C. ABDUL HAKEEM COLLEGE [AUTONOMOUS]

[Affiliated to Thiruvalluvar University, Vellore]

MELVISHARAM – 632509

Syllabus under CBCS Pattern

Learning Outcome Based Curriculum Frame work [LOCF]

with effect from 2018 onwards

M.Phil. Mathematics

Prepared By

PG & Research Department of Mathematics

PROGRAM SPECIFIC OUTCOME

On completion of the M.Phil Mathematics, the student will be able to,

PSO 1: To develop the research knowledge in the field of pure and applied mathematics.

PSO 2: To acquire problem solving capability.

PSO 3: To write the research articles independently in the field of mathematics and publish them in reputed journals.

PSO 4: To enhance the teaching skills in mathematics.

C. ABDUL HAKEEM COLLEGE [AUTONOMOUS] MELVISHARAM
MASTER OF PHILOSOPHY - DEGREE COURSE
UNDER CBCS PATTERN

[With effect from batch 2018-2019 ONWARDS]

M.Phil., Mathematics

Course M.Phil - Mathematics(U)

Batch 2018-2019

Total Credits **36**

S.No	E/D	Cate.	Type	S. Code	S. Name	I.Ma	I.Mi	E.Ma	E.Mi	P	M	Cr	Pt
Semester - 1					**Subject Count - 3**						**Total Credits - 30**		
1	E	Theory	Main	M18MMA101	Algebra and Analysis	25	0	75	38	50	5	III	
2	E	Theory	Main	M18MMA102	Topology and Differential Equations	25	0	75	38	50	5	III	
3	E	Theory	Guide	M18MMA103	Graph Theory with Applications (Internal)	25	0	75	38	50	5	III	
4	E	Theory	Guide	M18MMA104	Asymptotic Behaviour of Linear and Non- Linear Differential Equations (Internal)	25	0	75	38	50	5	III	
5	E	Theory	Guide	M18MMA105	Lie Groups and Ordinary Differential Equations (Internal)	25	0	75	38	50	5	III	
6	E	Theory	Guide	M18MMA106	Algebraic Topology (Internal)	25	0	75	38	50	5	III	
7	E	Theory	Guide	M18MMA107	Fuzzy Logic and Fuzzy Cognitive map(Internal)	25	0	75	38	50	5	III	
Semester - 2					**Subject Count - 1**						**Total Credits - 21**		
1	E	Theory	Dissertation	M18MMA201	Dissertation with Viva Voce	20	0	80	38	50	21	III	

CORE PAPER – 1
ALGEBRA AND ANALYSIS

Objectives : This course aims to acquire the knowledge in the field of Algebra and Analysis	
Course Outcome(s): At the end of the course, the student will able to	
CO1	Analyze the algebraic structures rings, ideals and modules.
CO 2	Give examples to chain conditions, Noetherian rings and Artin rings.
CO3	Explain L_p spaces and Fourier transform concepts.

UNIT-I: RINGS, IDEALS AND MODULES

Rings and ring homomorphisms - Ideals, Quotient rings - Zero-divisors, Nilpotent elements, Units - Prime ideals and maximal ideals - Nilradical and Jacobson radical - Operations on ideals - Extension and contraction - Exercises - Modules and module homomorphisms - Submodules and quotient modules - Operations on submodules - Direct sum and product - Finitely generated modules - Exact sequences - Tensor product of modules - Restriction and extension of scalars - Exactness properties of the tensor product - Algebras - Tensor product of algebras - Exercises.

UNIT-II: RINGS, MODULES OF FRACTIONS AND PRIMARY DECOMPOSITION

Local properties - Extended and contracted ideals in rings of fractions Exercises - Primary Decomposition - Exercises.

UNIT-III: CHAIN CONDITIONS, NOETHERIAN RINGS AND ARTIN RINGS

Chain conditions - Exercises - Primary decomposition in Noetherian rings - Exercises - Artin Rings - Exercises.

UNIT-IV: ABSTRACT INTEGRATION AND LP - SPACES

The concept of measurability - simple functions - Elementary properties of measures - Integration of positive functions - Integration of complex functions - The role played by sets of measure zero - Convex functions and inequalities - LP - spaces

UNIT-V: FOURIER TRANSFORMS AND HOLOMORPHIC FOURIER TRANSFORMS

Formal properties - The Invention Theorem - the Plancheral Theorem - The Banach algebra L1 - Introduction - Two Theorems of Paley and Wiener - Quasi - analytic classes - The Denjoy - Carleman theorem.

TEXT BOOKS:

1. M.F. Atiyah, I.G. Macdonald, Introduction to Commutative Algebra, Addison - Wesley Publishing Company, 1969.
Unit -I Chapter -1 (pp 1 to 10), Chapter -2 (pp 17 to 31)

Unit -II Chapter -3 (pp 36 to 43), Chapter -4 (pp 50 to 55)
Unit -III Chapter -6 (pp 74 to 78), Chapter -7 (pp 80 to 84), Chapter -8 (pp 89 to 91)

2. Walter Rudin, Real and Complex Analysis, 3rd Edition, McGraw Hill International, 1986.

Unit -IV Chapter -1 (pp 5 to 31), Chapter -3 (pp 61 to 69)
Unit -V Chapter -9 (pp 178 to 193), Chapter -19 (pp 371 to 383)

CORE PAPER – 2
TOPOLOGY AND DIFFERENTIAL EQUATIONS

Objectives: To develop the skills in advanced concepts of topological spaces and the applied differential equations	
Course Outcomes: At the end of the course, the student will able to	
CO1	Describe the concepts of fundamental group and covering spaces.
CO2	Explain the geometry of simplicial complexes.
CO3	Solve the linear system and non-linear system.

UNIT-I: FUNDAMENTAL GROUP AND COVERING SPACES
Homotopy - Fundamental group - Covering spaces.

UNIT-II: SIMPLICIAL COMPLEXES
Geometry of Simplicial Complexes - Bary Centric subdivisions - Simplicial approximation Theorem - Fundamental Group of a simplicial Complex.

UNIT-III: LINEAR SYSTEMS
Uncoupled Linear System - Diagonalization - Exponentionals operators - The Fundamental Theorem for linear system - Linear System in R^2 - Complex Eigen Values - Multiple Eigen Values - Non Homogeneous Linear System.

UNIT-IV: NON LINEAR SYSTEMS: LOCAL THEORY
Some preliminary concepts & definitions - The Fundamental Existence Uniqueness Theorem - Dependence on Initial Conditions and Parameters - The Maximum Interval of Existence - The Flow Defined by a Differential Equation.

UNIT-V: NON LINEAR SYSTEMS
Linearization - The Stable Manifold Theorem - Dynamical Systems and Global Existence Theorems - Limit Sets and Attractors.

TEXT BOOK(S):

1. I.M. Singer, J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer - Verlag, New York, 1967.

Unit - I Chapter - 3 (pp 49 - 77)
Unit - II Chapter - 4 (pp 78 - 108)

2. L. Perko, Differential Equation and Dynamical System, Third Edition, Springer - Verlag, New York, 2006.

Unit - III
Chapter - 1 (Sections 1.1 to 1.7 and 1.10)
(pp 1 - 39, 60 - 63)
Unit - IV
Chapter - 2 (Sections 2.1 to 2.5)
(pp 65 - 101)
Unit - V
Chapter - 2 (Sections 2.6 and 2.7)
(pp 101 - 118)
Chapter - 3 (Sections 3.1 and 3.2)
(pp 181 - 199)

GUIDE PAPER: Graph Theory with applications

Objective: This course aims to provide the concrete ideas of graph theory

Course Outcome(s): At the end of the course, the students will able to	
CO 1	Recognize the various graphs , paths and circuits.
CO 2	Apply Matrix to represent the various graphs.
CO 3	Analyze the concepts of coloring , covering, partitioning and directed graphs.
CO 4	Formulate the real world problems into system of Graphs in Switching and Coding Theory.

UNIT-I:

Paths and Circuits.

Chapter 2 : Sections 2.1 – 2.10

UNIT-II:

Matrix Representation of graphs.

Chapter 7 : Sections 7.1 – 7.9.

UNIT-III:

Coloring, Covering and Partitioning.

Chapter 8 : Sections 8.1 – 8.6.

UNIT-IV:

Directed Graphs.

Chapter 9 : Sections 9.1 – 9.11.

UNIT-V:

Graphs in Switching and Coding Theory.

Chapter 12 : Sections 12.1 – 12.6.

Treatment as in: ***Graph Theory with applications to engineering and Computer Science.***

By **:** NARSINGH DEO

Publication **:** Prentice Hall of India Private Limited, New Delhi.

Guide paper - Asymptotic Behaviour of Linear and Non- Linear Differential Equations

Objective: This course aims to provide the concrete idea of oscillations and asymptotic behavior of both linear and non linear systems.

Course Outcome(s): At the end of the course, the students will able to	
CO 1	Describe existence and uniqueness of solutions.
CO 2	Identify isolated singularities of linear systems .
CO 3	Analyze asymptotic behavior of both linear and non linear systems.
CO 4	Study oscillation behavior and its applications.

UNIT-I:

EXISTENCE AND UNIQUENESS OF SOLUTIONS.

CHAPTER 1 AND 2.

UNIT-II:

LINEAR SYSTEMS WITH ISOLATED SINGULARITIES.

CHAPTER 5.

UNIT-III:

ASYMPTOTIC BEHAVIOUR OF LINEAR SYSTEMS CONTAINING A LARGE PARAMETER.

UNIT-IV:

OSCILLATION AND COMPARISON THEOREMS FOR SECOND ORDER LINEAR EQUATIONS AND APPLICATIONS.

UNIT-V:

ASYMPTOTIC BEHAVIOR OF NON LINEAR SYSTEMS.

Treatment as in: THEORY OF ORDINARY DIFFERENTIAL EQUATIONS.

By **:** EARL A. CODDINGTON NORMAN LEVINSON.

Publication **:** TATA MCGRAW-HILL EDITION.

Guide paper - Lie Groups and Ordinary Differential Equations

Objective: This course aims to provide the concrete ideas of theory of Lie group of transformations and solve the given system of differential equations from point transformations

Course Outcome(s): At the end of the course, the students will able to	
CO 1	Define one-parameter Lie group of transformations in R^n and illustrate through examples
CO 2	Apply symmetry analysis to find point symmetries, infinitesimal generators and Lie algebra of a given system of differential equations
CO 3	Using point transformations reduce the order of a given differential equations
CO 4	Formulate the real world problems into system of differential equations and identity them is invariant under a one or several parameter Lie group of transformations

UNIT-I:

LIE GROUPS OF TRANSFORMATIONS AND INFINITESIMAL TRANSFORMATIONS

UNIT-II:

POINT TRANSFORMATIONS AND EXTENDED INFINITESIMAL TRANSFORMATIONS

UNIT-III:

LIE ALGEBRAS

UNIT-IV:

INVARIANCE OF SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL

EQUATIONS

UNIT-V:

REDUCTION OF ORDER OF ODES AND CONTACT SYMMETRIES

Treatment as in: Symmetry and Integration Methods for Differential Equations

By **:** George W.Bluman and Stephen C.Anco

Publication **:** Springer –Verlag, New York.

ALGEBRAIC TOPOLOGY(Guide Paper)
(M18MMA106)

Objective: This course aims to develop the skills in Algebraic Topology

Course Outcome(s): At the end of the course, the students will able to	
CO 1	Describe the fundamental group of the circle, the fundamental group of S_n, and some surfaces.
CO 2	Recognize the concepts of separation theorem in the plane and imdedding graphs in the plane.
CO 3	Apply the concepts of Seifert –van Kampen Theorem wherever possible in groups.
CO 4	Compute the Fundamental Groups of Surfaces and construct the compact surfaces.

Unit I:

The Fundamental Group - Homotopy of Paths – The Fundamental Group – Covering Spaces – The Fundamental Group of the Circle – Retraction and Fixed Points.

Unit II:

The Fundamental Group - The Fundamental Theorem of Algebra – The Borsuk –Ulam Theorem – Deformation Retracts and Homotopy Type – The Fundamental Group of S_n – Fundamental Groups of Some Surfaces.

Unit III:

Separation Theorem in the Plane - The Jordan Separation Theorem – Invariance of Domain – The Jordan Curve Theorem – Imbedding Graphs in the Plane.

Unit IV:

The Seifert –van Kampen Theorem - Direct Sums of Abelian Groups – Free Products of Groups – Free Groups – The Seifert – van Kampen Theorem – The Fundamental Group of a Wedge of Circles.

Unit V:

Classification of Surfaces - Fundamental Groups of Surfaces – Homology of Surfaces – Cutting and Pasting – The Classification Theorem – Constructing Compact Surfaces.

Text Book:

J. R. Munkres, Topology, Second Edition, Pearson Education, New Delhi, 2006.

Unit I: Chapter 9 (Sec 51-55)

Unit II: Chapter 9 (Sec 56-60)

Unit III: Chapter 10 (Sec 61-64)

Unit IV: Chapter 11 (Sec 67-71)

Unit V: Chapter 12 (Sec 74-78)

Books for Reference:

1. J. Dugundiji, Topology, Allyn and Bacon, Boston, 1966.

2. W.S.Massey,Algebraic Topology-An Introduction,Springer-Verlag,New York,1976

GUIDE PAPER: FUZZY LOGIC AND FUZZY COGNITIVE MAP

Objective: This course aims to develop the skills in fuzzy logic and fuzzy cognitive map

Course Outcome(s): At the end of the course, the students will able to	
CO 1	Describe the fuzzy logic and fuzzy relational concepts
CO 2	Construct the models in various fuzzy systems
CO 3	Apply the fuzzy cognitive map wherever possible in real life situation
CO 4	Compute the Hamming distance and Kosko – Hamming distance between two fuzzy cognitive maps

UNIT I FUZZY LOGIC

Fuzzy logic – Fuzzy logic rule base- Interpretation of Fuzzy IF-THEN Rules- Evaluation of Fuzzy IF-THEN Rules

UNIT II FUZZY RELATIONS

Fuzzy Relations – Types of relations - max-min composition of fuzzy relations

UNIT III FUZZY SYSTEM MODELING

Fuzzy Systems - Modeling of Static Fuzzy Systems- Discrete-Time Dynamic Fuzzy Systems and their Stability Analysis-Modeling of Continuous-Time Dynamic Fuzzy Control Systems

UNIT IV FUZZY COGNITIVE MAP

Definition of Fuzzy Cognitive Maps - Fuzzy Cognitive Maps – Properties and Models- FCM for Decision Support in an Intelligent Intrusion Detection System- A Strategic Planning Simulation Based on FCM Knowledge

UNIT V DISTANCE IN ROW MATRICES

Hamming distance between two matrices- Kosko-Hamming distance between two fuzzy cognitive maps- Kosko-Hamming weight

TEXT BOOKS

1. Introduction to Fuzzy Sets, Fuzzy Logic and Fuzzy Control Systems, Guanrong Chen and Trung Tat Pham, CRC PRESS, 2001
   Chapter 2: IV, V, VI, Chapter 3: I, II, III **(Unit I, II & III)**

2. Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps**,** W.B.Vasantha Kandasamy and Florentin Smarandache , Xiquan publishing house, 2003
Chapter 1: Full **(Unit IV)**

3. Distance in matrices and their applications to fuzzy models and neutrosophic models,W. B. Vasantha Kandasamy, Florentin Smarandache and Ilanthenral K, *EuropaNova* & Educational *Publisher*, Brussels, 2014
   Chapter 2: Full **(Unit V)**