transformations - Real Quadratic Forms.

Chapter 6: Sections 6.8, 6.10 and 6.11 (Omit section 6.9)

Text Book: I.N. Herstein. ***Topics in Algebra*** (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Reference Books:

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)

E - Resources:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	3	3	2	2
CO2	3	2	2	-	2	-	-	2	2	2	2
CO3	3	2	2	-	2	-	-	2	3	2	3
CO4	3	2	3	-	2	-	-	3	3	3	3
CO5	3	3	3	-	2	-	-	3	3	2	3
Mean	**3**	**2.4**	**2.6**	**-**	**2**	**-**	**-**	**2.6**	**2.8**	**2.2**	**2.6**

3 – Strong; 2 – Medium; 1 – Low

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N. Mohamedazarudeen	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*CC*	***P24MMA102***	***REAL ANALYSIS - I***	***90***	***5***	***25***	***75***	***100***

Objectives:

To have a detailed study of functions of bounded variation, Riemann –Stieltjes Integrals, double sequence, double series and uniform convergence.

COURSE OUTCOME(s): At the end of the course the student will be able to		**Cognitive Level**
CO1	Analyze the functions of bounded variations and infinite products.	**K4**
CO2	Illustrate the characteristics of Riemann – Stieltjes Integrals.	**K3**
CO3	Evaluate the existence of the Riemann – Stieltjes Integrals and proofs of various fundamental theorems for Riemann – Stieltjes Integrals. Assess the relationship between Riemann Integrals and Riemann Stieltjes Integrals.	**K5**
CO4	Perform various tests to check whether the given series converges or not.	**K3**
CO5	Analyze how uniform convergence affects the preservation of continuity, differentiability and integrability of functions.	**K4**

Course Outcomes (COs)

Syllabus:

Unit – I **(18 Hours)**

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 increasing functions - Continuous functions of bounded variation – Infinite Products.

Chapter - 6: Sections 6.1 to 6.8

Chapter – 8: Section 8.26

Unit – II **(18 Hours)**

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 - Step functions as Integrators - Reduction of a Riemann-Stieltjes Integral to a Finite Sum - Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition.

Chapter - 7: Sections 7.1 to 7.13

Unit – III **(18 Hours)**

Integrators of bounded variation - Sufficient conditions for the existence of Riemann-Stieltjes integrals - Necessary conditions for the existence of Riemann-Stieltjes integrals- 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- Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign – Interchanging the order of Integration.

Chapter - 7: Sections 7.15 to 7.25

Unit – IV **(18 Hours)**

Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability.

Chapter 8: Sections 8.8, 8.15, 8.17, 8.18, 8.23 to 8.25

Unit – V **(18 Hours)**

Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Uniform convergence and Riemann - Stieltjes integration - Uniform convergence and differentiation - Sufficient conditions for uniform convergence of a series - Mean convergence.

Chapter – 9: Sections 9.1 to 9.6, 9.8, 9.10, 9.11, 9.13

Text Books:

Tom M. Apostol: Mathematical Analysis, 2nd Edition, Addison-Wesley PublishingCompany Inc. New York, 1997

Reference Books:

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 Anslysis, Wiley Eastern Limited.NewDelhi, 1991.
4. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, NewDelhi, 1991.
5. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson Education, (Indianprint) 2003.

E-Resources:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Cos	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	2	-	3	3	2	2
CO2	3	2	2	-	2	2	-	2	2	2	2
CO3	3	2	2	-	2	2	-	2	2	2	2
CO4	2	2	2	-	2	2	-	2	2	2	2
CO5	2	3	2	-	2	2	-	2	3	2	2
Mean	2.4	2.2	2	-	2	2	-	2.2	2.4	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
A Mohammed Hakil	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*CC*	***P24MMA103***	***ORDINARY DIFFERENTIAL EQUATIONS***	***90***	***5***	***25***	***75***	***100***

Objectives:

To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Examine the qualitative behavior of solutions of systems of ordinary differential equations	**K4**
CO2	Examine the physical phenomena modeled by ordinary differential equations and dynamical systems.	**K4**
CO3	Analyze the solutions of ordinary differential equations using appropriate methods and give examples.	**K4**
CO4	Construct the Euler and the Bessel's equations.	**K6**
CO5	Explain the existence and uniqueness of solutions to first order ordinary differential equations.	**K5**

Syllabus:

Unit – I Linear equations with constant coefficients (18 Hours)

Second order homogeneous equation-Initial value problems for second order equations-Linear dependence and independence-Wronskian and a formula for the Wronskian-The non-homogeneous equation of order two.

Chapter 2: Sections 1 to 6

Unit – II Linear equations with constant coefficients (18 Hours)

Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equations - Algebra of constant coefficient operators.

Chapter 2: Sections 7 to 12.

Unit – III Linear equations with variable coefficients (18 Hours)

Initial value problems for the homogeneous equation: Existence and uniqueness theorems – 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.

Chapter 3: Sections 1 to 8 (Omit section 9)

Unit – IV Linear equations with regular singular points (18 Hours)

The Euler equation – Second order equations with regular singular points –The Exceptional cases – The Bessel equation.

Chapter 4: Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)

Unit – V Existence and uniqueness of solutions to first order equations: (18 Hours)

Equation with variable separated – Exact equations – The method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)

Text Books:

E.A.Coddington, *An introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987

Reference Books:

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. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

E-Resources

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	3	2	2	2
CO2	3	2	3	2	3	-	-	3	2	2	2
CO3	3	3	3	3	2	-	-	2	2	2	2
CO4	3	3	3	3	2	-	-	2	2	2	2
CO5	2	3	2	2	3	-	-	3	2	2	2
Mean	2.6	2.8	2.6	2.6	2.4	-	-	2.6	2	2	2

3 – Strong; 2 – Medium; 1 – Low

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S M R	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC1-4a*	***P24EMA101***	***PROGRAMMING IN C++ AND NUMERICAL ANALYSIS (ELECTIVE - I)***	***42***	***2***	***25***	***75***	***100***

Objectives:

This course aims to learn the object-oriented programming concepts with C++ and numerical methods for hands-on experience on computers.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the C++ tokens, expressions, and OOPs concepts in C++.	**K5**
CO2	Create the C++ programs using special features like operator overloading and inheritance.	**K6**
CO3	Solve the non-linear equations using numerical methods	**K3**
CO4	Determine the solutions of the linear system of equations using numerical methods	**K5**
CO5	Solve the differential equations using numerical methods	**K3**

Syllabus:

Unit – I **(9 Hours)**

Basic concepts of Object-oriented programming- a simple C++ program – More C++ statements- An example with class - Structure of C++ program -Tokens-Keywords – Identifiers and constants -Basic data types - User-defined data types -derived data types -operators in C++ - Expressions and their types.

Chapter 1: Section 1.5

Chapter 2: Section 2.3 to 2.6

Chapter 3: Section 3.2 to 3.6, 3.8, 3.14, 3.20

Unit – II **(9 Hours)**

Defining Operator Overloading- Overloading unary operators -overloading binary operators- overloading binary operators using friends – Inheritance: Introduction – defining derived classes - single inheritance -multilevel inheritance – multiple inheritance -Hierarchical inheritance – Hybrid inheritance.

Chapter 7: Section 7.1 to 7.5

Chapter 8: Section 8.1 to 8.3, 8.5 to 8.8 (omit 8.4)

Unit – III **(9 Hours)**

Non-linear Equations: Bisection method- Secant Method - Regula Falsi Method - Newton‘s method - Fixed Point method.

Chapter 2: Section 2.1 to 2.4, 2.6 (omit 2.5)

Unit – IV **(9 Hours)**

System of Linear Equations: Gauss- Elimination Method-Crout‘s method -Jacobi‘s method - Gauss-Seidel Method. Numerical Integration: Basic Trapezoidal rule – Composite Trapezoidal rule – Simpson’s 1/3 rule – Composite Simpson’s 1/3 rule - Simpson’s 3/8 rule – Composite Simpson’s 3/8 rule

Chapter 3: Section 3.1(omit 3.1.2), 3.3, 3.6 (3.6.1 & 3.6.2)

Chapter 5: Section 5.3.1 to 5.3.6

Unit – V **(9 Hours)**

Difference equation - Differential Equations: Single Step methods -Euler's method – Taylor's series method -Runge-Kutta Methods – Second order and fourth order Runge-Kutta Methods.

Chapter 6: Section 6.1, 6.2 (omit 6.2.1), 6.3

Text Books:

1. E. Balagurusamy, Object Oriented Programming with C++, TataMcGraw Hill, New Delhi, 1999.
2. Devi Prasad, An Introduction to Numerical Analysis (3rd edn)Narosa Publishing House, New Delhi, 2006.

Reference Books:

1. D. Ravichandran, Programming with C++, Tata McGraw Hill, NewDelhi, 1996
2. Conte and de Boor, Numerical Analysis, McGraw Hill, New York,1990
3. John H.Mathews, Numerical Methods for Mathematics, Science andEngineering (2nd Edn.), Prentice Hall, New Delhi, 2000

E-Resources

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes			Mean
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	
CO1	3	3	3	3	2	-	-	1	3	3	3	2.7
CO2	3	3	3	3	2	-	-	1	3	3	3	2.7
CO3	3	3	3	3	-	-	-	1	3	2	2	2.5
CO4	3	3	3	3	-	-	-	1	3	2	2	2.5
CO5	3	3	3	3	-	-	-	1	3	2	2	2.5
Mean	3	3	3	3	2	-	-	1	3	2.4	2.4	3

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC1-4a*	***P24EMAP11***	***PROGRAMMING IN C++ - PRACTICAL***	***30***	***1***	***25***	***75***	***100***

Objectives: This course aims to gain practical programming knowledge in C++.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the special features of C++	**K5**
CO2	Create the C++ programs by applying OOP concepts	**K6**
CO3	Develop the C++ programs for obtaining the solutions of mathematical problems	**K3**
CO4	Create the C++ programs for the numerical methods	**K6**
CO5	Apply the C++ programming in real life application problems	**K3**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

1. C++ program for printing a string
2. C++ program for finding the average of two numbers
3. C++ program using class
4. C++ program using scope resolution operator
5. C++ program for arithmetic operations using inline function
6. C++ program for finding the factorial of a number
7. C++ program for solving tower of Hanoi problem
8. C++ program for the use of math functions
9. C++ program for swapping private data of classes
10. C++ program for using inheritance concepts
11. C++ program for the use of Numerical methods

Text Books: E. Balagurusamy, Object Oriented Programming with C++, TataMcGraw Hill, New Delhi, 1999.

E-Resources

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3. http://www.opensource.org, www.mathpages.com

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes			Mean
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	
CO1	3	2	3	3	2	-	-	2	3	2	2	2.4
CO2	3	2	3	3	2	-	-	2	3	2	2	2.4
CO3	3	3	3	3	2	-	-	2	3	2	2	2.6
CO4	3	3	3	3	2	-	-	2	3	2	2	2.6
CO5	3	3	3	3	2	-	-	2	3	2	2	2.6
Mean	3	2.6	3	3	2	-	-	2	3	2	2	2.5

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC1-1*	***P24EMA103***	***NUMBER THEORY AND CRYPTOGRAPHY (ELECTIVE - I)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To introduce various cryptosystems and apply them in the necessary fields.
2. To understand the concepts of public key and primality.
3. Demonstrate ability to learn elementary ideas from number theory which will have applications in cryptography.
4. To learn the public key cryptography and RSA algorithm.
5. To get the knowledge about Factoring concepts.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Acquire the knowledge of elementary number theory	**K3**
CO2	Apply various cryptosystems and understand the concepts of quadratic residues and reciprocity	**K3**
CO3	Develop the idea of public key cryptography, RSA Algorithms.	**K6**
CO4	Solve problems using the continued fraction method and the quadratic sieve method	**K6**
CO5	Analyze Fermat factorization and factor bases.	**K4**

Syllabus:

Unit – I Some topics in Elementary Number Theory Time (15 Hours)

Estimates for doing arithmetic – Divisibility and Euclidean Algorithm –Congruence's– Some applications to Factoring.

Chapter 1: Full

Unit – II Cryptography (15 Hours)

Some simple cryptosystems – Enciphering matrices.

Chapter 3: Full

Unit – III Quadratic Residues (15 Hours)

Quadratics Residues and reciprocity.

Chapter 2: Full

Unit – IV Public Key (15 Hours)

The idea of Public key Cryptography – RSA– DiscreteLog– Knapsack –Zero–Knowledge protocols and oblivious transfer.

Chapter 4: Full

Unit – V **Primality and Factoring** **(15 Hours)**

Pseudo primes – The rho method – Fermat factorization and factorbases – The continued fraction method – The quadratic sieve method.

Chapter 5: Full

Text Books:

Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York, 1987

Reference Books:

1. I.Niven and H.S.Zuckermann, An Introduction to Theory ofNumbers(Edn. 3), Wiley Eastern Ltd., New Delhi,1976
2. David M.Burton, Elementary Number Theory, Brown Publishers,Iowa,1989
3. K.Ireland and M.Rosen, A Classical Introduction to ModernNumberTheory, Springer Verlag, 1972
4. N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.

E-Resources

1. https://nptel.ac.in/courses/111101137
2. https://archive.nptel.ac.in/courses/106/103/106103015/
3. https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	-	-	2	2	3	3
CO2	3	2	2	3	2	-	-	2	1	3	3
CO3	2	2	2	3	2	-	-	2	3	2	2
CO4	2	3	2	3	2	-	-	2	2	2	2
CO5	3	3	2	3	2	-	-	2	2	2	2
Mean	2.4	2.4	2	3	2	-	-	2	2	2.4	2.4

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
A Mohammed Hakil	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC1-2*	***P24EMA104***	***GRAPH THEORY AND ITS APPLICATIONS (ELECTIVE - I)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To study and develop the concepts of graphs, sub graphs, trees, connectivity, Euler tours, Hamilton cycles, matching, coloring ofgraphs, independent sets, cliques, vertex coloring, and planar graphs.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Classify the types of graphs and features.	K2
CO2	Explain the properties of graphs in terms of Eulerian and Hamiltonian.	K5
CO3	Explain matching and coverings with examples	K5
CO4	Apply the colouring techniques to graphs to model the real-life applications	K3
CO5	Analyze the planarity techniques to prove the theorems in graphs.	K4

Syllabus:

Unit – I Graphs, Subgraphs and Trees (15 Hours)

Graphs and simple graphs - Graph Isomorphism - The Incidence andAdjacency Matrices- Subgraphs - Vertex Degrees - Paths and Connection- Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

Chapter 1: Section 1.1 - 1.7

Chapter 2: Section 2.1 - 2.3

Unit – II Connectivity, Euler Tours and Hamilton Cycles (15 Hours)

Connectivity - Blocks - Euler tours – Hamilton

Chapter 3: Section 3.1 -3.2

Chapter 4: Section 4.1 - 4.2

Unit – III Matchings, Edge Colourings (15 Hours)

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

Chapter 5: Section 5.1 - 5.2

Chapter 6: Section 6.1 - 6.2

Unit – IV Independent Sets and Cliques, Vertex Colourings (15 Hours)

Independent sets - Ramsey's Theorem – Chromatic Number -Brooks' Theorem - Chromatic Polynomials.

Chapter 7: Section 7.1 – 7.2

Chapter 8: Section 8.1 – 8.2, 8.4

Unit – V Planar Graphs (15 Hours)

Plane and planar Graphs - Dual graphs - Euler's Formula – The Five-Colour Theorem and the Four-Colour Conjecture.

Chapter 9: Section 9.1 - 9.3, 9.6

Text Books:

J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications,Macmillan, London, 1976.

Reference Books:

1. J.Clark and D.A.Holton, A First look at Graph Theory, AlliedPublishers, New Delhi, 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, Algorithmic Graph Theory, CambridgeUniversity Press, Cambridge, 1989.
4. R.J.Wilson and J.J.Watkins, Graphs : An IntroductoryApproach, John Wiley andSons, New York, 1989.
5. R.J.Wilson, Introduction to Graph Theory, Pearson Education 4th Edition, 2 0 04, Indian Print.
6. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd.1987.

E-Resources

https://nptel.ac.in/courses/111106050/

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COs	Programme Outcomes								Programme Specific Outcomes			Mean
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	
CO1	3	3	2	3	-	-	-	2	3	2	2	2.5
CO2	3	3	2	3	-	-	-	2	3	2	2	2.5
CO3	3	3	2	3	-	-	-	2	3	2	2	2.5
CO4	3	3	2	3	-	-	-	2	3	2	2	2.5
CO5	3	3	2	3	-	-	-	2	3	2	2	2.5
Mean	3	3	2	3	-	-	-	2	3	2	2	2.5

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
MSM	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC1-3*	***P24EMA105***	***FORMAL LANGUAGES AND AUTOMATA THEORY (ELECTIVE - I)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages.
2. To classify machines by their power to recognize languages. Employ finite state machines to solve problems in computing.
3. To explain deterministic and non-deterministic machines.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Define basic concepts of finite automata and regular expressions	K1
CO2	Explain the properties of regular languages.	K5
CO3	Discuss finite automata theory.	K6
CO4	Explain the concept of context free grammars and its normal forms, properties	K5
CO5	Identify push down automata and context free languages.	K3

Syllabus:

Unit – I Finite Automata and Regular Expressions (15 Hours)

Finite state systems- Deterministic Finite state Automata- Non deterministic Finite Automata- Finite Automata with Epsilon- Transitions – Regular Expressions- Finite Automata and Regular Expressions

Unit – II Properties of Regular Languages (15 Hours)

The Pumping Lemma for Regular Languages – Application of thePumping Lemma – Closure Properties of Regular Languages – Reversal – Homomorphism – Decision properties of Regular Languages –Converting NFA's to DFA'S – Minimization of DFA's

Unit – III Context Free Grammars and Languages (15 Hours)

Context Free Grammars – Parse Trees – Normal forms for Context Free Grammars – Chomsky Normal Form – Greibach Normal Form

Unit – IV Pushdown Automata (15 Hours)

Definition – The languages of a PDA – Equivalence of PDA's and CFG's – Deterministic Pushdown Automata.

Unit – V Properties of Context-Free Languages (15 Hours)

The Pumping Lemma for Context-free Languages – Closure Properties of Context- Free Languages – Decision properties of CFL's.

Text Books:

1. Introduction to Automata Theory Languages and Computation. Hopcroft H.E. and Ullman J. D. Pearson Education.
2. Introduction to Theory of Computation - Sipser 2nd edition Thomson

Reference Books:

1. Languages and Computation, Pearson Education, 2013.
2. A Salomaa , Formal Languages , Academic press , New York , 19732.John C. Martin,
3. Introduction to Languages and theory of Computations (2ndEdn), Tata – McGraw Hill company Ltd., New Delhi, 1997.
4. Dr. Rani Siromoney , Formal Languages and Automata,The Christian Literature Society, 1979.

E-Resources

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	-	-	3	2	2
CO2	3	2	2	3	-	-	-	-	3	2	2
CO3	3	2	2	3	-	-	-	-	3	2	2
CO4	3	2	2	3	-	-	-	-	3	2	2
CO5	3	2	2	3	-	-	-	-	3	2	2
Mean	3	2	2	3	-	-	-	-	3	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
MSM	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC2-1*	***P24EMA106***	***LIE GROUPS and LIE ALGEBRAS (ELECTIVE - II)***	*75*	*3*	*25*	*75*	*100*

Objectives:

1. In physics, Lie groups appear as symmetry groups of physical systems, and their Lie algebras (tangent vectors near the identity)may be thought of as infinitesimal symmetry motions.
2. Lie algebras and their representations are used extensively in physics, Notably in quantum mechanics and particle physics.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Demonstrate systematic understanding of key aspects of Matrix Lie Groups and Lie groups.	**K2**
CO2	Determine the exponential of a matrix.	**K5**
CO3	Distinguish Lie groups and Lie Algebras.	**K4**
CO4	Determine the representation of sl (2 ; C).	**K5**
CO5	Explain reductive Lie algebra	**K5**

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

Unit – I **(15 Hours)**

Matrix Lie Groups: Definitions, Examples, Topological properties, Homomorphisms, Lie groups

Chapter 1 (FULL)

Unit – II **(15 Hours)**

The Matrix Exponential: The Exponential of a matrix, computing the Exponential, The matrix logarithm, further properties of the exponential, the polar decomposition

Chapter 2(FULL)

Unit – III **(15 Hours)**

Lie Algebras: Simple, solvable and nilpotent Lie algebras, the Lie algebra of a matrix Lie group, Lie group and Lie algebra homomorphisms, the complexification of a real Lie algebras, the exponential map

Chapter 3(FULL)

Unit – IV **(15 Hours)**

Basic Representation Theory: Representations, new representation from old, complete reducibility, schur's lemma, representations of sl(2,C), group versus Lie algebra representations, a nonmatrix lie group

Chapter 4(FULL)

Unit – V **(15 Hours)**

Semi simple Lie Algebras: Semisimple and reductive Lie algebras, Cartan subalgebras, roots and root spaces, the Weyl group, root systems, simple Lie algebras, the root systems of the classical Lie algebras

Chapter 7(FULL)

Text Books:

Brain Hall, Lie Groups, Lie Algebras and Representations: An Elementary Introduction (Second Edition), Springer, USA, 2015.

Reference Books:

1. V. S. Varadarajan, Lie groups, Lie algebras and their representations,Sringer 1984.
2. Brian Hall, Lie groups, Lie algebras and representations, Springer2003.
3. Barry Simon, Representations of finite and compact groups, AMS1996.
4. A. W. Knapp, Representation theory of semi smiple Lie groups. Anoverview based on examples, Princeton university press 2002.
5. S. Kumaresan S, A course in differential geometry and Lie groups, Texts and Readings in Mathematics, 22. Hindustan Book Agency, New Delhi, 2002.

E-Resources:

1. https://archive.nptel.ac.in/courses/111/108/111108134/
2. https://www.digimat.in/nptel/courses/video/111108134/L42.html

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	3	2	2
CO2	3	2	2	2	-	-	-	-	3	2	2
CO3	3	2	2	2	-	-	-	-	3	2	2
CO4	3	2	2	2	-	-	-	-	3	2	2
CO5	3	2	2	2	-	-	-	-	3	2	2
Mean	3	2	2	2	-	-	-	-	3	2	2

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
SH	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC2-2*	***P24EMA102***	***MATHEMATICAL PROGRAMMING (ELECTIVE - II)***	***75***	***3***	***25***	***75***	***100***

Objectives:

This course introduces advanced topics in Linear, non-linear programming and Queuing systems.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Determine the solution of Integer Linear Programming Problems (ILLP).	**K5**
CO2	Solve Dynamic Programming Problems.	**K3**
CO3	Analyze the concepts of constrained and unconstrained problems and to solve constrained Non-Linear Programming Problems (NLPP) using Lagrangian multiplier method and Kuhn Tucker condition.	**K4**
CO4	Find the basic feasible solution and alternative optimum solution for Linear Programming Problems (LPP).	**K2**
CO5	Construct and Analyze priority Queuing systems.	**K4**

Syllabus:

Unit – I Integer Linear Programming (15 Hours)

Types of Integer Linear Programming Problems - Concept of Cutting Plane solution – Gomory's All Integer Cutting Plane Method – Gomory's mixed-Integer Cutting Plane method - Branch and Bound Method – Applications of Zero-One Integer Programming.

Chapter-7: Section 7.1 - 7.7

Unit – II Dynamic Programming (15 Hours)

Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty – Dynamic Programming approach for solving Linear Programming Problem.

Chapter-20: Section 20.1 - 20.5

Unit – III (15 Hours)

Classical Optimization Methods: Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints

Non-linear Programming Methods: Examples of Non-linear programming problem (NLPP) – The General NLPP: Graphical solution method- Quadratic Programming: Wolfe's modified Simplex Method.

Chapter-23: Section 23.1 - 23.4

Chapter-24: Section 24.1 - 24.4 (**Only 24.4.1 and 24.4.2)**

Unit – IV Theory of Simplex Method (15 Hours)

Canonical and Standard form of LP problem- Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solutions - Unbounded solution - Optimality condition - Some complications and their resolutions - Degeneracy and its resolution.

Chapter-25: Section 25.1 - 25.4, 25.6-25.9.

Unit – V Queuing Theory (15 Hours)

Essential Features of a Queuing system- Performance Measures of Queuing system Probability Distributions in Queuing systems -Classification of Queuing Models-Single server Queuing Model- Multi-server Queuing Models (**Only: Model-I to Model-IV**).

Chapter 16: Section 16.1 - 16.7.

Text Books: J.K.Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd.

Reference Books:

1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice -Hall of India Private Limited, New Delhi, 1997.
2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7thEdition) TataMcGraw Hill ompany, New Delhi, 2001.
3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization(2nd Edition) Prentice Hall Pvt Ltd., New York, 1979
4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990.

E-Resources:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	-	-	2	2	3	1
CO2	2	2	3	2	2	-	-	2	2	3	2
CO3	2	2	3	2	2	-	-	1	2	3	2
CO4	2	2	3	2	2	-	-	1	2	3	2
CO5	2	2	3	2	2	-	-	2	2	3	2
Mean	2	2	3	2	2	-	-	1.6	2	3	1.8

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
SH	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC*	***P24EMA107***	***FUZZY MATHEMATICS AND THEIR APPLICATIONS (ELECTIVE - II)***	***75***	***3***	***25***	***75***	***100***

Objectives:

Fuzzy is one of the latest topic in Mathematics that has real life applications. Hence it is essential for the students to learn this topic. This topic introduces the concept of uncertainty and fuzziness in logic that will enable the student to develop their intuitive mind further.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Apply domain knowledge from classical sets to fuzzy sets with illustrations and to know about the operations on fuzzy sets.	**K3**
CO2	Explain the fuzzy arithmetic, Linguistic variables and examine Fuzzy equations.	**K5**
CO3	Classify fuzzy relations and properties of fuzzy relations.	**K3**
CO4	Examine fuzzy Decision making problem and Fuzzy Linear programming problem.	**K4**
CO5	Explain the applications of fuzzy logic in various fields.	**K5**

Syllabus:

Unit – I **(15 Hours)**

From Classical (Crisp) Sets to Fuzzy sets : Fuzzy sets: Basic types – **Fuzzy sets Versus Crisp sets :** Extension Principle for fuzzy sets – **Operations on Fuzzy sets:** Types of operations – Fuzzy complements.

Chapter 1: Sections 1.3 and 2.3

Chapter 3: Sections 3.1 and 3.2

Unit – II : Fuzzy Arithmetic **(15 Hours)**

Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals –Arithmetic operations on Fuzzy numbers –Lattice of Fuzzy numbers– Fuzzy equations.

Chapter 4: Sections 4.1 - 4.6

Unit – III: Fuzzy Relations **(15 Hours)**

Crisp Versus Fuzzy Relations - Projections and Cylindric Extensions -Binary Fuzzy Relations - Binary Relations on a Single Set - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Ordering Relations

Chapter 5: Sections 5.1 - 5.7

Unit -IV: Fuzzy Decision Making **(15 Hours)**

General Discussion –Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy

linear programming.
Chap 15: 15.1 to 15.7

Unit-V: Applications **(15 Hours)**

Medicine – Economics – Fuzzy Systems and Genetic Algorithms –Fuzzy Regression – Interpersonal Communication – Other Applications.
Chap 17: 17.1 to 17.7

Text Books: George J. Klir and Bo Yuan, ***Fuzzy sets and Fuzzy Logic Theory and Applications***, Prentice Hall of India, (2007).

Reference Books:

1. H.J.Zimmermann, ***Fuzzy set theory and its applications***, Springer (2012).
2. A. K. Bhargava, ***Fuzzy Set Theory, FuzzyLogic and their Applications***, published by S. Chand Pvt. Limited (2013).

E - Resources:

1. https://nptel.ac.in/courses/108/104/108104157/
2. https://nptel.ac.in/courses/111/102/111102130/
3. https://nptel.ac.in/courses/127/105/127105006/
4. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
5. http://www.opensource.org, www.mathpages.com

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	3	3	2	2
CO2	3	2	2	-	2	-	-	2	2	2	2
CO3	2	2	2	-	2	-	-	2	3	2	3
CO4	2	2	2	-	2	-	-	2	3	2	3
CO5	3	3	3	-	2	-	-	2	3	2	3
Mean	2.6	2.4	2.4	-	2	-	-	2.2	2.8	2	2.6

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. Mohamedazarudeen	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
I	*DSEC*	***P24EMA108***	***DISCRETE MATHEMATICS (ELECTIVE - II)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To introduce the algebraic structures of lattices and Boolean algebra.Construct the switching circuits with applications.
2. To educate the finite fields and its mathematics properties.
3. To inculcate the polynomials over finite fields, irreducibility and factorization of polynomials.
4. To indoctrinate the coding theory with the linear and cyclic codes.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Determine the minimal form of Boolean polynomials.	**K5**
CO2	Explain the switching circuits with applications	**K5**
CO3	Explain the properties of finite fields	**K5**
CO4	Identify the given polynomial over finite fields is reducible or not.	**K3**
CO5	Apply the coding theory with the linear and cyclic codes in cryptography.	**K3**

Syllabus:

UNIT-I: Lattices **(15 hours)**

Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials - Minimal Forms of Boolean Polynomials.

Chapter 1: Sections 1–4 and 6

UNIT- II: Applications of Lattices **(15 hours)**

Switching Circuits – Applications of Switching Circuits.

Chapter 2: Sections 7–8

UNIT-III: Finite Fields **(15 hours)**

Finite Fields.

Chapter 3: Section 13

UNIT-IV: Polynomials **(15 hours)**

Irreducible Polynomials over Finite Fields - Factorization of Polynomialsover Finite Fields.

Chapter 3: Sections 14 and 15

UNIT -V: Coding Theory **(15 hours)**

Linear Codes – Cyclic Codes.

Chapter 4: Sections 17 and 18

Text Books: Rudolf Lidl and Gunter Pilz, ***Applied Abstract Algebra***, 2nd Edition (Second Indian Reprint), Springer Verlag, New York, 2006.

Reference Books:

1. A.Gill, ***Applied Algebra for Computer Science***, Prentice Hall Inc., NewJersey.
2. J.L.Gersting, ***Mathematical Structures for Computer Science***,3rdEdn., ComputerSciencePress, New York.
3. S. Wiitala,***Discrete Mathematics*** - A Unified Approach, McGraw HillBook Co.

E-Resources:

1.http://www.discrete-math-hub.com/resources-and-help.html

2.https://onlinecourses.nptel.ac.in/noc22_cs123/preview

3. https://onlinecourses.nptel.ac.in/noc22_cs85/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	3	3	2	2
CO2	3	2	2	-	2	-	-	2	2	2	2
CO3	2	2	2	-	2	-	-	2	3	2	3
CO4	2	2	2	-	2	-	-	2	3	2	3
CO5	3	3	3	-	2	-	-	2	3	2	3
Mean	2.6	2.4	2.4	-	2	-	-	2.2	2.8	2	2.6

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. Mohamedazarudeen	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*CC*	***P24MMA201***	***REAL ANALYSIS - II***	***90***	***5***	***25***	***75***	***100***

Objectives: To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus

Course Outcomes (COs)

COURSE OUTCOME(s): At the end of the course the student will be able to		**Cognitive Level**
CO1	Measure the Sets using range of a function.	**K4**
CO2	Use precise integrals depending on the nature of function.	**K3**
CO3	Identify the conditions under which a Fourier series converges.	**K3**
CO4	Examine the concept of differentiability and analyze its characteristics.	**K4**
CO5	Evaluate the existence of a solution for the implicit function and critically assess the extrema of the function.	**K5**

Syllabus:

UNIT – I: Measure on the Real line (18 Hours)

Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability.

Chapter 2: Section 2.1 to 2.5 (de Barra)

UNIT – II: Integration of Functions of a Real variable (18 Hours)

Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals.

Chapter 3: Section 3.1, 3.2 and 3.4 (de Barra)

UNIT - III: Fourier Series and Fourier Integrals (18 Hours)

Introduction - Orthogonal systems 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 for trigonometric series - The Riemann Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series.

Chapter 11: Sections 11.1 to 11.13 (Apostol)

UNIT - IV: Multivariable Differential Calculus (18 Hours)

Introduction - The Directional derivative - Directional derivatives and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - An application to Complex-valued Functions - 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 Formula for functions from R^n to R^1.

Chapter 12: Section 12.1 to 12.14 (Apostol)

UNIT - V: Implicit Functions and Extremum Problems (18 Hours)

Introduction - Functions with non-zero Jacobian determinants - The inverse function theorem -The Implicit function theorem - Extrema of real valued functions of one variable - Extrema of real valued functions of severable variables - Extremum problems with side conditions.

Chapter 13: Sections 13.1 to 13.7 (Apostol)

Text Books:

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M. Apostol: Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Reference Books:

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, NewYork, 1979.
5. Malik,S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited. NewDelhi, 1991.
6. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, NewDelhi, 1991

E-Resources

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	1	2	2	2	2
CO2	2	2	2	2	2	-	2	2	2	2	2
CO3	2	2	2	2	2	-	3	2	2	2	2
CO4	3	3	2	2	2	-	3	2	2	3	2
CO5	3	3	2	2	2	-	2	3	2	3	1
Mean	2.4	2.4	2	2	2.2	-	2.2	2.2	2	2.4	1.8

Prepared by	Verified by
A Mohammed Hakil	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*CC*	***P24MMA202***	***ADVANCED ALGEBRA***	***75***	***4***	***25***	***75***	***100***

Objectives:

To study field extensions, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.

Course Outcomes (COs) and Cognitive Level Mapping:

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Construct the extension field from a given field.	**K6**
CO2	Find the splitting field of given polynomial over a given field and evaluate its degree.	**K5**
CO3	Prove the fundamental theorem of Galois theory.	**K5**
CO4	Explain the properties of finite fields	**K5**
CO5	Identify the given division ring is algebraic over real numbers or complex numbers or ring of real quaternions or not.	**K3**

Syllabus:

Unit-I: Fields: **(15 Hours)**

Extension Fields – The Transcendence of e.

Chapter 5: Sections 5.1 and 5.2

Unit-II: **Fields:** **(15 Hours)**

Roots of Polynomials - More about Roots

Chapter 5: Sections 5.3 and 5.5

Unit-III: Fields: **(15 Hours)**

The Elements of Galois theory.

Chapter 5: Section 5.6

Unit-IV: Finite Fields: **(15 Hours)**

Finite Fields- Wedderburn's Theorem on Finite Division Rings.

Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)

Unit-V: Fields: **(15 Hours)**

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

Chapter 5: Section 5.7 (Omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)

Chapter 7: Sections 7.3 and 7.4 (Omit lemmas 7.4.5 and 7.4.6)

Text Books: I.N. Herstein. ***Topics in Algebra*** (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Reference Books:

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. (IndianEdition).

E - Resources:

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	3	3	2	2
CO2	3	3	2	-	2	-	-	2	2	2	2
CO3	2	2	2	-	2	-	-	2	3	2	3
CO4	2	2	2	-	2	-	-	2	3	2	3
CO5	3	3	3	-	2	-	-	2	3	2	3
Mean	**2.6**	**2.6**	**2.4**	**-**	**2**	**-**	**-**	**2.2**	**2.8**	**2**	**2.6**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
N. Mohamedazarudeen	HOD

Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*CC*	***P24MMA203***	***PARTIAL DIFFERENTIAL EQUATIONS***	***75***	***4***	***25***	***75***	***100***

Objectives: To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Classify the second order equations and find their general solutions	**K4**
CO2	Analyze the Cauchy problem and solve spherical and cylindrical wave equations	**K4**
CO3	Apply the method of Separation of variables, solve the vibrating string, Heat conduction problems, Laplace and beam equations.	**K6**
CO4	Apply maximum and minimum principle's and solve Dirichlet, Neumann problems	**K3**
CO5	Utilize the Green's function and Lapalace, Helmholtz operators, solve Dirichlet, Newmann and Higher dimensional Problems	**K3**

Syllabus:

Unit – I **(15 Hours)**

Mathematical Models: The classical equations-The vibrating string – The vibrating membrane – waves in an elastic medium – Conduction of heat in solids – The gravitational potential.

Classification of second-order equations: Second-order equations in two independent variables – Canonical forms – Equations with constant coefficients – General solution

Chapter 2: Sections 2.1 to 2.6

Chapter 3: Sections 3.1 to 3.4 (Omit 3.5)

Unit – II The Cauchy Problem **(15 Hours)**

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

Chapter 4: Sections 4.1 to 4.11

Unit – III Method of separation of variables **(15 Hours)**

Separation of variables- The vibrating string problem – Existence and uniqueness of solution of the vibrating string problem – The heat conduction problem – Existence and uniqueness of solution of the heat conduction problem – The Laplace and beam equations

Chapter 6: Sections 6.1 to 6.6 (Omit section 6.7)

Unit – IV Boundary-Value Problems **(15 Hours)**

Boundary-value problems – Maximum and minimum principles– Uniqueness and continuity theorems – Dirichlet Problem for a circle, a circular annulus, and a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.

Chapter 8: Sections 8.1 to 8.9

Unit – V Green's Function (15 Hours)

The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigenfunctions – Higher dimensional problems – Neumann Problem.

Chapter 10: Section 10.1 to 10.9

Text Books: Tyn Myint-U and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers (Third Edition), North Hollan, New York, 1987.

Reference Books:

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

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

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	2	1	2	3	2
CO2	3	3	3	3	3	-	3	3	3	3	2
CO3	2	3	3	3	2	-	2	2	2	2	2
CO4	2	3	2	2	3	-	2	2	2	2	2
CO5	3	3	3	3	3	-	3	2	2	3	2
Mean	2.4	2.8	2.6	2.6	2.6	-	2.4	2	2.2	2.6	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC3-1*	***P24EMA203***	***ALGEBRAIC TOPOLOGY (ELECTIVE - III)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To introduce the notion of homotopy and covering spaces.
2. To study the van kampen theorem

COURSE OUTCOME(s): At the end of the course the student will be able to		**Cognitive Level**
CO1	Apply homotopy to determine when continuous maps between spaces can be deformed into each other and classify spaces based on homotopic equivalence.	**K3**
CO2	Apply the concept of fundamental groups to compute the fundamental group of the circle (S^1) and interpret its significance in terms of integer winding.	**K3**
CO3	Analyze the application of Van Kampen's theorem to determine the fundamental group of a space by examining the interactions between subspaces and their fundamental groups.	**K4**
CO4	Evaluate the implications of the homotopy lifting property and covering projections for the fundamental groups of spaces, assessing how these concepts reveal the structure of covering spaces and their associated groups.	**K5**
CO5	Analyze the classification of covering spaces and covering transformations to evaluate their connections with the fundamental group of the base space.	**K5**

Course Outcomes (COs)

Syllabus:

UNIT I: HOMOTOPY **(15 Hours)**

Homotopy and Homotopy type, contractible spaces, retraction and deformation, Homotopy extension property.

UNIT II: THE FUNDAMENTAL GROUP **(15 Hours)**

Fundamental groups, the Fundamental group of the circle, applications- Brouwer fixed point theorem in dimension 2.

UNIT III: VAN KAMPEN THEOREM **(15 Hours)**

Free product of groups, Van Kampen theorem, simple applications.

UNIT IV: COVERING SPACES **(15 Hours)**

Covering projections, Homotopy lifting property, relations with fundamental group.

UNIT V: MORE ON COVERING SPACES **(15 Hours)**

The classification of covering spaces, covering transformations.

Text Books:

Topology- A first course by James R. Munkres, Prentice-Hall of India, Pvt.Ltd, 3rd print.

Reference Books:

1. Hatcher A.," Algebraic topology", Cambridge University Press, New York 2002.
2. Rotman J.J., "An introduction to algebraic topology, Graduate text in Mathematics 119", Springer-Verlag, New York, 1988.
3. Spanier E.H., "Algebraic topology", Springer-Verlag, paper-back, New York, 1994.

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1. https://www.maths.ed.ac.uk/-v1ranik/papers/diecktop.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	2	2	3	-	-	3	2	2	2
CO2	3	2	2	2	3	-	-	3	3	1	2
CO3	2	3	2	2	1	-	-	3	2	2	2
CO4	3	2	2	2	3	-	-	1	2	3	3
CO5	2	2	2	2	2	-	-	2	2	3	1
Mean	2.4	2.4	2	2	2.4	-	-	2.4	2.2	2.2	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC3-2*	***P24EMA201***	***MATHEMATICAL STATISTICS (ELECTIVE - III)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To acquire knowledge about Statistics, and its importance in various areas such as Medical, Engineering, Agricultural etc.
2. To apply the techniques of hypothesis testing, the significance test, and parametric and non-parametric tests in real-life problems.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Apply chi-square, Student-t, Fishers - Z distributions for independent normally distributed random variables	K3
CO2	Apply the parametric tests for large and small samples.	K3
CO3	Explain the estimation theory in sampling.	K5
CO4	Analyze the experimental data for the one-way classification and multiple classification.	K4
CO5	Examine the non-parametric tests in sampling theory.	K4

Syllabus:

Unit – I **(15 Hours)**

The notion of a sample - The notion of a statistic - The distribution of the arithmetic mean of independent normally distributed random variables – The chi-square distribution- The distribution of the statistic - Student's t-distribution –Fisher's Z-distribution.

Chapter 9: Section 9.1 to 9.7

Unit – II **(15 Hours)**

Significance Test: The concept of a statistical test - Parametric test for small samples - Parametric tests for large – samples- Examples based on small and large samples - The chi – square test.

Chapter 12: Section 12.1 to 12.4

Unit – III **(15 Hours)**

Theory of Estimation: Preliminary notions - Consistent estimate - Unbiased estimate - Sufficiency of an estimate - The efficiency of an estimate – Asymptotically most efficient estimates – Methods of finding estimates.

Chapter 13: Section 13.1 to 13.7

Unit – IV **(15 Hours)**

An outline of analysis of variance: One way classification – Multiple classification Theory of Hypothesis testing: Preliminary remarks – The power function and OC function.

Chapter 15: Section 15.1 to 15.2.

Chapter 16: Section 16.1 to 16.2

Unit – V **(15 Hours)**

Most powerful tests – Uniformly most powerful test -unbiased test – the power and consistency of nonparametric tests

Chapter 16: Section 16.3 to 16.6

Text Books:

Marek Fisz - Probability Theory and Mathematical Statistics, 3rdEdition – John Wiley and Sons Inc, 1963.

Reference Books:

1. Suddhenda Biswas and G. L. Sriwastav – Mathematical Statistics – Narosa Publishing House, 2011.
2. Alexander M. Mood, Franklin A.Graybill and Duane C.Bose – Introduction to Theory of Statistics, 3rd Edition - Tata McGraw Hill, 1974.
3. P. Kandasamy, K. Thilagavathy and K. Gunavathy - Probability, Statistics and Queuing Theory, 2nd Edition - Sultan Chand and Sons, 2005

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2. https://r.search.yahoo.com/_
3. http://mathforum.org
4. http://ocw.mit.edu/ocwweb/Mathematics
5. http://www.opensource.org
6. https://nptel.ac.in
7. https://www.probability.net
8. www.coursera.org

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes			Mean
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	
CO1	3	3	3	3	-	-	-	1	3	2	2	2.5
CO2	3	3	3	3	-	-	-	1	3	2	2	2.5
CO3	3	3	3	3	-	-	-	1	3	2	2	2.5
CO4	3	3	3	3	-	-	-	1	3	2	2	2.5
CO5	3	3	3	3	-	-	-	1	3	2	2	2.5
Mean	3	3	3	3	-	-	-	1	3	2	2	2.5

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC3-3*	***P24EMAP21***	***R PROGRAMMING LANGUAGE (ELECTIVE - III) – PRACTICAL***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To master the use of R interactive environment with an understanding of the use of R documentation.
2. To use R for descriptive statistics and write simple programs in R

Course Outcomes (COs)

COURSE OUTCOME(s): At the end of the course the student will be able to		**Cognitive Level**
CO1	Create a sequence and execute arithmetic operations.	**K6**
CO2	Examine the CSV file and conduct various operations on the data.	**K4**
CO3	Create an array, a matrix, graphs, data frames and carry out various operations	**K6**
CO4	Find the correlation and the linear regression between two variables	**K3**
CO5	Analyze the data and execute specific statistical test.	**K4**

Syllabus:

1. Perform arithmetic operations.
2. Create a Sequence and find the mean of numbers.
3. Find the first 10 Fibonacci numbers.
4. Find the factors of a given number.
5. Find the Maximum and Minimum of a given vector.
6. Read the CSV file and display the content.
7. Create matrix and perform matrix operations.
8. Create a bar plot a scatter plot and a line graph.
9. Create a data frame and display the details.
10. Extract rows and columns from a data frame.
11. Create a list containing strings, numbers and vectors.
12. Find the Correlation and the Linear Regression between two variables.
13. Perform conditional executions.
14. Fit Binomial, Poisson and Normal distributions.
15. Perform Chi Square test for independence of attributes

Text Books:

W. John Braun, Duncan J. Murdoch, A first course in statisticalprogramming with R, Cambridge University Press, 2007.

Reference Books:

1. Gardener, M. Beginning R: The statistical programming language, JohnWiley & Sons, 2012.
2. Martin, T. The Undergraduate Guide to R. A beginner's introduction toR programming Language, 2009.
3. Chambers, J. Software for data analysis: programming with R. SpringerScience & Business Media, 2008.

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3. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf
4. https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf
5. https://nptel.ac.in/
6. https://swayam.gov.in/nc_details/NPTEL
7. https://www.coursera.org/
8. https://spoken-tutorial.org/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	-	2	2	2	2	2
CO2	2	2	3	3	2	-	2	2	2	2	2
CO3	2	2	2	3	2	-	2	2	2	2	3
CO4	2	2	2	3	2	-	2	2	2	2	2
CO5	2	2	3	2	2	-	2	2	2	2	2
Mean	2	2	2.6	2.8	2	-	2	2	2	2	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC3-4*	***P24EMA205***	***TENSOR ANALYSIS AND RELATIVITY THEORY (ELECTIVE - III)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To introduce vector algebra and vector calculus and special relativity and relativistic kinematics, dynamics and accelerated systems.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Classify the system of different orders in Tenor Algebra.	**K4**
CO2	Explain about Tensor Calculus in Riemann spaces.	**K5**
CO3	Explain the concept of Covariant of differentiation and intrinsic differentiation	**K5**
CO4	Explain about the theory of relativity and Doppler effect.	**K5**
CO5	Analyze about the conservation of mass and energy.	**K4**

Syllabus:

Unit – I Tensor Algebra **(15 Hours)**

Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in Sn - Invariants - Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors - Zero Tensor - Tensor Field Algebra of Tensors - Equality of Tensors - Symmetric and Skew – symmetric tensors - Outer multiplication, Contraction and Inner Multiplication - Quotient Law of Tensors - Reciprocal Tensor of Tensor Relative Tensor - Cross Product of Vectors.

Chapter I: Section I.1 - I.3, I.7 and I.8 and

Chapter II: Section II.1 - II.19

Unit – II Tensor Calculus **(15 Hours)**

Riemannian Space - Christoffel Symbols and their properties

Chapter III: Section III.1 and III.2

Unit – III Tensor Calculus (Contd) **(15 Hours)**

Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation.

Chapter III: Section III.3 - III.5

Unit – IV Special theory of Relativity **(15 Hours)**

Galilean Transformation - Maxwell‘s equations - The ether Theory - The Principle of Relativity. Relativistic Kinematics : Lorentz Transformation equations - Events and simultaneity - Example - Einstein Train - Time dilation - Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - World line - Example - twin paradox - addition of velocities- Relativistic Doppler effect.

Chapter 7: Sections 7.1 and 7.2

Unit – V Relativistic Dynamics (15 Hours)

Momentum - Energy - Momentum - energy four vector - Force - Conservation of Energy - Mass and energy - Example - inelastic collision - Principle of equivalence - Lagrangian and Hamiltonian formulations. Accelerated Systems: Rocket with constant acceleration - example - Rocket with constant thrust.

Chapter 7 : Sections 7.3 and 7.4

Text Books:

1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I,II and III)
2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (For Units IV and V)

Reference Books:

1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
2. A.S.Eddington, The Mathematical Theory of Relativity, CambridgeUniversity Press, 1930.
3. P.G.Bergman, An Introduction to Theory of Relativity, New York,1942
4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus,Cambridge, 1938.
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2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org,
4. www.mathpages.com

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	-	-	-	2	3	3	2
CO2	2	3	3	2	-	-	-	1	3	2	2
CO3	2	3	3	2	-	-	-	1	3	2	2
CO4	2	2	3	2	-	-	-	2	2	2	2
CO5	2	2	3	3	-	-	-	2	2	2	2
Mean	2	2.6	3	2.2	-	-	-	1.6	2.6	2.2	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC401*	***P24EMA206***	***WAVELETS (ELECTIVE - IV)***	***75***	***3***	***25***	***75***	***100***

Objectives:

To establish the theory necessary to understand and use wavelets and related constructions.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Determine Integral Wavelets transforms, Fourier and Inverse Fourier transformation.	K5
CO2	Explain the concepts of Fourier and wavelets series and their properties.	K2
CO3	Construct cardinal splines and its interpolation formula.	K3
CO4	Analyze about the multi resolution analysis.	K4
CO5	Determine the interpolation of cardinal spline wavelets.	K5

Syllabus:

UNIT 1: **(15 Hours)**

An Overview: Fourier to Wavelets – Integral Wavelets Transform and Time frequency analysis – Inversion formulas and duals – Classification of Wavelets – Multi-resolution analysis – Spines and Wavelets.

Fourier Analysis: Fourier and Inverse Fourier Transformation – Continuous Time Convolution – The delta function – Fourier Transformation of square integrable functions.

UNIT 2: **(15 Hours)**

Fourier Analysis (Cont.…..)

Fourier series – Basic Convergence Theory – Poisson Summation Formula.

Wavelet Transforms and Time Frequency Analysis

The Gabor Transforms – Short time Fourier Transforms and the uncertainty principle – The integral Wavelet Transform – Dyadic Wavelets – Inversion – Frames – Wavelet Series.

UNIT 3: **Cardinal Spline Analysis** **(15 Hours)**

Cardinal Spline spaces – B-splines and their basic properties – The time scale relation and an interpolating graphical display algorithm – B-Net representations and computation of cardinal splines - Constructions of cardinal splines – constructions of spline application formulas – Construction of Spline interpolation formulas.

UNIT 4: **Scaling functions and Wavelets** **(15 Hours)**

Multi-resolution analysis – Scaling functions with finite two scale relation Direction sum Decompositions of Wavelets and their duals.

UNIT 5: **Cardinal Splines Wavelets** **(15 Hours)**

Interpolating splines wavelets – Compactly supported spline – Wavelet– Computation of Cardinal spline Wavelets – Euler – Frebenious Polynomials.

Text Books: Charles K. Chui, An Introduction to Wavelets. Academic Press, 1992.

Reference Books:

1. Chui C. K. (ed), Approximation theory and Fourier Analysis,Academic Press Boston, 1991.
2. Daribechies I, Wavelets, CBMS-NSF Series in Appl, SIAMPhiladelphia, 1992.
3. Schurnaker L, L. Spline Functions: Basic Theory, Wiley, New York,1981.
4. Nurnberger G, Applications to Spline Functions, Springer Verlag, New York, 1989

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2. https://onlinecourses.nptel.ac.in/noc23_ee32/preview

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Cos	Programme Outcomes								PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	-	-	2	2	2	2
CO2	2	2	3	3	2	-	-	2	2	2	2
CO3	2	2	2	3	2	-	-	2	2	2	2
CO4	2	2	2	3	2	-	-	2	2	2	2
CO5	2	2	3	2	2	-	-	2	2	2	2
Mean	2	2	2.6	2.8	2	-	-	2	2	2	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC4-2*	***P24EMA207***	***MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE (ELECTIVE - IV)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
2. To understand about the basic theory of problem-solving paradigms and search strategies in artificial intelligence.
3. To make the students familiar with knowledge representation, planning, learning, natural language processing and robotics.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Explain the various learning algorithms and Heuristic space search for making models.	**K5**
CO2	Demonstrate the Neural network and Genetic algorithms for modeling.	**K2**
CO3	Develop the mathematical models by using Baysian and Computational learning algorithms.	**K3**
CO4	Construct the optimization models by using informed search strategies and knowledge representation.	**K6**
CO5	Construct the models for making simple and complex decisions in uncertainty situations.	**K6**

Syllabus:

Unit I: Introduction (15 Hours)

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

Unit II: Neural Networks and Genetic Algorithms (15 Hours)

Neural Network Representation – Problems – Perceptrons –Multilayer Networks and Back Propagation Algorithms– Advanced Topics – Genetic Algorithms– Hypothesis Space Search– Genetic programming –Models of Evaluation and Learning.

Unit III: Bayesian and Computational Learning (15 Hours)

Bayes Theorem – Concept Learning – Maximum Likelihood –Minimum Description Length Principle – Bayes Optimal Classifier –Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network– EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

Unit IV: (15 Hours)

Introduction - Intelligent Agents- Problem Solving - by Searching -Informed Search Strategies-Optimization Problems – Adversarial Search-Knowledge and Reasoning - Logical Agents - First-Order Logic - Inference in First-Order Logic - Knowledge Representation

Unit V: **(15 Hours)**

Planning – Planning and Acting in the Real World – Uncertain knowledge and reasoning - Uncertainty - Probabilistic Reasoning -Probabilistic Reasoning over Time - Making Simple Decisions -Making Complex Decisions.

Text Books:

1. Tom M. Mitchell,―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Third Edition, Prentice Hall of India, New Delhi, 2010

Reference Books:

1. Ethem Alpaydin,―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2. Stephen Marsland,―Machine Learning: An Algorithmic Perspective, CRC Press,2009.
3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, Andreas Beham, ―Genetic Algorithms and Genetic Programming, CRC Press Taylor and Francis Group.
4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017.
5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002.

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3. http://www.opensource.org,
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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes			Mean
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	
CO1	3	3	3	3	-	-	-	1	3	2	2	2.5
CO2	3	3	3	3	-	-	-	1	3	2	2	2.5
CO3	3	3	3	3	-	-	-	1	3	2	2	2.5
CO4	3	3	3	3	-	-	-	1	3	2	2	2.5
CO5	3	3	3	3	-	-	-	1	3	2	2	2.5
Mean	3	3	3	3	-	-	-	1	3	2	2	2.5

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC4-3*	***P24EMA208***	***NEURAL NETWORKS (ELECTIVE - IV)***	***75***	***3***	***25***	***75***	***100***

Objectives: To know the main fundamental principles and techniques of neural network systems and investigate the principal neural network models and applications.

Course Outcomes (COs)

Cos	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Analyze different neuron network models	**K4**
CO2	Classify the basic ideas behind most common learning algorithms for multilayer perceptions, radial basis function networks.	**K4**
CO3	Explain Hebb rule and analyze back propagation algorithms with examples.	**K5**
CO4	Examine convergence and generalization and implement common learning algorithms.	**K4**
CO5	Illustrate derivatives and necessary conditions for optimality and to evaluate quadratic functions.	**K2**

Syllabus:

Unit – I Neuron Model and Network Architectures (15 Hours)

Mathematical Neural Model-Network Architectures-Perceptron-Hamming Network-Hopfield Network-Learning Rules.

Unit – II Perceptron Architectures (15 Hours)

Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.

Unit – III Supervised Hebbian Learning (15 Hours)

The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation-Multilayer Perceptrons.

Unit-IV Back Propagation (15 Hours)

Back Propagation algorithm-convergence and Generalization-Performances surfaces and optimum points-Taylor series.

Unit – V Performance Surface and Performance Optimizations (15 Hours)

Directional derivatives-Minima-Necessary conditions for optimality-Quadratic functions-Performance optimizations-Steepest Descent Newton's method-Conjugate Gradient.

Text Books: Martin T. Hagan, Howard B/Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi, 2002.

Reference Books:

1. James A.Freeman, David M.Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003.
2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.

E-Resources:

1. https://nptel.ac.in/courses/117/105/117105084/
2. https://nptel.ac.in/courses/106/106/106106184/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	POs								PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
CO1	3	3	2	3	3	-	3	3	2	3	3
CO2	3	3	2	2	2	-	3	2	2	2	2
CO3	2	2	2	3	2	-	2	3	2	2	2
CO4	2	2	1	2	2	-	3	3	2	2	2
CO5	2	2	3	2	3	-	2	2	2	2	2
Mean	2.4	2.4	2	2.4	2.4	-	2.6	2.6	2	2.2	2.2
Mean Overall Score											

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*DSEC4-4*	***P24EMA202***	***DIFFERENCE EQUATIONS (ELECTIVE - IV)***	***75***	***3***	***25***	***75***	***100***

Objectives:

1. To provide basic knowledge about the discretization process, the discrete version of difference equations and understand the linear periodic systems.
2. To develop the student's ability to difference equations using Z-transforms.
3. Enable to use of Oscillation Theory.
4. To study oscillation and asymptotic behavior of solutions of certain classes of difference equations.

Course Outcomes (COs)

COs	CO Statement (After completing the course, the students will be able to)	Cognitive Level
CO1	Solve Second order and Higher order Linear Difference Equations	**K3**
CO2	Use Putzer algorithm to find the solution of the system of Linear Difference Equations and Describe Jordan Canonical forms.	**K3**
CO3	Determine the solution of Linear Difference Equations by using Z-transforms.	**K5**
CO4	Examine the solution of the Difference Equations is Oscillatory or Non-Oscillatory.	**K4**
CO5	Analyze the Asymptotic Behavior of Difference Equations.	**K4**

Syllabus:

Unit – I Linear Difference Equations of Higher Order (15 Hours)

Difference Calculus-General Theory of Linear Difference Equations- Linear Homogeneous Equations with Constant coefficients – Non-homogeneous equations: Method of Undetermined Coefficients, The method of variation of constants - Limiting behavior of Solutions.

Chapter 2: Sections 2.1 to 2.5

Unit – II Systems of Linear Difference Equations (15 Hours)

Autonomous Systems - The Basic Theory - The Jordan form –Linear periodic systems.

Chapter 3: Sections 3.1to 3.4

Unit – III The Z-Transform Method (15 Hours)

Definitions and Examples, Properties of the Z-transform-The Inverse Z-transform and Solutions of Difference Equations: The Power series method, the partial fractions method, the inversion integral method.

Chapter 6: Sections 6.1 to 6.2

Unit – IV Oscillation Theory (15 Hours)

Three-term difference Equations–Self Adjoint Second-Order Equations- Non-linear Difference Equations.

Chapter 7: Sections 7.1 to 7.3

Unit – V Asymptotic Behavior Difference Equations (15 Hours)

Tools of Approximation – Poincare's Theorem - Asymptotically Diagonal Systems – High-Order Difference Equations - Second Order Difference Equations.

Chapter 8: Sections 8.1 to 8.5

Text Books: Saber N. Elaydi, An Introduction to Difference Equations, Third Edition, Springer Verlag, NewYork, 2005(First Indian Reprint 2008).

Reference Books:

1. Ronald E.Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition, CRC Press, New York, 2015.
2. R.P.Agarwal, Difference Equations and Inequalities, Marcel Dekker, 1999.
3. S.Goldberg, Introduction to Difference Equations, Dover Publications,1986
4. V.Lakshmikantham and Trigiante,Theory of Difference Equations Numerical Methods and Applications, Second Edition, Academic Press, New York,1988.
5. Walter G. Kelly, Allan C. Peterson, Difference Equations, An Introduction with Applications,Academic Press, New York, 2001(First Indian Reprint 2006).

E-Resources

1. http://people.math.aau.dk/~matarne/11-mat/notes2011a.pdf,
2. http://pj.freefaculty.org/guides/stat/Math/Difference Equations/Difference Equations-guide.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	Programme Outcomes								Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	-	-	2	2	3	2
CO2	2	3	3	2	2	-	-	2	2	3	2
CO3	2	3	3	2	2	-	-	2	2	3	2
CO4	2	2	3	2	2	-	-	2	2	3	2
CO5	2	2	3	2	2	-	-	1	2	3	2
Mean	2	2.4	3	2	2	-	-	1.8	2	3	2

3 – Strong; 2 – Medium; 1 – Low

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Sem	*Category*	*Course Code*	*Course Title*	*Hours*	*Credits*	*Int. Marks*	*Ext. Marks*	*Max. Marks*
II	*SEC*	***P24SMAP21***	***MATHEMATICAL DOCUMENTATION USING LATEX-PRACTICAL***	***75***	***2***	***25***	***75***	***100***

Objectives:

This course aims to practice the students in mathematics document preparation

Course Outcomes (COs)

COs	**CO Statement** (After completing the course, the students will be able to)	**Cognitive Level**
CO1	Compile latex code for type setting.	K6
CO2	Create tables, list.	K6
CO3	Create title page	K6
CO4	Create code for mathematics equation	K6
CO5	Create bibliography management	K6

Cognitive Levels (K1-Remember**; K2-**Understand**; K3-**Apply**; K4-**Analyze**; K5-**Evaluate**; K6-**Create**)**

Syllabus:

1. Simple typesetting
2. Title Creation
3. List
4. Page layout (page size, margins, page style)
5. Formatting (font size, text alignment)
6. Tables
7. Figures
8. Typesetting mathematics
9. Bibliography management

Reference Books:

Latex tutorials-A primer Indian Tex users group, 2002, 2003 Indian Tex User Group Floor III, SJP Buildings, Cotton Hills, Trivandrum- 695014, India

E-Resources:

1. www.tug.org
2. https://www.math.ucdavis.edu.in

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

COs	**Programme Outcomes**								**Programme Specific Outcomes**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**1**	**1**	**3**	**2**
CO2	**2**	**2**	**3**	**2**	**2**	**-**	**-**	**1**	**1**	**3**	**2**
CO3	**2**	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**3**	**2**
CO4	**1**	**3**	**3**	**3**	**1**	**-**	**-**	**1**	**1**	**3**	**2**
CO5	**2**	**2**	**3**	**2**	**2**	**-**	**-**	**1**	**1**	**3**	**2**

3 – Strong; 2 – Medium; 1 – Low

Prepared by	Verified by
ASF	HOD