MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

M.PHIL IN MATHEMATICS

SYLLABUS

(WITH EFFECT FROM 2021-2022)

(UNDER CHOICE BASED CREDIT SYSTEM)

DEPARTMENT OF MATHEMATICS

MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL-624 101

MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL

M.Phil. – SYLLABUS - 2021 -2022 Onwards

Programme Name: M.Phil .Mathematics

Eligibility: M.Sc. Mathematics.

Medium: English

Objective of The Programme:

1. To provide students a firm grip on all the facets of pure and applied mathematics and include the student an ardor for mathematical knowledge
2. To propel the student towards higher academic ambitions in advanced Mathematics
3. To develop in the student logical , heuristic, systematic and critical ways of thinking to assist in problem solving in their chosen career.
4. To provide the student some inputs in teaching methodology and psychology of teaching

Programme Outcomes(POs)

On completion of the Programme, the learner will be able :

PO1: to acquire advanced conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline

PO2: to apply knowledge and critically evaluate the concepts and scientific developments to take up any challenge

PO3: to visualize and work on laboratory multidisciplinary tasks related to current research in the fields of mathematical , Physical and Life sciences

PO4: to acquire research based knowledge and design methods to investigate complex problems in research/industrial field and achieve employability/self employment

PO5: to communicate effectively ideas verbally in English, leading to Entrepreneurship ventures such as consultancy and training

PO6: to Employ innovative and environment friendly methods, novel idea to solve complex and challenging societal and environmental issues

Programme Specific Outcome (PSOs)

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

PSO1: to develop research level thinking in the field of pure and applied mathematics.
PSO2: to develop abstract mathematical thinking

PSO3: to assimilate mathematics independently and solve advanced mathematical problems.
PSO4: to write research articles in mathematics and to publish it in reputed journals.

PSO5 : to develop and enhance teaching skills in mathematics.

Subject Code	Subject	Credit	Hours	Formative	Summative	Total
Semester I						
M21MTT11	Research Methodology	4	10	40	60	100
M21MTT12	Advanced Algebra and Analysis	4	10	40	60	100
M21PST13	Teaching Learning skill/Professional Skills-I	4	10	40	60	100
Semester II						
M21MTT21	Special paper Related to Project	4	10	40	60	100
M21MTD21	Dissertation	14	20	120	80	200
TOTAL CREDITS		**30**		**TOTAL MARKS**		**600**

The M.Phil course consists of four theory papers. Paper 3 is common for all the programmes. Special Paper 4 is pertaining to the area of specialization chosen by the candidate under a guide. It is purely internal (framing syllabus, question setting and evaluation).

Each candidate will submit a dissertation on a topic in the relevant discipline after carrying out the project work under the supervision of a guide. The project may be theoretical or experimental. The duration of the project will be for six months or more as per the discretion of the Department.

The dissertation will be evaluated by an external examiner and viva voce will be conducted by a committee consisting of the guide and the department faculty.

The examination will be for 100 marks in each of the theory papers. The question paper will cover the entire syllabus. The duration of the examination is 3 hours.

List of Specialization Paper /Area Paper

1. Fuzzy Graphs And Fuzzy Hyper Graphs
2. Fuzzy Theory And Applications
3. Topology and Image Processing
4. Non Linear Differential Equations
5. Inventory Control Models
6. Directed Study*

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

*Any other paper as per the choice of any faculty member in the Department of Mathematics shall be added in this list. The syllabus will be framed by the Department and shall be implemented after getting approval from the Board of Studies.

Semester -I

Course Code	Course Name	Category	T	P	Credit
M21MTT11	**Research Methodology**	**Core- I**	**10**	**-**	**4**

Objectives:

- 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.
- To import knowledge about Fundamental Group and Separation Theorem in the Plane
- To import knowledge 2^{nd} order PDE by linear system with applications.
- The learner will be gain combined knowledge in research methodology, advanced topology and problem solving by PDE.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO 1: Construct the fundamental group of a topological space.

CO 2 : Understands the connection between covering spaces and fundamental group

CO 3 : Work with cell complexes and the basic notions of homotopy theory

CO 4 : Solve the calculations with differential forms and characterize the exterior Derivative.

CO 5: Know Stroke's theorem and understand how this generalizes classical theorems in Calculus.

CO Number	CO Statement	Knowledge Level
CO1	Research Report: Structure of report, Contents steps in drafting , Layout of research reporting and Styles of reporting. Construct the fundamental group of a topological space	K1 and K2
CO2	Understands the connection between covering spaces and fundamental group	K2
CO3	Work with cell complexes and the basic notions of homotopy theory	K4
CO4	Solve the calculations with differential forms and characterize the exterior Derivative	K5
CO5	Know Stroke's theorem and understand how this generalizes classical theorems in Calculus.	K6

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

TOTAL SCORE: 49 X 3 + 6 X 2 = 159

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

Reference Books:

1. W. S. Massey, " Algebraic Topology- An Introduction", Springer-Verlag , New York, 1976
2. G.F.Simmons, " Differential Equations ", Tata McGraw Hill, NewDelhi (1979).
3. J.K.Aggarwal , "Notes on Nonlinear Systems ", Van Nostrand, 1972.

Periodicals:

1. MathematicsNewsletter
2. Discrete Mathematical Sciences and Cryptography.
3. Journal of Topology and its Applications
4. Journal of Differential Geometry

Websites & E-Learning Sources:

1.http://www.mathforum.org

2. http://www.opensource.org

3.http://khanacademy.org

4. http://in.ixl.com

5.http://www.learningwave.com

Teaching Methodology

1. Problem Solving-Group Discussion
2. Quiz-Seminar
3. Peer Learning

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Semester -I

Course Code	Course Name	Category	T	P	Credit
M21MTT12	**Advanced Algebra and Analysis**	**Core- II**	**10**	**-**	**4**

Objectives:

To enable the students to

1. Achieve an advanced mastery of representations of associative algebras.
2. Realise the importance of modules as central objects in algebra and to study some applications.
3. Gain knowledge of the theory of semi simple algebras
4. State the axioms of L_p spaces.
5. Apply appropriate techniques of integration to product spaces.

Course Outcomes:

Upon successful completion of this course , students will be able to:

CO 1: Integrate knowledge at the forefront of associative algebra which forms the basics of higher mathematics

CO 2: Investigate the properties of modules and appreciate its important results.
CO 3: Learn about semi simple algebras and be familiar with examples
CO 4: Define the L p spaces and determine whether functions are in L p
CO 5: Evaluate problems in product spaces using the powerful concept of integration

CO Number	CO Statement	Knowledge Level
CO1	Integrate knowledge at the forefront of associative algebra which forms the basics of higher mathematics.	K1 and K2
CO2	Investigate the properties of modules and appreciate its important results	K3 andK6
CO3	Learn about semi simple algebras and be familiar with examples.	K4
CO4	Define the L^p spaces and determine whether functions are in L^p	K2
CO5	Evaluate problems in product spaces using the powerful concept of integration	K5

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	M	S	S	S	S	M	S
CO5	S	M	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

TOTAL SCORE: 47 X 3 + 8 X 2 = 157

Unit –I : Free Abelian groups:

Free Abelian groups, Finitely generated Abelian groups and Examples, Krull-Smidt theorem – Indecomposable , Classification of Finite groups, Nilpotent groups and solvable groups, Normal series and subnormal series

Unit II : Modules :

Modules – R- Module – Sub module and Examples, Homomorphisms and Exact Sequences, Free modules and vector spaces, Projective modules and Injective modules, Hom and Duality, Tensor products, Modules over PID, Field Extension and Fundamental theorem of Galois theory, Splitting fields

Unit III: The Structure of Semi simple Algebras

The Structure of Semi simple Algebras – Semi simple Algebras and Examples – Minimal Right Ideal – Simple Algebras – Matrices of Homomorphisms – Wedderbum's Structure theorem - Maschke's Theorem and Examples – The Radical - The Radical of an Algebra – Nakayama's Lemma- The Jacobson Radical

Unit –IV: LP-Spaces:

LP-Spaces - Convex functions and inequalities – Jensen's Inequality – Conjugate Exponents – Essential supremum – Essential bounded- The LP-spaces - Approximation by continuous functions – Vanish at infinity

Unit –V: Integration on Product Spaces:

Integration on Product Spaces - Measurability on cartesian products - Product of the measurable function - σ - Finite measurable - The Fubini theorem - Counter Examples - Completion of product measures - Lebesgue measure -Convolutions – Borel Mesearable - Distribution functions

Text Books

1. Hungerford T.W., 2014, Algebra, Springer-Verlag, New York (For Unit I and II)
2. Richard S. Pierce, "Associative Algebras" Springger-Verlag, New York Heidelberg Berlin 2017 (For Unit III)
3. Walter Rudin,"Real And Complex Analysis" Third Edition McGRAW-HILL International Edition Mathematics series 1987 (For Units IV and V)

Periodicals:

The Mathematics Intelligencer

Mathematics Newsletters

Journal in Algebra and Number Theory

Journal of Algebraic combinatorics

WEBSITES & e-LEARNING SOURCES:

http://www.mathforum.org

https://sites.math.northwestern.edu/~len/d70/chap5.pdf

https://www.math.ksu.edu/~nagy/real-an/4-03-lp-spaces.pdf

https://link.springer.com/chapter/10.1007/978-3-642-88044-5_6

Teaching Methodology

1. Problem Solving-Group Discussion
2. Quiz-Seminar
3. Peer Learning

List of Specialization Paper /Area Paper

1. Fuzzy Graphs and Fuzzy Hyper Graphs
2. Fuzzy Theory and Applications
3. Topology and Image Processing
4. Non Linear Differential Equations
5. Inventory Control Models
6. Directed Study*

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

*Any other paper as per the choice of any faculty member in the Department of Mathematics shall be added in this list. The syllabus will be framed by the Department and shall be implemented after getting approval from the Board of Studies.

Semester -II

Course Code	Course Name	Category	T	P	Credit
M21MTT21	**Fuzzy Graphs and Fuzzy Hyper Graphs**	**Specialization Paper**	**10**	**-**	**4**

Objectives:

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

Course Outcomes:

Upon successful completion of this course , students will be able

CO 1: to understand Fuzzy relations,Fuzzy equivalence Relations and Pattern Classification
CO 2 : to analyse the various Characterization of fuzzy grapes and their applications
CO 3 : to evaluate the the Gilmore and Hoffman characterization-and Operations on fuzzy Graphs
CO 4 : to create applications of Fuzzy Transversals of fuzzy graphsusing the Properties of Tr(H)
CO 5: to apply Coloring of fuzzy hyper graphs using various methods

CO Number	CO Statement	Knowledge Level
CO1	Understand Fuzzy relations, Fuzzy equivalence Relations and Pattern Classification	K1 and K2
CO2	Analyse the various Characterization of fuzzy grapes and their applications	K2 and K4
CO3	Evaluate the the Gilmore and Hoffman characterization-and Operations on fuzzy graphs	K5
CO4	Create applications of Fuzzy Transversals of fuzzy graphs.	K6
CO5	Coloring of fuzzy hyper graphs using various methods	K3 and k4

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

TOTAL SCORE: 49 X 3 + 6 X 2 = 159

Unit -I: Fuzzy Subsets:
Fuzzy Subsets: Fuzzy relations- Introduction about Fuzzy relations – Definition and examples of Fuzzy relations- Fuzzy equivalence Relations- Introduction about Fuzzy equivalence Relations - Definition and examples of Fuzzy equivalence Relations Pattern Classification-Similarity relations.

Unit- II: Fuzzy Graphs:
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

Unit- III: Fuzzy Interval and Operation on Fuzzy Graphs:
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.

Unit -IV: Fuzzy Hyper Graph:
Fuzzy Hyper Graph: Fuzzy hyper graph- Introduction about Fuzzy hyper graph-Drfinition and examples of Fuzzy hyper graph- Application of Fuzzy hyper graph Fuzzy Transversals of fuzzy graphs-Properties of Tr(H) –Construction H^s.

Unit -V : Coloring and Intersection of Fuzzy Hyper Graph:
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.

Text Book:

1. John N. Mordeson, PremchandS. Nair "Fuzzy graphs and fuzzy hyper graphs", , 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

Course Code	Course Name	Category	T	P	Credit
M21MTT21	**Fuzzy Theory and Applications**	**Specialization Paper**	**10**	**-**	**4**

Objectives:

To enable students to

- understand the concepts of fuzzy sets and its operations.
- introduce advanced concepts in Fuzzy Mathematics leading to research.
- know fuzzy numbers and fuzzy relations.
- understand the application of fuzzy in various Engineering fields.
- impart knowledge and skills in fuzzy decision making proble

Course Outcomes:

Upon successful completion of this course , students will be able to

CO 1: Effectively use fuzzy operations.

CO 2 : Recognize fuzzy numbers as a foundation of fuzzy sets and fuzzy Mathematics

CO 3 : Represent the strength of association between elements of the two sets.

CO 4 : Predict non linear trends.

CO 5: Identify the formulation and solutions of design problems that are developed using fuzzy theory.

CO Number	CO Statement	Knowledge Level
CO1	Understand the use fuzzy operations	K1 and K2
CO2	Recognize fuzzy numbers as a foundation of fuzzy sets and fuzzy Mathematics	K2
CO3	Represent the strength of association between elements of the two sets	K4
CO4	Predict and evaluate the non linear trends	K5
CO5	Identify the formulation and solutions of design problems that aredeveloped using fuzzy theory.	K6

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

Total Score: 49 X 3 + 6 X 2 = 159

Unit- I: From Classical (Crisp) Sets to Fuzzy Sets:
From Classical (Crisp) Sets to Fuzzy Sets: A Grand Paradigm Shift – Introduction –Crisp Sets: An Overview – Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts – Characteristics and Significance of the Paradigm Shift .Fuzzy Sets Versus Crisp Sets: Additional Properties of α – cuts – Representations of Fuzzy Sets – Extension Principle for Fuzzy Sets. Operations on Fuzzy Sets: Types of Operations – Fuzzy Complements.

Unit- II: Fuzzy Arithmetic and Fuzzy Relations:
Fuzzy Arithmetic: Fuzzy Numbers– Linguistic Variables – Arithmetic Operations On Intervals – Arithmetic Operations On Fuzzy Numbers – Lattice of Fuzzy Numbers – Fuzzy Equations.
Fuzzy Relations: Crisp Versus Fuzzy Relations – Projections and Cylindric Extensions – Binary Fuzzy Relations - Binary Relations on a Single Set – Fuzzy Equivalence Relations

Unit- III: Fuzzy Relations (cont.):
Fuzzy Relations (cont.): Fuzzy Ordering Relations – Fuzzy Morphisms – Sup-i Compositions of Fuzzy Relations –Inf-□ ᵢ Compositions of Fuzzy Relations.
Fuzzy Relation Equations: Solution Method – Fuzzy Relational Equations Based on sup- i compositions – Fuzzy Relational Equations based on inf-□ ᵢ Compositions

Unit- IV: Fuzzy Logic and Constructing Fuzzy Sets:
Fuzzy Logic: Fuzzy Propositions – Fuzzy Quantifiers– Linguistic Hedges – Inference From Conditional Fuzzy Propositions
Constructing Fuzzy Sets: Methods of Construction: An Overview – Direct Methods with One Expert – Indirect Method With One Expert

Unit -V:- Fuzzy Decision Making:
Fuzzy Decision Making: General Discussion – Individual Decision Making – Multiperson Decision Making – MultiCriteria Decision Making – MultiStage Decision Making – Fuzzy Ranking Methods – Fuzzy Linear Programming.

Text Book:

1. George Klir and Bo Yuan, " Fuzzy Sets And Fuzzy Logic – Theory and Applications ", 2009, PHI Learning Pvt Ltd, New Delhi.

Unit I - Sections: 1.1 – 1.5, 2.1 – 2.3, 3.1 & 3.2.
Unit II- Sections: 4.1 – 4.6, 5.1 – 5.5.
Unit III- Sections: 5.7 – 5.10, 6.3 – 6.5.
Unit IV- Sections: 8.3 – 8.6, 10.2, 10.3, 10.5, 12.2 &12.3
Unit V- Sections: 15.1 – 15.7.

Reference Books:

1. Ahmad M. Ibrahim, "Introduction to Applied Fuzzy Electronics ". New Delhi : Prentice Hall India, 1997.

2. Bart.Kosko,"NeuralNetworks and fuzzy systems ", New Delhi :Prentice-Hall of India, 2003.

3. George Klir J. and Folger Tina A.," Fuzzy Sets, Uncertainty and Information ".New Delhi: Prentice Hall India, 2004.

4. Toshiro Terano,AsaiKiyoji, SugenoMichio, "Applied Fuzzy Systems ".New York : A.P. Professional, 1994.

5. ZadehLotfi A., " Fuzzy Sets and Their Applications to Cognitive and Decision Processes", New York, Academic Press, 1975.

Periodicals:

Journal of Intelligent & Fuzzy Systems
International Journal of Fuzzy System and Applications
International Journal of Fuzzy Computation and Modelling The Mathematics Intelligencer
Mathematics News Letter

WEBSITES AND E-LEARNING SOURCES:

http://mathforum.org
http://www.sjsu.edu/faculty/watkins/fuzzysets.htm
https://www.britannica.com/science/fuzzy-logic
https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_decision_making.htm

Teaching Methodology

Lecture (chalk and talk),Problem Solving, Discussion and Interactive session Assignment and Seminar.

Semester -II

Course Code	Course Name	Category	T	P	Credit
M21MTT21	**Topology and Image Processing**	**Specialization Paper**	**10**	**-**	**4**

Objectives:

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

Course Outcomes:

Upon successful completion of this course , Students will be able to

CO 1: Understand the concept of continuous functions and the product topology.

CO 2 : Understands the Connectedness and compactness

CO 3 : Work with The separation axioms and Normal spaces

CO 4 : Understand the concept of Digital Image Fundamentals

CO 5: Analyse Image compression standards, image segmentation and Detection of discontinuouities.

CO Number	CO Statement	Knowledge Level
CO1	Concept of continuous functions and the product topology	K1 and K2
CO2	Apply Connectedness and compactness concepts in image analysis	K3
CO3	Work with The separation axioms and Normal spaces	K4
CO4	Concept of Digital Image Fundamentals-Evaluation	K5
CO5	Analyse Image compression standards, image segmentation and Detection of discontinuouities.	K4

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

TOTAL SCORE: 49 X 3 + 6 X 2 = 159

Unit- I: Topological Space and Continuous Functions:

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:

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:

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:

Digital Image Fundamentals: Introduction – An image model- An image model in Two dimension - An image model in Three dimension- Sampling and quantization – Basic relationships between pixels – Examples for relationships between pixels -Image geometry – Properties of 2D fourier transform.

Unit -V: Image Compression:

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. James R.Munkres "Topology", 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. A.K.Jainprentil "Fundamentals of digital image processing", Hall of India 1989.
   Unit IV and Unit V.

Reference Books:

1. W.S. Massey "Algebraic Topology-An Introduction", Springer Verlay Network 1976.
2. C.Gonzalez and R.E.Woods "Digital Image Processing " Pearson Education, Inc", 2008

Teaching Methodology

Lecture (chalk and talk),Problem Solving, Discussion and Interactive session

Assignment and Seminar.

Semester -II

Course Code	Course Name	Category	T	P	Credit
M21MTT21	**Non Linear Differential Equations**	**Specialization Paper /**	**10**	**-**	**4**

Objectives:

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

Course Outcomes:

Upon successful completion of this course , Students will be able to

CO 1: understand general phase plane and some population models.

CO 2 : work with Equivalent linear equation by harmonic balance and accuracy of a Period estimate.

CO 3 : work with amplitude equation for undammed pendulum and its applications

CO 4 : analyze Time Varying Systems.

CO 5: evaluate Stability of linear systems.

CO Number	CO Statement	Knowledge Level
CO1	Understand general phase plane and some population models	K1 and K2
CO2	*Work with Equivalent linear equation by harmonic balance and accuracy of a Period estimate*	K2 and K3
CO3	Work with amplitude equation for undammed pendulum and its applications	K3
CO4	Analyze Time Varying Systems	K4
CO5	Evaluate Stability of linear systems.	K5

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

Total Score: 45 X 3 + 10 X 2 = 155

Unit- I : First order systems in two variables and linearization:

First order systems in two variables and linearization: Introduction and definition of First order systems in two variables .The general phase plane-some population models – Introduction , definition and examples of population models Linear approximation at equilibrium points – Linear systems in matrix form.

Unit -II: Averaging Methods:

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:

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:

Linear Systems: : Introduction and definition of Linear Systems -Time Varying Systems – Introduction and definition Time Varying Systems- Constant coefficient System – Introduction and definition Constant coefficient System -Periodic Coefficients – Floquet Theory – Wronskian.

Unit- V: Stability:

Stability: Introduction and definition of Stability -Poincare stability – solutions- paths and norms – Liapunov stability -Stability of linear systems – Introduction and definition Stability of linear systems -Comparison theorem for the zero solutions of nearly – linear systems- Examples .

Text Book:

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

Reference Books:

1. G.F.Simmons , " Differential Equations", Tata McGraw Hill, NewDelhi (1979).

2. David A. Sanchez , "Ordinary Differential Equations and Stability Theory, Dover Publications, Inc. New York (1968).

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

Teaching Methodology

Lecture (chalk and talk),Problem Solving, Discussion and Interactive session

Assignment and Seminar.

SEMESTER -II

Course Code	Course Name	Category	T	P	Credit
M21MTT21	**Inventory Control Models**	**Specialization Paper**	**10**	**-**	**4**

Objectives:

- To provide knowledge in Inventory control system.
- To solve inventory control problems using various techniques.
- To construct the required mathematical model for the given assumptions.
- To apply our models in suitable firms.
- .

Course Outcomes:

Upon successful completion of this course , Students will be able to

CO 1: Understand inventory control, Forecasting, Demand models , Constant model, Trend model, Trend-seasonal model,
CO 2 : Work with various type of Quantity discounts

CO 3 : Work with distribution of the inventory position, an important relationship, Compound Poisson demand, Normally distributed demand
CO 4 : Analyze Service levels.

CO 5: Evaluate Optimality of (s,S) policies, Updating order quantities and reorder points in practice.

CO Number	CO Statement	Knowledge Level
CO1	Understand inventory control, Forecasting, Demand models	K1 and K2
CO2	Evaluate various type of Quantity discounts	K5
CO3	Apply distribution of the inventory position, an important relationship,Compound Poisson demand, Normally distributed demand	K3
CO4	Analyze Service levels	K4
CO5	Evaluate Optimality of (s,S) policies, Updating order quantities and reorder points in practice.	K5

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	M	S	S	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	S	M

Score rate : S- Strong = 3 , M-Medium = 2, L-Low:1

Total Score: 45 X 3 + 10 X 2 = 155

Unit- I: Importance and objectives of inventory control:
Importance and objectives of inventory control, Forecasting - Objectives and approaches, Demand models - Constant model, Trend model, Trend-seasonal model, Choosing demand model, Moving average, Exponential smoothing, Exponential smoothing with trend,Winter's trend-seasonal method, Using regression analysis, Costs and concepts - Considered costs and other assumptions, Different ordering systems.

Unit- II: Deterministic lot sizing model:
Deterministic lot sizing model -The classical economic order quantity model - Optimal order quantity, Sensitivity analysis, Reorder point, Finite production rate, Quantity discounts, Backorders allowed, Time varying demand, The Wagner-Whitin algorithm, The Silver-Meal heuristic, A heuristic that balances holding and ordering costs.

Unit- III: Single echelon systems:
Single echelon systems - Reorder points, Discrete stochastic demand - Compound Poisson demand, Logarithmic compounding distribution, Geometric compounding distribution, Smooth demand,Fitting discrete demand distributions in practice, Continuous stochastic demand - Normally distributed demand, Gamma distributed demand, Continuous review (R, Q) policy inventory leveldistribution - Distribution of the inventory position, An important relationship, Compound Poisson demand, Normally distributed demand.

Unit- IV: Service levels:
Service levels, Shortage costs, Determining the safety stock, Fill rate and ready rate constraints - Compound Poisson demand,Normally distributed demand, Fill rate – a different approach, Shortage cost per unit and time unit - Compound Poisson demand,Normally distributed demand,Shortage cost per unit, Continuous review (s, S) policy, Periodic review

fill rate - Basic assumptions, Compound Poisson demand - (R, Q) policy, Compound Poisson demand - (s, S) policy, Normally distributed demand - (R, Q) policy.

Unit- V: The Newsboy Model:

The newsboy model, A model with lost sales, Stochastic lead-times - Two types of stochastic lead-times, Handling sequential deliveries independent of the lead-timedemand, Handling independent lead-times, Comparison of the two types of stochastic lead-times, Joint optimization of order quantity and reorder point - Discrete demand of (R, Q) policy and (s, S) policy, An iterative technique, Fill rate constraint - a simple approach, Optimality of ordering policies - Optimality of(R, Q) policies when ordering in batches, Optimality of (s,S) policies, Updating order quantities and reorder points in practice.

Text Books:

1. Sven Axsater . "Inventory Control " (Second Edition), (Lund UniversityLund, Sweden), Springer Science, LLC, New Yark, USA, 2006.

2. G. Hadley (University of Chicago), T.M. Whitin "Analysis of Inventory Systems ", (University of California, Berkeley), Prentice-Hall, 1963.

Teaching Methodology

Lecture (chalk and talk),Problem Solving, Discussion and Interactive session

Assignment and Seminar

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