HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

DEPARTMENT OF MATHEMATICS

MASTER OF SCIENCE – MATHEMATICS

SYLLABUS

Choice Based Credit System – CBCS

(As per TANSCHE/MKU Guidelines)

with

Outcome Based Education (OBE)

(with effect from Academic Year 2023 -2024 onwards)

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College Vision and Mission

Vision

Our vision is to provide the best type of higher education to all, especially to students hailing from minority Muslim community, rural agricultural families and other deprived, under privileged sections of the society, inculcating the sense of social responsibility in them. Our college is committed to produce talented, duty-bound citizens to take up the challenges of the changing times.

Mission

Our mission is to impart and inculcate social values, spirit of service and religious tolerance as envisioned by our beloved Founder President Hajee Karutha Rowther.

The Vision beckons..... the Mission continues forever.

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Department Vision and Mission

Vision

Department of Mathematics will promote and support a comprehensive, innovative and dynamic learning environment that meets the changing needs of a diverse global students population prepare the young minds for the rapidly changing mathematical techniques.

Mission

The mission of the mathematics degree program is to equip students with analytic and problem solving skill for career and graduate work classes develop studentabilities and aptitudes to apply mathematical methods and ideas not only to problems in mathematics and related field such as the science, computer science, statistics but also to virtually any area of inquiry students learn to communicate ideas effectively andthey are encouraged to develop intellectually and to become involved with professional origination. The department cooperates fully with the school of education in meeting its mission for candidates for a degree in education with mathematics.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc., Mathematics**
Programme Code	
Duration	**PG - 2 years**
Programme Outcomes (POs)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Globalcontext. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiplecultures and a global perspective

	PO 10: Moral and ethical awareness/reasoning Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and applydiverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals tosustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaboratingwith stakeholders for mutual benefit.

M.Sc., Mathematics ProgrammeSpecific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & appliedproblems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other'sideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decisionmaking and leadership skill that will facilitate startups and high potential organizations.

To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Mapping of Course Learning Outcomes (CLOs) 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	6	…	1	2	…
CLO1										
CLO2										
CLO3										
CLO4										
CLO5										

Programme Scheme Eligibility

A candidate who has passed B.Sc., Mathematics as the Major subject with Physics Ancillary is eligible for the Master of Science – Maths Degree.

Duration of the Course:

M.Sc., Mathematics – 2 years (4 Semesters)

Medium of instruction:

English.

For Programme Completion

A Candidate shall complete:

- Part III - Core papers in semesters I, II, III and IV respectively
- Part III - Elective papers in semesters I, II, III and IV respectively
- Part IV - Non- Major Elective papers in semester II and III respectively

- Part IV - Skill Enhancement Course papers in semester II, III and IV respectively
- Part V – Extension activity in semester IV respectively

Scheme of Examinations under Choice Based Credit System

Term End Examinations (TEE)	- 75 Marks
Continuous Internal Assessment Examinations (CIAE)	- 25 Marks
Total	- 100 Marks

Pattern of Continuous Internal Assessment Examinations (CIAE)

Average of Two Internal Tests (each 20 marks)	- 20 Marks
Seminar / Quiz / Assignment	- 05 Marks
Total	- 25 Marks

Practical Examination

Internal	– 40 marks
External	– 60 marks
Total	- 100 Marks

Pattern of Term End Examinations

(Max. Marks: 75 / Time: 3 Hours)

External Examinations Question Paper Pattern

Section – A (10 X 1 = 10 Marks)

Answer ALL the questions.

- Questions 1 - 10
- Two questions from each UNIT
- Multiple choice questions and each question carries Four choices

Section – B (5 X 7 = 35 Marks)

Answer ALL the questions, choosing either a or b.

- Questions 11 - 15
- Two questions from each UNIT (either…. or…. type)
- Descriptive Type

Section – C (3 X 10 = 30 Marks)

- Answer ALL the questions, choosing either a or b.
- Questions 16 – 18
- Descriptive Type

Passing Marks

A Candidate passes the M.Sc., Mathematics degree by scoring a minimum of 50% of Marks (internal + external) in each course of the Programme. No minimum marks for internal assessment.

- Minimum 34 Marks (45%) for External Examination in Theory Courses.
- Minimum 27 Marks (45%) for External Examination in Practical.

Credit Distribution for PG Programme in MathematicsM.Sc., Mathematics

	Course Code	First Year Semester-I	Credit	Hours per week(L/T/P)
Part A	23PMACC11	Core – I Algebraic Structures	5	6
	23PMACC12	Core – II Real Analysis I	5	6
	23PMACC13	Core – III Ordinary Differential Equations	4	6
	23PMADE11	Elective-I Graph Theory and Applications	3	6(5L + 1T)
	23PMAGE11	Elective-II Fuzzy Sets and Their Applications	3	6(5L + 1T)
		Total	**20**	**30**

	Course Code	Semester-II	Credit	Hours per week(L/T/P)
Part A	23PMACC21	Core – IV Advanced Algebra	5	6
	23PMACC22	Core – V Real Analysis II	5	6
	23PMACC23	Core – VI Partial Differential Equations	4	6
	23PMADE21	Elective-III Statistical Data Analysis using R-Programming	3	4
	23PMAGE21	Elective-IV Calculus of variations	3	4
Part B	23PMASE2P	Part Skill Enhancement Course SEC- I Mathematical Documentation using LATEX	2	4
		Total	**22**	**30**

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC11	**ALGEBRAIC STURUCTURES**	**Core**	5	6	25	75	100

Learning Objectives		
L1	To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms	
UNIT	**Contents**	**No. of Hours**
I	Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only). **Chapter 2: Section 2.11 and 2.12(Omit Lemma 2.12.5)**	18
II	Solvable groups - Direct products - Finite abelian groups- Modules. **Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)** **Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)** **Chapter 4: Section4.5**	18
III	Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations. **Chapter 6: Section 6.4, 6.5**	18
IV	Jordan form - rational canonical form. **Chapter 6 : Section 6.6 and 6.7**	18
V	Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form. **Chapter 6 : Section 6.8, 6.10 and 6.11 (Omit 6.9)**	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Recall basic counting principle, define class equations to solve problems, explainSylow's theorems and apply the theorem to find number of Sylow subgroups	K1,K2,K3,K4, K5
2	Define Solvable groups, define direct products, examine the properties of finiteabelian groups, define modules	K1,K2,K3,K4, K5
3	Define similar Transformations, define invariant subspace, explore the properties oftriangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.	K1,K2,K3,K4, K5,K6
4	Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.	K1,K2,K3,K4, K5,K6

5	Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using thetriangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation inHermitian, unitary and normal	K1,K2,K3,K4, K5,K6
Textbooks		
1	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)	
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 (1980), also published by Hindustan Publishing Company, New Delhi.	
Web Resources		
1.	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,	
2.	http://www.opensource.org, www.algebra.com	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-
CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC12	**REAL ANALYSIS I**	**Core**	5	6	25	75	100

Learning Objectives		
L1	To work comfortably with functions of bounded variation, Riemann- Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.	
UNIT	**Contents**	**No. of Hours**
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. **Chapter – 6 : Section 6.1 to 6.8** **Infinite Series :** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. **Chapter 8 : Section 8.8, 8.15, 8.17, 8.18**	18
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 - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems. **Chapter - 7 : Section 7.1 to 7.14**	18
III	**The Riemann-Stieltjes Integral** : Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- 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 integral- Riemann-Stieltjes integrals depending on a parameter - Differentiation under integral sign-Lebesgue criterion for existence of Riemann integrals. **Chapter - 7 Section :7.15 to 7.26**	18
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. **Chapter - 8 Section: 8.20, 8.21 to 8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Section: 9.14, 9.15, 9.19, 9.20, 9.22, 9.23**	18
V	**Sequences of Functions:** Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergenceand Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Section: 9.1 to 9.6, 9.8, 9.9, 9.10, 9.11, 9.13**	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Analyze and evaluate functions of bounded variation and Rectifiable Curves.	K1,K2,K3,K4, K5
2	Describe the concept of Riemann-Stieltjes integral and its properties.	K1,K2,K3,K4, K5
3	Demonstrate the concept of step function, upper function, Lebesgue function andtheir integrals.	K1,K2,K3,K4, K5,K6
4	Construct various mathematical proofs using the properties of Lebesgue integralsand establish the Levi monotone convergence theorem.	K1,K2,K3,K4, K5,K6
5	Formulate the concept and properties of inner products, norms and measurablefunctions.	K1,K2,K3,K4, K5,K6

Textbooks

1	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

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 Analysis, Wiley Eastern Limited, New Delhi, 1991.
4.	Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.
5.	Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.
6.	A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, PearsonEducation, (Indian print) 2003.

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

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-
CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC13	**ORDINARY DIFFERENTIAL EQUATIONS**	**Core**	4	6	25	75	100

Learning Objectives		
L1	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	
UNIT	**Contents**	**No. of Hours**
I	**Linear equations with constant coefficients** Second order homogeneous equations-Initial value problems-Lineardependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two. **Chapter 2: Section 1 to 6**	18
II	**Linear equations with constant coefficients** Homogeneous and non-homogeneous equation of order n –Initial valueproblems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators. **Chapter 2 : Section 7 to 12**.	18
III	**Linear equation with variable coefficients** Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation. **Chapter : 3 Section 1 to 8 (Omit section 9)**	18
IV	**Linear equation with regular singular points** Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function. **Chapter 4 : Section 1 to 4 and 6 to 8 (Omit sections 5 and 9)**	18
V	**Existence and uniqueness of solutions to first order equations**: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem. **Chapter 5 : Section 1 to 6 (Omit Sections 7 to 9)**	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Establish the qualitative behavior of solutions of systems of differential equations	K1,K2,K3,K4, K5

2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	K1,K2,K3,K4, K5
3	Analyze solutions using appropriate methods and give examples.	K1,K2,K3,K4, K5,K6
4	Formulate Green's function for boundary value problems.	K1,K2,K3,K4, K5,K6
5	Understand and use various theoretical ideas and results that underlie the mathematics in this course.	K1,K2,K3,K4, K5,K6
Textbooks		
1	E.A.Coddington, *A 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 OrdinaryDifferential Equations,* Narosa Publishing House, New Delhi,2002.	
Web Resources		
1.	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,	
2.	http://www.opensource.org, www.mathpages.com	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-
CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMADE11	GRAPH THEORY AND APPLICATIONS	Elective	3	6	25	75	100

Learning Objectives		
L1	To study the graph theoretical concepts and algorithms that help tomodel real life situations.	
UNIT	**Contents**	**No. of Hours**
I	Trees, Cut Edges and Bonds, Cut Vertices, Cayley's Formula – Applications: The Connector Problem – Connectivity, Blocks – Applications: Construction of Reliable CommunicationNetworks. **Chapter 2 : Section 2.1-2.5 and Chapter 3: Section 3.1-3.3**	18
II	Euler Tours, Hamiltonian Cycles –Applications: The Chinese Postman Problem, The Travelling Salesman Problem. **Chapter 4: Section 4.1-4.4.**	18
III	Matching's, Matching's and Coverings in Bipartite Graphs, Perfect Matching – Applications: The Personnel Assignment Problem, The Optimal Assignment Problem**.** **Chapter 5: Section 5.1-5.5**	18
IV	Chromatic Number, Brook's Theorem, Hajos' Conjecture, Chromatic Polynomials, Girth and Chromatic Number – Applications: A Storage Problem. **Chapter 8: Section 8.1-8.6.**	18
V	Directed Graphs, Directed Paths, Directed Cycles – Applications: A Job Sequencing Problem, Designing as Efficient Computer Drum, Making a Road System One-Way. **Chapter 10: Section 10.1-10.6.**	18
	Total	**90**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Study the properties of Trees, Connectivity and Blocks with its applications.	K1,K2,K3,K4, K5
2	Discuss Euler tour, Hamiltonian cycles and its suitable applications.	K1,K2,K3,K4, K5
3	Understand the concepts of Matching's, Coverings and Perfect Matching's.	K1,K2,K3,K4, K5,K6
4	Apply domain knowledge in Chromatic number, Brook's Theorem, Hajos'Conjecture and Chromatic polynomials.	K1,K2,K3,K4, K5,K6

5	Define Directed graphs, Directed paths and Directed cycles and apply results to Practical problems.	K1,K2,K3,K4, K5,K6
Textbooks		
1	J.A Bondy and U.S.R Murty, *Graph Theory with Applications*, North Holland, 1976.	
Reference Books		
1.	John Clark and D. Allan Holton, *Graph theory*, World Scientific Publishing Co. Pvt.Ltd, 1991.	
2.	Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, Prentice Hall, 1974.	
Web Resources		
1.	https://www.zib.de/groetschel/teaching/WS1314/BondyMurtyGTW A.pdf,	
2.	http://ignited.in/I/a/252519,	
3.	https://www.mygreatlearning.com/blog/application-of-graph theory/https://in.coursera.org/learn/graphs,	
4.	https://neo4j.com/blog/top-13-resources-graph-theory-algorithms/	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	2	2	1
CO 2	3	2	3	2	1
CO 3	3	1	2	1	1
CO 4	2	3	3	2	2
CO 5	3	3	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	-
CO2	2	2	1	2	-
CO3	2	1	2	2	-
CO4	2	2	3	3	-
CO5	1	3	2	2	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMAGE11	FUZZY SETS AND THEIR APPLICATIONS	Elective	3	6	25	75	100

Learning Objectives		
L1	To introduce the concept of uncertainty and fuzziness in logic and to study fuzzy arithmetic, fuzzy relations and construction offuzzy sets	
UNIT	**Contents**	**No. of Hours**
I	**Crisp sets and fuzzy sets**: Overview of Classic sets, Membership function, Height of afuzzy set- Normal and subnormal fuzzy sets-Support –Level sets, fuzzy points, α cuts-Decomposition Theorems, Extension Principle.	18
II	**Operation on Fuzzy sets**: Standard fuzzy operations- Union, intersection and complement- Properties De. Morgan's law- α cuts of fuzzyoperation.	18
III	**Fuzzy relation**: Cartesian products, Crisp relations-cardinality- operations and properties of crisp and Fuzzy relations, Image and inverse image of Fuzzy sets- Various definitions of fuzzy operations- Generalizations- Non intersecting Fuzzy sets, Tolerance and equivalence relations.	18
IV	**Decision making in Fuzzy environment:** General Discussion- Individual Decision making- multi person decision making- multi criteria decision making - multi stage decision making- fuzzy ranking methods-fuzzy linear programming	18
V	**Applications**: Medicine- Economics-Fuzzy systems and Genetic applications- Fuzzy Regression- Interpersonal communication- Other Applications	18
	Total	**90**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Crisp sets and fuzzy sets	K1,K2,K3,K4, K5
2	Operation on Fuzzy sets	K1,K2,K3,K4, K5
3	Fuzzy relation	K1,K2,K3,K4, K5,K6
4	Decision making in Fuzzy environment	K1,K2,K3,K4, K5,K6

5	Applications	K1,K2,K3,K4, K5,K6
Textbooks		
1	George J. Klir and Bo Tuan, *Fuzzy Sets and Fuzzy Logic Theoryand applications*, PHI Leaning private Limited, New Delhi, 2009	
Reference Books		
1.	A.K. Bhargava, Fuzzy Set Theory Fuzzy Logic and their Applications, published by S. Chand Pvt limited, 2013	
2.	S. Rajasekaran & Y.A. Vijiaylakshmi Pai, Neural Networks, Fuzzy logic and genetic algorithms, Prentice Hall of India	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	3	2	1
CO 2	3	2	3	2	1
CO 3	3	2	3	2	1
CO 4	3	2	3	2	1
CO 5	3	2	3	2	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	-
CO2	2	3	2	2	-
CO3	2	3	2	2	-
CO4	2	3	2	2	-
CO5	2	3	2	2	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC21	**ADVANCED ALGEBRA**	**Core**	5	6	25	75	100

Learning Objectives		
L1	To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.	
UNIT	**Contents**	**No. of Hours**
I	Extension fields – Transcendence of e. **Chapter 5: Section 5.1 and 5.2**	18
II	Roots of Polynomials.- More about roots **Chapter 5: Section 5.3 and 5.5**	18
III	Elements of Galois theory. **Chapter 5 : Section 5.6**	18
IV	Finite fields - Wedderburn's theorem on finite divisionrings. **Chapter 7: Section 7.1 and 7.2 (Theorem 7.2.1 only)**	18
V	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 : Section 7.3 and 7.4**	18
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Prove theorems applying algebraic ways of thinking.	K1,K2,K3,K4, K5
2	Connect groups with roots of polynomials.	K1,K2,K3,K4, K5
3	Compose clear and accurate proofs using the concepts of Galois Theory.	K1,K2,K3,K4, K5,K6
4	Bring out insight into Abstract Algebra with focus on axiomatic theories.	K1,K2,K3,K4, K5,K6
5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem	K1,K2,K3,K4, K5,K6

Textbooks	
1	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)

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

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-
CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC22	REAL ANALYSIS II	Core	5	6	25	75	100

Learning Objectives		
L1	To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.	
UNIT	**Contents**	**No. of Hours**
I	**Measure on the Real line**: Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability **Chapter - 2 Section 2.1 to 2.5 (de Barra)**	18
II	**Integration of Functions of a Real variable**: Integration ofNon-negative functions - The General Integral - Riemann and Lebesgue Integrals **Chapter - 3 Section 3.1,3.2 and 3.4 (de Barra)**	18
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 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- Consequences of Fejer's theorem - The Weierstrass approximation theorem . **Chapter 11 : Section 11.1 to 11.15 (Apostol)**	18
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 R^n to R^1 **Chapter 12 : Section 12.1 to 12.14 (Apostol)**	18
V	**Implicit Functions and Extremum Problems:** Functions with non-zero Jacobian determinants – The inverse function theorem-	18

	The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions. **Chapter 13 : Section 13.1 to 13.7 (Apostol)**	
	Total	**90**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.	K1,K2,K3,K4, K5
2	Analyze the representation and convergence problems of Fourier series.	K1,K2,K3,K4, K5
3	Analyze and evaluate the difference between transforms of various functions.	K1,K2,K3,K4, K5,K6
4	Formulate and evaluate complex contour integrals directly and by thefundamental theorem.	K1,K2,K3,K4, K5,K6
5	Apply the Cauchy integral theorem in its various versions to compute contourintegration.	K1,K2,K3,K4, K5,K6

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

Mapping with Programme Outcomes:

CO /PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-
CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMACC23	PARTIAL DIFFERENTIAL EQUATIONS	Core	4	6	25	75	100

Learning Objectives		
L1	To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.	
UNIT	**Contents**	**No. of Hours**
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. **Chapter 2 : Section 2.1 to 2.6** **Chapter 3 : Section 3.1 to 3.4 (Omit 3.5)**	18
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. **Chapter 4 : Section 4.1 to 4.11**	18
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 anduniqueness of solution of heat conduction problem – Laplace and beam equations **Chapter 6 : Section 6.1 to 6.6 (Omit section 6.7)**	18
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 fora circle and a rectangle. **Chapter 8 : Section 8.1 to 8.9**	18
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. **Chapter 10 : Section 10.1 to 10.9**	18

	Total	90
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	To understand and classify second order equations and find general solutions	K1,K2,K3,K4, K5
2	To analyze and solve wave equations in different polar coordinates	K1,K2,K3,K4, K5
3	To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations	K1,K2,K3,K4, K5,K6
4	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K1,K2,K3,K4, K5,K6
5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	K1,K2,K3,K4, K5,K6
Textbooks		
1	TynMyint.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.	
Web Resources		
1.	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,	
2.	http://www.opensource.org, www.mathpages.com	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	3	2	3
CO 2	2	1	3	1	3
CO 3	3	2	3	1	3
CO 4	1	2	3	2	3
CO 5	3	1	2	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	-

CO2	3	3	2	1	-
CO3	3	3	2	1	-
CO4	3	3	2	1	-
CO5	3	3	2	1	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMADE21	STATISTICAL DATA ANALYSIS USING R-PROGRAMMING	Elective	3	4	25	75	100

Learning Objectives		
L1	After successful completion of the course students should be able to (i) understand the basics in R programming.(ii) Import, review,manipulate and summarize datasets in R.(iii) Explore datasets to create testable hypotheses and identify appropriate statistical tests.(iv) Perform appropriate statistical tests using R. (v) Create andedit visualizations with R.	
UNIT	**Contents**	**No. of Hours**
I	**Getting Started**: Installing R- Running R -The Comprehensive R Archive Network - Manuals- Contributed documentation -Getting help in R -Worked examples of functions- Demonstrations of R functions- Packages in R - Contents of packages - Installing packages - Command line versus scripts- Data editor- Changing the look of the R screen - Good housekeeping - Linking to other computer languages. **Section 1.1 – 1.11**	12
II	**Essentials of the R Language**: Calculations - Complex numbers in R - Rounding - Arithmetic -Modulo and integer quotients - Variablenames and assignment - Operators - Integers – Factors, Writing R functions- Arithmetic mean of a single sample - Median of a single sample - Geometric mean - Harmonic mean - Variance - Degrees of freedom - Variance ratio test. **Section 2.1 and 2.15 (2.15 .1 – 2.15.7)**	12
III	**Graphics**: Plots with two variables - Plotting with two continuous explanatory variables Scatterplots - Adding other shapes to a plot- Drawing mathematical functions - Shape and size of the graphics window - Plotting with a categorical explanatory variable - Plots for single samples - Plots with multiple variables- Special plots. **Section 5.1- 5.11**	12
IV	**Probability Functions:** Continuous probability distributions - Normal distribution - The central limit theorem - Maximum likelihood with the normal distribution - Generating random numbers with exact mean and standard deviation - Comparing data with a normal distribution - Other distributions used in hypothesis testing - The chi-square distribution - Fisher's F distribution - Student's t distribution - The gamma distribution - The exponential distribution -The beta distribution - The Cauchy distribution - The lognormal distribution - The logistic distribution - The log-logistic distribution - The Weibull distribution - Multivariate normal distribution -The uniform distribution - Plotting empirical cumulative distribution functions.	12

	Section 7.3	
V	**Discrete probability distributions:** The Bernoulli distribution - The binomial distribution - The geometric distribution - The hyper geometric distribution - The multinomial distribution - The Poisson distribution - The negative binomial distribution - The Wilcoxon rank-sum statistic- Analysis of Variance- ANOVA (one- way). **Section 7.4 and Section 11.1**	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	The Comprehensive R Archive Network	K1,K2,K3,K4, K5
2	Essentials of the R Language	K1,K2,K3,K4, K5
3	Graphics, Plots with two variables	K1,K2,K3,K4, K5,K6
4	Probability functions	K1,K2,K3,K4, K5,K6
5	Discrete probability distributions	K1,K2,K3,K4, K5,K6

Textbooks	
1	Michael J. Crawley Imperial College London at Silwood Park, UK
2	A John Wiley & Sons, Ltd., PublicationThis edition first published 2013
Reference Books	
1.	Sudha G. Purohit et.al., Statistics Using R, Narosa Publishing House, , India(2008)
2.	John Verzani, SimpleR-Using R for Introductory Statistics, (http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.)
3.	W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R , Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2 (2012-10-26) (http://www.r-project.org)
4.	D. E. Knuth: *The TEX Book*, Addison-Wesley, Reading, secondedition, 1986
Web Resources	
1.	http://www.bio.ic.ac.uk/research/mjcraw/therbook/index.htm

Mapping with Programme Outcomes:

CO /PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	2	3	2	1
CO 2	3	2	3	2	1
CO 3	3	2	3	2	1
CO 4	3	2	3	2	1
CO 5	3	2	3	2	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	-
CO2	2	3	2	2	-
CO3	2	3	2	2	-
CO4	2	3	2	2	-
CO5	2	3	2	2	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMAGE21	CALCULUS OF VARIATIONS	Elective	3	4	25	75	100

Learning Objectives	
L1	After successful completion of the course students should be able to (i)Explain the concepts of variation and its properties(ii)Import,the Parametric representations of variational problems (iii)Construct thevariational problems with fixed and moving boundaries(iii) Examinethe different methods to solve variational problems(iv) Classify Isoperimetric Problems

UNIT	Contents	No. of Hours
I	**The method of variations in problems with fixed boundaries:**Variations and its properties-Euler's equation. **Chapter -6 Section 1 –3**	12
II	**The method of variations in problems with fixed boundaries:** Functions of the forms Functionals involving Derivatives of Higher order Functional depending on the functions of several independent variables-Parametric representations of variational problems. **Chapter -6 Section 4 –6**	12
III	**Variational Problems with Moving Boundaries-Certain other Problems:** Simple problems with movable Boundaries –Problemwith Movable boundaries for Functional of the form $\int_{x_0}^{x_1} F(x,y,z,y',z')dx$ -Problem with movable boundaries-Problem with movable boundaries for functional of the form $\int_{x_0}^{x_1} F(x,y,z,y',y'')dx$ -Extremals with corners –one sided variations. **Chapter -7 Section 1-4**	12
IV	**Sufficient condition for an Extremum**: Field of Extremals-The Function $E(x,y,p,y')$ -Transforming the Euler Equations to the canonical form-Problems . **Chapter -8 Section 1-3**	12
V	**Variational Problems of constrained extrema**: Constraints of the form $\varphi(x,y_1,y_2,.....y_n) = 0$ -Constraints of the form $\varphi(x, y_1, y_2, ...y_n, y_1', y_2', ...y_n') = 0$ -Isoperimetric Problems **Chapter 9 Section 1-3**	12
	Total	**60**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	

1	Variations and its properties	K1,K2,K3,K4, K5
2	Essentials of the Parametric representations	K1,K2,K3,K4, K5
3	Explanation of movable Boundaries	K1,K2,K3,K4, K5,K6
4	Field of Extremals	K1,K2,K3,K4, K5,K6
5	Isoperimetric Problems	K1,K2,K3,K4, K5,K6
Textbooks		
1	L Elsgolts, Differential Equations and Calculus ofvariations , Mir Publishers,Moscow.1977	
Reference Books		
1.	Abdul-Majid Wazwaz, Linear and Nonlinear Integral Equations-Methodsand Applications,Springer, New York. 2011.	
2.	Elsgolts Lev, Differential Equations and the Calculus of Variations, University Press of Pacific, USA. 2003	
3.	Mijanur Rahaman Seikh and Prasun Kumar Nayak., Integral Equations and Calculus of Variations, Alpha Science International Limited, 2021.	

Mapping with Programme Outcomes:

CO /PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	2	3	2	1
CO 2	2	2	3	3	1
CO 3	3	2	3	2	1
CO 4	3	3	2	3	1
CO 5	3	2	3	2	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	3	2	-
CO2	2	3	2	2	-
CO3	2	3	2	2	-
CO4	2	3	2	2	-
CO5	2	3	2	2	-

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23PMASE2P	MATHEMATICAL DOCUMENTATION USING LATEX	SEC	2	4	25	75	100

Learning Objectives		
L1	To introduce students with a software that is used for typesetting and develop typing skill for students with various documents formats of LATEX.	
UNIT	Contents	No. of Hours
I	1. Constructing Arrays & Table Using LATEX. 2.Construct a document with different Alignments (Left, Right, Center, Justify). 3.Typing mathematical Expression Using All Expressions.	12
II	4. Typing mathematical Expression Using inequalities. 5. Insert Picture in a LATEX. 6.Typing mathematical Expression involving Differentiation, Integration, and Trignometry.	12
III	7.Typing a letter for Applying a job. 8. Creation of an Article Using LATEX. 9.Latex Code to form display 4x4 matrix using Array.	12
IV	10.Latex Code to form a equation using Union, intersection and summation. 11. Latex Code to form display 3x3 Matrix using Nested Array. 12. Latex Code to display text with bullets	12
V	13. Latex Code to display the Ph.d thesis format. 14. Latex Code to display the Bibliography. 15. Latex Code to display Logical and Visual design.	12
	Total	**60**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Know how to create basic types of LaTex documents (article).	K1,K2,K3,K4, K5
2	Typeset latex commands.	K1,K2,K3,K4, K5
3	Create a paragraph, symbols, comments and font style.	K1,K2,K3,K4, K5,K6
4	Change font characteristics.	K1,K2,K3,K4, K5,K6
5	Know about various environments.	K1,K2,K3,K4, K5,K6

Textbooks	
1	Math into Latex : *An Introduction to Latex and AMS Latex*
2	George Grazer ISBN 0-8176-3805-9. © Birkhauser Boston 1996.

Reference Books	
1.	*.A document preparation system LATEX*, Second Edition,Leslie Lamport
2.	LATEX- *A Beginner Guide to Professional documentation*, S. Swapna Kumar.
Web Resources	
1.	https://services.math.duke.edu/computing/tex/online.html,
2.	https://www.overleaf.com/learn

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	1	1	1	1
CO 2	3	2	1	1	1
CO 3	3	2	1	1	1
CO 4	3	1	1	1	1
CO 5	3	2	1	1	1

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	1	-
CO2	2	3	3	2	-
CO3	1	3	2	2	-
CO4	1	3	2	1	-
CO5	2	3	2	2	-

Strong-3 Medium-2 Low-1