MASTER OF PHILOSOPHY IN MATHEMATICS

SYLLABUS

(With effect from 2018-2019)

(Under Choice Based Credit System)

DEPARTMENT OF MATHEMATICS

Mother Teresa Women's University

Kodaikanal-624 101

CURRICULUM UNDER CHOICE BASED CREDIT SYSTEM

Semester	Paper No. and Sub code	Title of the paper	Hours / Week	Credit	Int. Marks	Ext. Marks	Total marks
I	MMTT11	Research Methodology	10	4	40	60	100
	MMTT12	Mathematical Methods	10	4	40	60	100
	MMTT13	Professionals Skills	10	4	40	60	100
II	MMTT21	Area paper / special paper	10	4	40	60	100
	MMTD22	Dissertation and Viva	20	12+ 2	40	60	100 100 200
Total				30			600

For each Course other than the Dissertation

Continuous Internal Assessment : 40 Marks

End Semester Examination : 60 Marks

Total : 100 Marks

Question paper pattern for Course I - IV

Answer any 5 Questions 05 x 12 = 60 Marks

Q. No 1 or 2 from Unit I Q. No 3 or 4 from Unit II

Q. No 5 or 6 from Unit III Q. No 7 or 8 from Unit IV

Q. No 9 or 10 from Unit V

CIA components

Tests (2x10) : 20 Marks ; Term Paper : 10 Marks ; Seminar : 10 Marks

Semester I

MMTT11 RESEARCH METHODOLOGY 6 Hours /4 Credits

Objectives

1. The systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge is Methodology.

2. To import knowledge about Fundamental Group and Separation Theorem in the Plane

3. To import knowledge 2nd order PDE by linear system with applications.

4. The learner will be gain combined knowledge in research methodology, advanced topology and problem solving by PDE.

Unit: I Research Report: Structure of report- Contents steps in drafting – Layout of research reporting – Styles of reporting – Types of report- Guidelines to review report- Typing instructions- Oral presentation- Types of research process- Data collection - Secondary data – Thesis writing : Thesis at tertiary level writing.

Unit: II The Fundamental Group: Homotopy of Paths – The Fundamental Group – Covering Spaces – The Fundamental Group of the Circle – Retraction and Fixed Points

Unit III: The Fundamental Group: The Fundamental Theorem of Algebra – The Borsuk – Ulam Theorem – Deformation Retracts and Homotopy. Type – The Fundamental Group of Sn – Fundamental Groups of Some Surfaces

Unit IV: Separation Theorem in the Plane: The Jordan Separation Theorem – Invariance of Domain – The Jordan Curve Theorem – Imbedding Graphs in the Plane.

Unit V: First order systems in two variables and linearization: The general phase plane-some population models – Linear approximation at equilibrium points – Linear systems in matrix form -Averaging Methods: An energy balance method for limit cycles – Amplitude and frequency estimates – slowly varying amplitudes – nearly periodic solutions - periodic solutions: harmony balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Text Books:

1. Research Methodology, R. Panneer Selvam, Prentice Hall of India, New Delhi, 2005. Unit I
2. Topology: A First Course, James R. Munkers, Second Edition Prentice Hall of India Pvt Ltd, NW, 2000 Unit II, Unit III, and Unit IV
3. Nonlinear Ordinary Differential Equations ,D.W.Jordan, &P.Smith, Clarendon Press, Oxford, 1977. Unit V

Reference Books:

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

2. Differential Equations by G.F.Simmons, Tata McGraw Hill, NewDelhi (1979).

3. Notes on Nonlinear Systems by J.K.Aggarwal, Van Nostrand, 1972.

Semester I

MMTT12 MATHEMATICAL METHODS 6 Hours/4Credits

Objectives:

1. *To import advanced level representation theorem, fourier transforms and conformal mapping theory, problems with boundary conditions.*
2. *To create perfect documentation in social and science discipline by LaTeX*
3. *To get more accurate results for mathematical equations through MATLAB.*
4. *The learner will be gain multiple knowledge by problem solving method and presentation style.*

Unit I: Reisz Representation Theorem**:** Topological preliminaries – Riesz representation theorem – Regularity properties of Borel measures –Lebegue measure – continuity properties of measurable functions.

Unit II: Fourier Transforms**:** Formal properties–Inversion theorem–The Plancherel theorem – Banach Algebra L^1.

Unit III: Conformal Mapping**:** Preservation of angles–Linear fractionaltransformations – Normal families - Riemann Mapping Theorem- The class-Continuity at the boundary – mapping of an annulus.

Unit IV: LaTeX: Text Formatting, TEX and its offering, What's different in LATEX 2ε, Distinguishing LATEX 2ε, Basics of LATEX file commands and Environments – commands names and arguments, Environments , Declarations, Lengths, Special characters , Fragile commands, Exercises, Document layout and Organization- Document class, Page style, Paths of the document , Table of contents, Fine- turning text ,Word division.

Unit V: MATLAB: Programming in MatLab–Polynomials, Curve Fitting and Interpolation-Applications in Numerical Analysis.

Text Books:

1.W. Rudin, Real and Complex Analysis, 3rd edition, McGraw Hill International, 1986. Unit I (Chapter 2), Unit II (Chapter 9), Unit III (Chapter 14)
2.Guide to LATEX ,H.Kopaka and P.W. Daly, third edition, Addison – Wesley , London, 1999. Unit IV (Chap 1,2,3)
3.Amos Gilat, MATLAB An Introduction with Applications, John wiley& sons, 2004.Unit V (Chapters 7, 8 and 10)

Reference Books:

1. V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005.
2. C.D. Aliprantis and O.Burkinshaw, Priniciples of Real Analysis 2edn, Academic Press, Inc. New York, 1990.
3. Serge Lang, Complex Analysis, Addison Wesley, 1977.
4. Introduction to MATLAB 7 for Engineers, William John Palm McGraw- Hill Professional, 2005.

Subject Code: MMTT21

List of area papers:

1. Domination in Graphs
2. Fuzzy Hyper Graphs
3. Fuzzy Sets, Logic and Theory of Neural Networks
4. Topology and image processing
5. Graph and Hypergraphs
6. Non Linear Differential Equations

Any other paper as per the choice of any faculty member of the Department of Mathematics shall be added in this list. The syllabus will be framed by the Department and shall be implemented after getting orders from the Vice-Chancellor.

One from the list of special paper may be selected by the students depending on the area of their research.

Semester II

DOMINATION IN GRAPHS **6 Hours/4Credits**

Objectives:

1. Domination is research level area.
2. To import knowledge about any diameter, independence and irredundance of graph
3. To provide verities of parameter in domination and operations.
4. The learner will be gain detail knowledge about domination.

Unit I: Bounds on the Domination Number: Introduction- Bounds in terms of order- Bounds in terms of order,degree, packing- Bounds in terms of order and size- Bounds in terms of degree,diameter and grith-bounds in terms of independents and covering – Product graphs and Vizing's Conjecture- Grid graphs.(Chap 2:2.1- 2.6)

Unit II: Dominations, Independents , Irredundance: Hereditary and super hereditary properties – Independent sets – Dominating sets- Irredundant sets- The domination chain- Extension chain- Extensions using maximality and minimality. (Chap 3:3.1-3.6)

Unit III: Efficiency, Condition on the Domination set: Introduction-Codes and cups-closed neighborhoods-Computational results-Realizability.(chap4:4.1-4.5)

UnitIV: Varieties of Domination: multiple Domination-Parity Restrictions-Locating-Domination-Distace domination-Strong and weak domination-Global and factor Domination – Domination in directed Graphs.(chap7:7.1-7.7)

Unit V: Sum and Product of Parameters: Nordhaus- Gaddum type results-Gallai type theorems – Other Sums and Products.(chap9:9.1-9.3)

References:

1. Teresa W.Haynes, Stephen T.H., Hedetniemi and Peter J Slater, "Fundamentals of Domination In Graphd", Marcel Deckker, Newyork,(1998)
2. Michael A.Henning, Anders Yeo, Total Dominations in Graphs, Springer Monographs in Mathematics (2013)
3. T.Hedetniemi, R.C.Lasker, "Topics on Dominations", Northoland, (1991).

Semester II

FUZZY GRAPHS AND FUZZY HYPER GRAPHS **6 Hours/4Credits**

Objectives:

1. *Fuzzy provides more reasonable and reachable results in all field.*
2. *To import conditions, properties and types of fuzzy graph and fuzzy hyper graphs*
3. *The learner will be gain research idea in fuzzy graph and fuzzy hyper graphs*

Unit I: Fuzzy Subsets: Fuzzy relations-Fuzzy equivalence Relations-Pattern Classification-Similarity relations. (Chapter 1: 1.1 to 1.4)

Unit II: Fuzzy Graphs: Paths and connectedness – Bridges and cut vertices-Forests and trees-Trees and cycles-Characterization of fuzzy trees-Fuzzy cut sets-Fuzzy chords, Fuzzy cotrees and fuzzy twigs- Fuzzy one chain with boundary 0, cobound and cocycles- Fuzzy cycle sets and Fuzzy cocycle set –Fuzzy Line graphs.(Chapter 2: 2.1 to 2.2)

Unit III: Fuzzy Interval and Operation on Fuzzy Graphs: Fuzzy intersection graphs-Fuzzy interval graphs-The Fulkerson and gross characterization-The Gilmore and Hoffman characterization-Operations on fuzzy graphs-Cartesian products and composition-Union and join-On fuzzy tree definitions. (Chapter 2: 2.3 to 2.5)

Unit IV: Fuzzy Hyper Graph: Fuzzy hyper graph-Fuzzy Transversals of fuzzy graphs-Properties of Tr(H) –Construction H^s. (Chapter 4: 4.1 to 4.2)

Unit V : Coloring and Intersection of Fuzzy Hyper Graph: Coloring of fuzzy hyper graphs-Beta degree coloring procedures-Chromatic values of fuzzy coloring-Intersecting fuzzy hyper graphs-Characterization of strongly intersection hyper graph-Simply ordered intersecting hyper graph-H dominant Transversals. (Chapter 4 : 4.3 to 4.4)

Text Book:

1. "Fuzzy graphs and fuzzy hyper graphs", John N. Mordeson, PremchandS. Nair, Physica-Verlag, A Springer-Verlag Company, 2000

Reference Books:

1. Klir, G.J.U.St.Chair, U.H., and Yuvan, B 'Fuzzy set theory, Foundations and applications', prentice Hall, Upper saddle river, N.J, 1997.
2. Rosenfeld, L.Zadeh, K.S.Fu, M.Shimura, 'Fuzzy sets and their applications',Academic press,1975
3. Berg, C.'Hyper graphs', North Holland , Amsterdam,1989.

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Semester II

FUZZY SETS, LOGIC AND THEORY OF NEURAL NETWORKS 6 Hours/4Credits

Objectives:

1. *To provide basic knowledge about fuzzy sets, relations, types, functionalities*
2. *To import partition problems , solutions with applications.*
3. *To understand applications in fuzzy*
4. *The learner will be gain fuzzy numbers, properties, framing equations for real time applications.*

Unit I: Fuzzy sets and Fuzzy Relations: Fuzzy sets – Basic Types and concepts – Properties of α – Cuts-Representations of fuzzy sets – Decomposition theorems – Extension principle for fuzzy sets. Crisp and fuzzy relations – Projections and cylindric extensions – Binary fuzzy relations – Binary relations on a single set – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Fuzzy morphisms – Sup-I compositions of fuzzy relations. Inf-wicompositions of fuzzy relations.

Unit II: Fuzzy Relation Equations: Introduction – Problem partitioning – Solution method – Fuzzy relations equations based on Sup-I Composition – Fuzzy relation equations based on Inf-wicompositions – Approximate solutions – The use of neural Networks.

Unit III: Fuzzy logic: Introduction – fuzzy propositions – Fuzzy Quantifiers – Linguistic hedges – Inference from conditional fuzzy propositions – Inference from conditional and qualified propositions-Inference qualified propositions.

Unit IV: Fuzzy control: Origin and objective – Automatic control – The fuzzy controllers, Types of fuzzy controllers – The mamdani controller – Defuzzification – The Sugeno controller, design parameters – scaling factors – fuzzy sets – Rules – adaptive fuzzy control – applications.

Unit V: Neural Network Theory: Neuronal Dynamics: Activations and signals – neurons as functions – signal monotonocity – biological activations and signals – Competitive neuronal signals – Neuron fields – Neuronal dynamical systems – Common signal functions – Pulse-Coded signal functions. Achieve models – Neuronal dynamical systems – Additive neuronal dynamics – Additive neuronal feedback – Additive Activation models – Bivalent additive BAM – Bidirectional stability – Lypunov functions – Bivalent BAM theorem.

Text Books:

1. "Fuzzy sets and fuzzy logic: Theory and applications", G.J. Klir and Yuvan boprentice hall of India, New Delhi, (2002). (Relevant Sections Only) Units I,II,III
2. "Fuzzy Set Theory and its Applications", H.J. Zimmermann, fourth edition, Kluwer publishers, London, (2001). (Relevant Sections Only) Unit V.

Reference Books:

1. “Introduction to the theory of fuzzy sets”,Kanufmann, Volume 1, Academic press, Inc., Orlando, Florida(1973)
2. “Fuzzy Mathematics: an introduction for engineers and scientists”, John.N. Moderson and premchandS.Nair-Playsicaverlag, Heidelberg, Germany,(1998).
3. “Neural Networks, Fuzzy logic and Genetic Algorithms synthesis and Applications” S.Rajasekaran and G.A. Vijayalakshmipai., prentice-Hall of India. New Delhi, (2004).

Semester II

TOPOLOGY AND IMAGE PROCESSING 6 Hours/4Credits

Objectives:

1. *To provide advanced level topological and function.*
2. *To impact knowledge about connected compactness and axioms in R.*
3. *Understand the concept of image process and compression.*
4. *The learner will be gain research ideas in topology and image processing together.*

Unit I: Topological Space and Continuous Functions: Topological spaces – Basis for topology – The order of topology – The product topology on X*Y – The Subspace topology – Closed sets and limit points – continuous functions – the product topology – the metric topology – the quotient topology.

Unit II: Connectedness and compactness: Connected spaces – Connected sub spaces of the real line – Compactness and local connectedness – Compact spaces – Compact subspaces of the real line - Limit point compactness – Local compactness.

Unit III: Count ability and separation axioms: The countability axioms – The separation axioms – Normal spaces – The Urysohn lemma – The Urysohn metrization theorem – The Tycon off theorem – The complete metric space.

Unit IV: Digital Image Fundamentals: Introduction – An imagr model-Sampling and quantization – Basic relationships between pixels – Image geometry – Properties of 2D fourier transform.

Unit V: Image Compression: Fundamentals – Image compression – models – Error free compression – Lossy compression – Image compression standards, image segmentation: Detection of discontinuouities – Edge linking and boundary detection – Thresholding – Region oriented segment – Use of motion segmentation.

Text Books:

1. "Topology" James R.Munkres, second edition, PHI Learning private limited, new Delhi, 2011.
   Unit I : Chapter 2: section 12 – 21
   Unit II : Chapter 3: section 23 – 29
   Unit III :Chapter 4: section 30 – 34, Chapter 5: section 37, chapter 7: section 43 and 45
2. "Fundamentals of digital image processing", A.K.Jainprentil Hall of India 1989.
   Unit IV and **Unit V.**

Reference Books:

1. "Algebraic Topology-An Introduction" W.S. Massey, Springer Verlay Network 1976.
2. "Digital Image Processing" C.Gonzalez and R.E.Woods, Addison Wesley.

Semester II

Graph and Hypergraphs **6 Hours/4Credits**

Objectives:

1. *Directed graphs is using more application in science and engineering.*
2. *Good understanding about in labeling*
3. *To provide knowledge in hypergraphs*
4. *The learner will be gain knowledge in graph, directed graph and hypergraph in advance level.*

Unit I: Directed graphs: Binary relation – relation matrix – cyclic digraph – arborescence – fundamental circuits in digraph – incidence matrix in digraph – adjacency matrix in digraph – perfect graphs: perfect graphs – product of graphs – chordal graphs – interval graphs – comparability graphs – circulation and nowhere-zero k-flows – group-valued flows.

Unit II: Labelings: Prodecessor and successor – Graceful labelling – Sequential functions – applications – magic graphs – conservative graphs.

Unit III: Dual Hypergraphs – Degrees-interecting families – the coloured edge property and Chavtal's conjecture.

Unit IV: The Helly property-section of a hypergraph – and the Kruskal-katona theorem – conformal hypergraphs.

Unit V: Transerval hypergraphs – athe coefficients τ and τ' – τ-critical hypergraphs – the kööproperty.

Text Books:

1. Graph Theory and its Applications by B.Sooryanarayana and G.K. Ranganath, Chand & Company Ltd ND 2001.
2. Topics in Graph Theory and Algorithms by Dr.M.Murugan, Muthali Publishing house, Chennai
3. Hypergraphs: Combinatorics of Finite sets by Claude BERGE, North-Holland, 1989.

Semester II

NON LINEAR DIFFERENTIAL EQUATIONS **6 Hours/ 4 Credits**

Objectives:

1. *To provide knowledge in linear ODE and Non linear ODE with application*
2. *To find solutions for undetermined conditions of balance and time estimate.*
3. *To give oscillation solutions in varies applications.*
4. *The learner will be gain supporting results for real time problems.*

Unit I : First order systems in two variables and linearization: The general phase plane-some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Unit II: Averaging Methods: An energy balance method for limit cycles – Amplitude and frequency estimates – slowly varying amplitudes – nearly periodic solutions - periodic solutions: harmony balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Unit III: Perturbation Methods: Outline of the direct method – Forced Oscillations far from resonance - Forced Oscillations near resonance with Weak excitation – Amplitude equation for undamped pendulum – Amplitude Perturbation for the pendulum equation – Lindstedt's Method – Forced oscillation of a self – excited equation – The Perturbation Method and Fourier series.

Unit IV: Linear Systems: Time Varying Systems – Constant coefficient System – Periodic Coefficients – Floquet Theory – Wronskian.

Unit V: Stability: Poincare stability – solutions, paths and norms – Liapunov stability Stability of linear systems – Comparison theorem for the zero solutions of nearly – linear systems.

Text Book

Nonlinear Ordinary Differential Equations ,D.W.Jordan, &P.Smith, ClarendonPress, Oxford, 1977.

References

1. Differential Equations by G.F.Simmons, Tata McGraw Hill, NewDelhi (1979).
2. Ordinary Differential Equations and Stability Theory ByD.A.Sanchez, Freeman (1968).
3. Notes on Nonlinear Systems by J.K.Aggarwal, Van Nostrand, 1972.