JAYARAJ ANNAPACKIAM COLLEGE FOR WOMEN (AUTONOMOUS)

A Unit of the Sisters of St. Anne of Tiruchirappalli

Accredited with 'A' Grade (3rd Cycle) by NAAC

DST - FIST Supported College Since 2015

(Affiliated to Mother Teresa Women's University, Kodaikanal)

PERIYAKULAM – 625 601, THENI DT.
TAMIL NADU.

M. PHIL. MATHEMATICS
2017 - 2020

DEPARTMENT OF MATHEMATICS

PROGRAM OUTCOME - M.PHIL

PO. NO.	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO
1.	Reflect critically on their own, with their peers' and synthetic working situations in the light of new concepts and course input.
2.	Identify relevant sources, evaluate them and to use these appropriately in their studies.
3.	Engage in independent study and group/pair work including the presentation of materials.
4.	Relate skills with self management and task achievement, meeting deadlines, problem-solving and metacognitive awareness.
5.	Associate study skill with data collection and researching, digesting, selecting, planning, writing and presenting articles for publication.
6.	Present reports on their findings in the respective category of work to improve their expertise and imbibe practical abilities.

PROGRAMME SPECIFIC OUTCOMES

PSO. NO	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO	PO MAPPED
PSO-1	Apply recent methodologies and techniques in research.	PO-5
PSO-2	Provide novel solutions to complex problems.	PO-2
PSO-3	Develop professional skills in Mathematics.	PO-4
PSO-4	Implement effective academic and personal strategies for carrying out research projects independently and ethically.	PO-6
PSO-5	Equip themselves to face the research challenges in Mathematics and apply fuzzy logic in pure and applied mathematics.	PO-1 PO-3

M. PHIL. MATHEMATICS COURSE PATTERN (2017 - 2020)

Sem	Subject Code	Subject Title	Hours	Credits
I	17MMA1C01	Research Methodology and Techniques	10	8
	17MMA1C02	Advanced Algebra & Analysis	14	12
	17MMA1E3A/ 17MMA1E3B/ 17MMA1E3C/ 17MMA1E3D/ 17MMA1E3E	In depth Study: Theory of Computation In depth Study: Advanced Topology In depth Study: Fuzzy Reliability Theory In depth Study: Mathematical Modelling In depth Study: Fuzzy set theory and its Applications	06	-
		Total	**30**	**20**
II	17MMA2E3A/ 17MMA2E3B/ 17MMA2E3C/ 17MMA2E3D/ 17MMA2E3E	In depth Study: Theory of Computation In depth Study: Advanced Topology In depth Study: Fuzzy Reliability Theory In depth Study: Mathematical Modelling In depth Study: Fuzzy set theory and its Applications	-	05
	17MMA2R01	Project	30	15
		Total for I & II Semesters	**60**	**40**

- In "Research Methodology and Techniques" paper Units I, II, III and IV are theory components and Unit V is Practical component.
- "In depth Study" papers are selected by the scholars as per their choice and they will do their dissertation work on the basis of their "In depth Study" paper.
- Question paper for the "In depth Study" paper will be set and valued by the Research advisor only.
- No External Exam for "In depth Study Paper"

The Components of CIA are as follows:

Subject Code	Subject Title	Mid Sem Test	End Sem Test	Seminar	Term Paper	Attendance	Total Marks	CIA Marks
17MMA1C01	Research Methodology and Techniques	30	30	10	05	05	80	40
17MMA1C02	Advanced Algebra & Analysis	30	30	10	05	05	80	40

CIA COMPONENTS FOR IN-DEPTH STUDY

Components		Marks
*Mid Semester	:	30
*End Semester	:	30
Attending Seminars (International/National) (Component I)	:	5
Paper Presentation in Seminars/Conferences (Component II)	:	15
Paper to be submitted in any International/National Research article format to the concerned guide (Component III)	:	15
Attendance (Component IV)	:	5
Total	**:**	**100**

* Mid Semester and End Semester examinations will be conducted in the I Semester and assessment in the II Semester.

The Distribution of Marks for CIA and SE for each Paper is indicated below:

Code	Subject Title	CIA Marks	SE Marks	Total Marks
17MMA1C01	Research Methodology and Techniques	40	60	100
17MMA1C02	Advanced Algebra &Analysis	40	60	100
17MMA1E3A/ 17MMA1E3B/ 17MMA1E3C/ 17MMA1E3D/ 17MMA1E3E	In-depth Study: Theory of Computation In-depth Study: Advanced Topology In-depth Study: Fuzzy Reliability Theory In-depth Study: Mathematical Modelling In-depth Study: Fuzzy set theory and its Applications	100	-	100

Semester Exam Question Pattern (External)

Code	Subject Title	Pattern	Total Marks
17MMA1C01	Research Methodology and Techniques	5 Questions, either or type, each question can have subdivisions and carries 12 marks. First 4 Questions, one from each unit I to Unit IV. Fifth question from unit III and Unit IV.	60 Marks
17MMA1C02	Advanced Algebra & Analysis	5 Questions, either or type, one from each unit. Each question can have subdivisions and carries 12 marks.	60 Marks

RESEARCH METHODOLOGY AND TECHNIQUES

Semester: I **Hours: 10**

Code : 17MMA1C01 **Credits: 8**

COURSE OUTCOMES:

- Familiar with Research Techniques.
- Acquire knowledge of L - Fuzzy Topology.
- Apply Simulation in diverse fields.
- Apply principles and concepts of graph theory in practical situation.
- Compute mathematical problems using MATLAB and familiar with LaTeX.

UNIT I: RESEARCH METHODOLOGY

An introduction-Meaning of Research-Objectives of Research- Motivation in Research-Types of Research - Research Methods versus Methodology-Research and Scientific Method-Criteria of Good Research- Defining the Research Problem-Selecting the Problem- Necessity of Defining the Problem-Technique involved in defining a Problem-Research Design-Meaning of Research Design- Need for Research Design- Features of a Good Design- Important concepts relating to Research Design - Report of thesis. **(30 Hours)**

UNIT II: SIMULATION MODELS

Methods of Simulation - Demand Supply Related Simulations - Waiting Line

Simulation Models- Inventory Simulation Models - Network Simulation Models.

(30 Hours)

UNIT III: GRAPH LABELLINGS AND DOMINATION IN GRAPHS

Introduction - Graceful and Related Labelling - Divisor Graphs - Dominating Sets and Domination Number - On Domination and Independent Numbers of Graphs.

(30 Hours)

UNIT IV: FUZZY TOPOLOGICAL SPACES

Fuzzy Topological Spaces - Interior, Closure operator - Kuratowski's 14 Sets Theorem - Fuzzy topological spaces via interior and closure operators - Quasi coincident relation - Q neighbourhood of a point - adherent points and accumulation points in L-Fuzzy topological space - derived sets and C.T.Yang's Theorem - Continuous functions on fuzzy topological spaces. **(30 Hours)**

UNIT V: MATLAB AND LATEX

Basics of MATLAB, input-output, General commands, Matrices and Vectors-Matrix and Arrays, operations-inline function - using Built-in-function-plotting Simple graphs. Applications-Linear Algebra - Curve Fitting and interpolation - Data Analysis and Statistics. Numerical Integration -ODE - Nonlinear Algebraic Equations. Basics of LATEX file, command names and arguments, Environments, Declarations, Length, Special characters, Document class, Page style, Part of the document, Table of contents, Changing font lists, Tables, Footnotes and Marginal notes. Mathematical formulas, Mathematical symbols, Additional elements.

(30 Hours)

COURSE BOOKS:

1. C.R. Kothari, Research Methodology - Methods & Techniques, Edition, 2004 New Age International (P) Limited Publishers.
2. Operations Research, R. Veerachamy & V. Ravi Kumar, I.K. International Publishing House Pvt. Ltd.
3. Graph Theory, G. Suresh Singh., PHI Learning Private Limited, New Delhi.
4. Liu Ying Ming and Luo Mao- Kang, Fuzzy Topology, World Scientific Publishing Co., Pvt., Ltd., 1997.
5. Rudra Pratap (2010), Getting started with MATLAB -A Quick introduction for scientists and Engineers. Oxford University press
6. LATEX Tutorial - A PRIMER .Indian TEX Users Group. Editor: E. Krishnan

Unit I : Book- 1 Chapter 1,2 &3

Unit II : Book -2 Chapter 16: 16.1-16.6

Unit III : Book-3 Chapter-12,13 (Sec 12.1,12.2, 12.4, 13.2, 13.3)

Unit IV : Book- 4 Chapter - 2: Section 2.2, Section 2.3

(2.3.1 to 2.3.7 and 2.3.21 to 2.3.31) and Section 2.4 .

***Unit V : Book -5** Chapter 1 :1.6(1.6.3,1.6.6)

Chapter 3:3.1,3.2,.3.5,3.6,3.8

Chapter 5:5.1 - 5.6

Book - 6 Chapter - 1,2,5,8,9,11,13.

*** Not for Theory Semester Examination**

ADVANCED ALGEBRA & ANALYSIS

Semester: I **Hours: 14**

Code : 17MMA1C02 **Credit: 12**

COURSE OUTCOMES:

- Get through knowledge on Modules and its applications.
- Apply localization in the study of projective modules as locally free modules.
- Understand the difference between Artinian rings and Noetherian rings.
- Identify the measurable sets and functions.
- Apply the concepts of Banach algebra in approximation theory.

UNIT I: MODULES

Free Modules - Projective Modules - Tensor Products - Flat Modules. **(42 Hours)**

UNIT II: LOCALISATION

Ideals - Local Rings - Localisation - Applications **(42 Hours)**

UNIT III: NOETHERIAN RINGS

Noetherian Modules - Primary Decomposition - Artinian Modules - Length of a Module. **(42 Hours)**

UNIT IV: POSITIVE BOREL MEASURES & L^P SPACES

Regularity properties of Borel Measure - Lebesgue measure - Continuity properties of measurable functions - convex functions and inequalities - the L^P spaces -Approximation by continuous functions. **(42 Hours)**

UNIT V: ELEMENTARY THEORY OF BANACH ALGEBRAS

Banach Algebras - introduction - invertible elements - ideals & homomorphism - Spectrum of an element in Banach Algebra - Spectral radius formula - Quotient Algebras - Applications **(42 Hours)**

COURSE BOOKS:

1. N. S. Gopalakrishnan, Commutative Algebra - Oxonian Press pvt Ltd, New Delhi
2. Walter Rudin, Real And Complex Analysis, Third Edition, Mcgraw - Hill International Editions

Book 1:	**Unit I**	**:**	Chapter 1	Sections 1.1 - 1.4
	Unit II	**:**	Chapter 2	Sections 2.1 - 2.4
	Unit III	**:**	Chapter 3	Sections 3.1 - 3.4
Book2:	**Unit IV**	**:**	Chapter 2	Sections 2.15 - 2.25
	Unit V	**:**	Chapter 3	Sections 3.1 - 3.17

THEORY OF COMPUTATION

Semester: I **Hours: 6**

Code : 17MMA1E3A **Credits: 5**

COURSE OUTCOMES:

- Provide a formal connection between algorithmic problem solving and the theory of languages.
- Identify the various categories of grammars and languages in the Chomsky hierarchy.
- Acquire the basic skills required for carrying out the research in the field of Theoretical Computer Science.
- Compare and analyze different computational models.
- Select, summarize and defend a research topic in theory of computation.

UNIT I: FORMAL LANGUAGES

Strings - Languages - Properties- Finite representations - Regular Expressions.

(18 Hours)

UNIT II: GRAMMAR

Definition - Hierarchy of Grammars - Derivation trees - ambiguity -leftmost derivation and ambiguity - inherent ambiguity. **(18 Hours)**

UNIT III: TWO - DIMENSIONAL LANGUAGES

Two - dimensional languages - Block of a picture - Column & row concatenation of pictures - Column & row closure of a picture language - regular expression, grammars. **(18 Hours)**

UNIT IV: COMPUTING SYSTEMS

Tiling systems: Local two - dimensional languages - Tiling recognizable languages - Closure properties - Domino systems - H system - P system.

(18 Hours)

UNIT V: FUZZY GRAMMARS

Fuzzy subset - Fuzzy languages - Types of grammars - Fuzzy context - free grammars - Context - free Max - pdt grammars - Context - free fuzzy languages.

(18 Hours)

COURSE BOOK:

Unit - I : D. Goswami and K. V. Krishna, Formal Languages and Automata Theory, November 5, 2010.

Chapter - 2 : Sections: 2.1 to 2.4

Unit - II : K. Krithivasan and R. Rama, Introduction to Formal Languages, Automata and Computability.

Chapter - 3 : Sections: 3.1 to 3.3

Unit - III : G. Rozenberg A. Salomaa, Hand Book of Formal Languages, Volume 3, Springer, 1997.

Chapter - 4 : Sections: 4.2, 4.3 & 4.5

Unit - IV : G. Rozenberg A. Salomaa, Hand Book of Formal Languages, Volume 3, Springer, 1997.

Chapter - 4 : Section: 4.7

Cristian S. Calude, Gheorghe Paun, Computing with cells and atoms, Biddle's Ltd, 2001.

Chapter - 2 : Sections: 2.9, Chapter - 3 : Sections: 3.1 to 3.3

Unit - V : John N. Mordeson & Davender S. Malik, Fuzzy Automata and Languages Theory and Applications, CRC Press Company, 2002.

Chapter - 1 : Sections: 1.4, Chapter - 4 : Sections: 4.1 to 4.4

ADVANCED TOPOLOGY

Semester: I **Hours: 6**

Code : 17MMA1E3B **Credit: 5**

COURSE OUTCOMES:

- Understand the basics of separation axioms in classical topology.
- Apply the topological concepts to nano topology.
- Compare classical topology with bitopology.
- Read and understand research articles published in journals.
- Write research article for publication.

UNIT I:

Homotopy of Paths - The Fundamental Group - The Fundamental Group of the Circle. **(18 Hours)**

UNIT II:

Application and additional examples of Fundamental Groups - Knots. **(18 Hours)**

UNIT III:

Bitopological Separation: Pairwise T_1 and T_2 Spaces - Pairwise Regular - Quasi-Metrizable Bitopological Spaces - Pairwise Normal Bitopological Spaces.

(18 Hours)

UNIT IV:

Bitopological Connectedness - Zero Dimentional Spaces - Pairwise Compact Spaces. **(18 Hours)**

UNIT V:

Nano Topology - Introduction and an application. **(18 Hours)**

COURSE BOOKS:

1. C.Wayne Patt, Foundations of Topology, II Edition - Jones & Bartlett Student Edition - 2012.
2. K. Chandrasekhara Rao, Topology, Narosa Publishing House Pvt. Ltd., 2009.
3. Prepared Course material.

BOOK 1 :

Unit I: Chapter - 8: Sections 8.1, 8.2 & 8.3
Unit II: Chapter - 8: Sections 8.5 & 8.6

BOOK 2 :

Unit III: Chapter 11 - Sections 11.1 to 11.4
Unit IV: Chapter 12 - Sections 12.1 to 12.3
Unit V: Prepared Course material

BOOKS FOR REFERENCE:

1. John L.Kelley, General Topology, D.Van Nostrand Company, INC, London, 2005.
2. Klaus Janich, Topology, Springer.

FUZZY RELIABILITY THEORY

Semester: I **Hours: 6**

Code : 17MMA1E3C **Credit: 5**

COURSE OUTCOMES:

- Explore the possible ways in functioning of systems.
- Apply scientific and systematic approach in Reliability models.
- Obtain extensive knowledge on Fuzzy Set theory.
- Get numerical solutions in areas which have significant uncertainties using fuzzy concept.
- Develop an intuitive feel that enable them to think probabilistically.

UNIT I

Reliability Theory - Introduction- Structure functions - Minimal path and Minimal cut Sets- Reliability of Systems of Independent Components. **(18 Hours)**

UNIT II

Bounds on the Reliability Function - Methods of Inclusion and Exclusion - Second Method for obtaining bounds of r(p) - System life as a Function of Component Lives - Expected System Life time- Systems with repair. **(18 Hours)**

UNIT III

Basic Concepts and Definitions of Fuzzy Sets- Intuitionistic Fuzzy Sets - Extension principle for intuitionistic fuzzy sets - Cartesian product of Intuitionistic Fuzzy sets - Extension Principle in Cartesian Space - Fault Tree Analysis - Advantages of Fault Tree Analysis. **(18 Hours)**

UNIT IV

Trapezoidal Intuitionistic Fuzzy Number (TrIFN) - Arithmetic operations of intuitionistic fuzzy numbers based on Extension Principle - Arithmetic operations of Intuitionistic fuzzy numbers based on (α, β)-cuts Method - Properties on TrIFN - Numerical Exposure Of Arithmetic Operation on Intuitionistic Fuzzy Number.

(18 Hours)

UNIT V

Triangular Intuitionistic Fuzzy Number (TIFN) - Chart of transformation rule on Intuitionistic Fuzzy Number - Arithmetic operations on Triangular Intuitionistic Fuzzy Number - Reliability Analysis of a Series and Parallel Network - Intuitionistic Fuzzy Equations and its application on Reliability Evaluation. **(18 Hours)**

COURSE BOOKS:

1. Introduction to Probability Models, Sheldon M. Ross, 10th Edition, Elsevier, Academic Press.
2. Course material prepared by the Guide.

Unit I : Book1 : Chapter 9: 9.1-9.3

Unit II : Book1 : Chapter 9: 9.4-9.7

Unit III, Unit IV and Unit V : Book2

MATHEMATICAL MODELLING

Semester: I **Hours: 6**

Code : 17MMA1E3D **Credit: 5**

COURSE OUTCOMES:

- Acquire the knowledge of formulating mathematical models of real life situations.
- Understand the model behavior and assess the model's ability to simulate important features of the natural systems.
- Know the conditions of optimality and various optimization techniques.
- Get aquainted with the computational methods.
- Inculcate interest in research.

UNIT I

Introduction - single variable optimization - multivariable optimization with no constraints - multivariable optimization with equality constraints - multivariable optimization with inequality constraints. **(18 Hours)**

UNIT II

Introduction - The meaning of inventory control - Functional role of inventory - Reasons for carrying inventory - Factors involved in inventory problem analysis - Inventory model building - Single item inventory control models without shortages. **(18 Hours)**

UNIT III

Single item inventory control models with shortage - muti-item inventory control models with constraints - single item inventory control models with quantity discounts **(18 Hours)**

UNIT IV

Inventory control models with uncertain demand - Information systems for inventory control - Selective inventory control techniques. **(18 Hours)**

UNIT V

Probabilistic inventory control models: Introduction - instantaneous demand inventory control models without setup cost - continuous demand inventory control models without setup cost - Instantaneous demand inventory control model with setup cost. **(18 Hours)**

COURSE BOOKS:

1. Optimization Theory and Applications, S. S. Rao (Second edition), Wiley Eastern Limited.
2. Operations Research Theory and Applications, J. K. Sharma 4th edition, Macmillan Publishers India Ltd.

   Unit I : Book1: Chapter 2: 2.1-2.5

   Unit II : Book2: Chapter 14: 14.1-14.7

   Unit III : Book2: Chapter 14:14.8-14.10

   Unit IV : Book2: Chapter 14:14.11-14.13

   Unit V : Book2: 15: 15.1-15.4

BOOK FOR REFERENCE:

1. R. Panneerselvam, Operations Research, Second Edition, Prentice - Hall of India Private Limited, New Delhi.

FUZZY SET THEORY AND ITS APPLICATIONS

Semester: I **Hours: 6**

Code : 17MMA1E3E **Credit: 5**

COURSE OUTCOMES:

- Acquire the necessary knowledge of important parts of fuzzy set theory
- Distinguish between the crisp set and fuzzy set concepts
- develop knowledge on evolutionary algorithms
- Demonstrate multi objective and combinatorial optimization problems
- Construct mathematical models for real life problems

UNIT I

Introduction -Fuzzy Sets - t- norms, t - co norms -Algebra of Fuzzy Sets-Mixed Fuzzy Logic -Alpha Cuts-Distance Between Fuzzy Sets **(18 Hours)**

UNIT II

Introduction -Fuzzy Numbers-Fuzzy Arithmetic-Interval Arithmetic- Alpha Cuts and Interval Arithmetic-Properties of Fuzzy Arithmetic-Fuzzy Max and Min-Inequalities-Defuzzification **(18 Hours)**

UNIT III

Introduction -Definitions-Transitive Closure-Fuzzy Equivalence Relation- Fuzzy Relation Equations **(18 Hours)**

UNIT IV

Introduction-Extension Principle- Alpha Cuts and Interval Arithmetic- Types of Fuzzy Functions-Inverse Functions-Derivatives **(18 Hours)**

UNIT V

Genetic Algorithms -Fuzzy Optimization-Maximum/ Minimum of Fuzzy Functions **(18 Hours)**

COURSE BOOK:

1. An Introduction to Fuzzy Logic and Fuzzy sets , James J. Buckley Esfandiar Eslami, Springer International Edition.

   Unit I : Chapter 3: 3.1-3.7

   Unit II : Chapter 4: 4.1-4.6

   Unit III : Chapter7: 7.1-7.5

   Unit IV : Chapter 8: 8.1 -8.6

   Unit V : Chapter 15 & Chapter 16: 16.1,16.2

BOOK FOR REFERENCE:

1. Fuzzy Set Theory and Its Applications, H. J. Zimmermann, Fourth Edition, Springer International Edition

PROJECT

Semester: II **Hours: 30**

Code : 17MMA2R01 **Credits: 15**

COURSE OUTCOMES:

- Obtain Mathematical maturity on understanding the subject and to see how the theory works.
- Improve abstract thinking and equip with creativity.
- Stimulate interest in research methodologies to pursue research.
- Construct numerical samples from real life problems.
- Have sustainable development in research.