DEPARTMENT OF MATHEMATICS

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme : M.Phil. Mathematics

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JAMAL MOHAMED COLLEGE (AUTONOMOUS)
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TIRUCHIRAPPALLI – 620 020

M.Phil. MATHEMATICS

Sem	Course Code	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
						CIA	ESE	
I	23MPMA1CC1	Core - I	Research Methodology	4*	4	25	75	100
	23MPMA1CC2	Core - II	Analysis and Applied Mathematics	4*	4	25	75	100
	23MPMA1CC3	Core - III	Teaching and Learning Skills (Common Paper)	4*	4	25	75	100
	23MPMA1CC4	Core - IV (Elective)	Paper on Topic of Research (The syllabus will be prepared by the guide and examination will be conducted by the COE)	4*	4	25	75	100
		*One hour library for each course						
			Total	**16**	**16**			**400**
II	23MPMA2PD		Dissertation#	-	8	-	200	200
			Grand Total	**16**	**24**			**600**

 # Evaluation of the Dissertation Viva voce shall be made jointly by the Research Supervisor and the External Examiner.

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC1	CORE – I	4	4	25	75	100
Course Title	Research Methodology						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Research Methodology: An introduction – *Defining the research problem* – Research design.	**12**
II	Noetherian modules – Primary decomposition – Artinian modules	**12**
III	Real Analysis: Vector spaces – Integration as a linear functional - Topological preliminaries – Regularity properties of Borel measures.	**12**
IV	Complex Measures: Total variation – Absolute – *Continuity* - Consequences of the Random Nikodym theorem - Bounded linear functional of L^p - Riesz representation Theorem.	**12**
V	Homotopy of paths – The Fundamental group – Covering spaces	**12**
VI	**Current trends (For CIA only) – Contemporary developments related to the course during the semester concerned.**	

…… Self Study

Text Books:

1. C.R.Kothari, Research Methodology, New Age International Publishers, Second Revised Edition Reprint, 2009.

2.N. S. Gopalakrishnan, Commutative Algebra, Oxonian Press Private Ltd, NewDelhi, Second Edition, 1988.

3.Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Company Limited, Third Edition(2006).

4. James R. Munkres, Topology a First Course, Prentice Hall of India Learning Private Ltd. 2009.

UNIT I	Chapter I, II & III Page No. 1 –54		**T.B-1**
UNIT II		Sections 3.1 – 3.3	**T.B-2**
UNIT III	Chapter 2	Sections 2.1 - 2.13, 2.15-2.18	**T.B-3**
UNIT IV	Chapter 6	Sections 6.1 - 6.19 (Page No.124-142)	**T.B-3**
UNIT V	Chapter 9	Sections 51,52,53	**T.B-4**

Reference Books:

1.David S. Dummit and Richard M. Foote, Abstract Algebra, Wiley-Student Edition, India, Second Edition, 2009.

2. G. De. Barra, Measure Theory and Integration, New Age International (P) Ltd., New Delhi, Reprint, 2009.

3. P. R. Halmos, Measure Theory, D. Van Nostrand Company Inc, Princeton N.J., 1950.

4. Serge Lang, Algebra, Addition- Wesley Publishing Company, Sydney, London, Second Edition (1970).

5. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, Second Edition, 2002.

Web Resources:

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://archive.nptel.ac.in/content/storage2/courses/downloads_new/111108135/noc20-ma02_Week_10_Assignment_01.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the proposed research problem of research design.	**K2**
CO2	apply the concept of Noetherian modules, Primary decomposition and Artinian modules	**K3**
CO3	analyse domain knowledge of topological preliminaries and regularity properties of Borel measures.	**K4**
CO4	evaluate on a total variation, Consequences of the Random Nikodym theorem and Riesz representation theorem.	**K5**
CO5	create the examples of fundamental group and Covering spaces	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**1.5**
CO3	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**-**	**1.8**
CO4	**-**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**1.8**
CO5	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**1.5**
Mean Overall Score											**1.92**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. S. Shajitha Begum

Dr. S. Mohamed Yusuff Ansari

Dr. A. Prasanna

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC2	CORE – II	4	4	25	75	100

Course Title	Analysis and Applied Mathematics

SYLLABUS		
Unit	**Contents**	**Hours**
I	Functional Analysis : *****General preliminaries on Banach Algebras*: The definition and some examples – Regular and singular elements – Topological divisors of zero. The Spectrum – The formula for the spectral radius – the radial and semi – simplicity. The structure of commutative Banach Algebra: The Gelfand mapping – Application of the formula r(x) = lim || x || - Involution in Banach Algebra. The Gelfand – Neumark theorem	**12**
II	Differential Equation (Linear and Non-Linear systems): Uncoupled linear systems – Diagonalization – Exponential of operators – The fundamental theorem for linear systems – linear system in R^2 – Complex Eigen values - Multiple Eigen Values - Some preliminary concepts and definitions – The fundamental existence – Uniqueness theorem.	**12**
III	Domination: The domination number of graph - Exploration - Stratification	**12**
IV	Mathematics of Cryptography: Introduction – Integer Arithmetic- Modular Arithmetic – Matrices – Linear Congruence. Traditional Symmetric-key. Ciphers: Introduction – Substitution Ciphers – Transposition Ciphers – Stream and Block Ciphers.	**12**
V	Fuzzy Graph: *Paths and Connectedness*- Fuzzy Bridges and Fuzzy Cut nodes- Fuzzy Forests and Fuzzy Trees.	**12**
VI	**Current trends (For CIA only) – Contemporary developments related to the course during the semester concerned**	

…… Self Study

Text Books:

1. G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill International Edition, Fifteenth Reprint, 2011.

2. L.Perko, Differential Equations and Dynamical Systems, Springer International Edition, Third Edition, 2009.

3. Gary Chartrand and PingZhang, Introduction to Graph Theory, McGraw Hill, International Edition, 2005.

4. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, Tata McGraw Hill Education Private Limited, New Delhi, Second Edition,2010.

5. A.Nagoor Gani and V. T. Chandrasekaran, A first look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd. Chennai, First Edition ,2010.

UNIT I	Chapter 12	Sections 64 - 69(Page No. 301 to 317)	
	Chapter 13	Sections 70 - 73 (Page No. 318 to 326)	**T.B-1**
UNIT II	Chapter 1	Sections 1.1 - 1.7	
	Chapter 2	Sections 2.1 - 2.2	**T.B-2**
UNIT III	Chapter 13	Sections 13.1 and 13.2	**T.B-3**
UNIT IV	Chapter 2	Sections 2.1 - 2.4	
	Chapter 3	Sections 3.1, 3.4	**T.B-4**
UNIT V	Chapter 3	Sections 3.1 – 3.3	**T.B-5**

Reference Books:
1. Balmohan V Limaye, Functional Analysis, New Age International (P) Ltd. New Delhi, Second Edition ,2009. 2. M.Murugan, Topics in Graph Theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, First Edition ,2003. 3. William Stallings, Cryptography and Network Security, Dorling Kindersley India Pvt. Ltd, Fifth Edition, 2011.
Web Resources:
1. **https://archive.nptel.ac.in/courses/111/105/111105037/** 2. **https://www.digimat.in/nptel/courses/video/111106102/L19.html**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the Gelfand mapping theorem and Gelfand – Neumark theorem	**K2**
CO2	apply the concepts of Linear and Non-Linear systems of Differential Equations in various problems.	**K3**
CO3	analyse the domain knowledge on the domination number of graph, Exploration and Stratification.	**K4**
CO4	evaluate the modular arithmetic and ciphers .	**K5**
CO5	create the Fuzzy Graph: Paths and Connectedness- Fuzzy Bridges and fuzzy cut nodes- Fuzzy Forests and Fuzzy Trees.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**2.1**
CO4	**3**	**3**	**-**	**3**	**3**	**3**	**3**		**3**	**3**	**2.4**
CO5	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**3**	**1.5**
										Mean Overall Score	**2.28**
										Correlation	**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. A. Mohamed Ismayil
Dr. P. Muruganantham
Dr. R. Jahir Hussain
Dr. A. Prasanna
Dr. A. Nagoor Gani

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC3	CORE – III	4	4	25	75	100
Course Title	Teaching and Learning Skills						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Learning in higher education: What is Learning? - Learning Hierarchy – Information Processing – Learning Events – Learning Outcomes – Motivation. Teaching technology –Designs: Technology – *Teaching Technology* – Instructional Technology and Education Technology – Instructional Designs – Combination of Teaching Strategies and Instructional Designs.	**12**
II	Teaching technology Large groups: Psycho – Dynamics of Group Learning – Lecture Method – Modified Forms of Lecture – Seminar – Symposium – Panel Discussion – Team Teaching – Project Approach – Workshop. Teaching in small groups: Small Group Instruction – *Group Discussions* – Simulation Approach – Role Playing - Buzz Group Technique – Brainstorming – Case Discussions – Assignment.	**12**
III	Class room management: Teacher and Class Room Management – Class Room Management: A Conceptual Analysis – Discipline – A component of Class Room Management – Strategies for Class Room Management – Behavior Problems of Students in Colleges – Human Relations in Educational Institutions. Professional Growth: Need and Importance of Professional Growth – Professional Ethics.	**12**
IV	Communication skills: Introduction to life skills – Communication – Emotional – Functional – Personality skills. Public speaking – Welcome speech- Introducing guests – Vote of Thanks – Speech on current topics like use of cell phones, beauty contests, pollution etc., Personality Development Soft skills – Body language – Goal setting – Positive attitude – Emotional intelligence, leadership qualities – Problem solving Conversation in selected context – Introduction, permission, request, offer, greetings, sympathy, apology, suggestion, permission, telephonic conversation, compliant, warning, gratitude. Communication for career – Preparation – Resume- Group Discussion - Interview – standard , Panel, walk-in, group, stress, mock interview (practice)	**12**
V	MATLAB: Introduction - What is MATLAB? – Does MATLAB do symbolic calculations? – Will MATLAB Run on My Computer? – Where do I get MATLAB? – Basis of MATLAB: MATLAB windows – Online help – Input output, File types. Tutorial Lessons: A minimum MATLAB session – creating and working with arrays of numbers – creating and printing simple plots – creating, saving and executing a script file. Applications: Linear Algebra – curve fitting interpolation – Numerical Integration – Ordinary differential equation.	**12**
VI	**Current trends (For CIA only) – Contemporary developments related to the course during the semester concerned.**	

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Text Books:

1. E.C. Vedanayagam, Teaching Technology For College Teachers, Striling Publishers Private Limited, 1988.
2. K. Alex, Soft Skills, S. Chand & company Ltd., New Delhi, First Edition, 2009.
3. Rudra Pratap, Getting Started with MATLAB 7, Oxford University Press, 2006.

UNIT I	Chapter 2 and 3		**T.B–1**
UNIT II	Chapter 4 and 5		**T.B–1**
UNIT III	Chapter 8 and 12		**T.B–1**
UNIT IV			**T.B–2**
UNIT V	Chapter 1	Sections 1.1 - 1.4 and 1.6 - 1.6.5	
	Chapter 2	Sections 2.1 - 2.4	
	Chapter 3	Sections 5.1 - 5.5	**T.B–3**

Reference Books:

1. Brian R. Hunt, Ronald L. Lipsman, Jonathan. M. Rosenberg, A Guide to MATLAB for Beginners and Experienced Users, Cambridge University Press, Reprint 2008.
2. Cheryl Hamilton, Communicating for results, Wads Worth cenage learning, Ninth Edition, USA, 2005.
3. Leena Sen, Verbal and non-verbal communication, Eastern Economy Editions, Prentice Hall of India Learning, Second Edition , 2011.
4. S.A.W.Bukari, Soft Skills Competencies for Success, Sanjee Book House, Trichy 2009.

Web Resource:

1. https://onlinecourses.nptel.ac.in/noc20_ge21/preview
2. https://onlinecourses.nptel.ac.in/noc20_ge05/preview

Course Outcomes

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

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	understand the effective teaching methods for classroom management.	**K2**
CO2	apply the domain knowledge of teaching and technology in Lecture, Seminar, Symposium, Panel Discussion, Team Teaching, Project and workshop.	**K3**
CO3	analyse the variety of Teaching - learning strategies, Instructional Designs in higher education	**K4**
CO4	demonstrate pursuit of knowledge as a character formation and interpersonal skills.	**K5**
CO5	create the MATLAB software's for Problem Solving.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	-	3	3	3	3	3	-	3	2.4
CO4	3	3	-	3	3	3	3	3	3	3	2.7
CO5	3	3	3	3	-	3	3	3	-	3	2.4
Mean Overall Score											2.7
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr. R. Jahir Hussain

Dr. M. Mohammed Jabarullah

Dr. A. Mohamed Ismayil

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Codes And Cryptography						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Introduction –Entropy –*Coding* -Efficient codes -Compression	**12**
II	Information capacity -Fano's inequality- Shannons's noisy coding theorem	**12**
III	Linear codes -Cyclic codes -BCH codes -Linear feedback shift Registers	**12**
IV	Cryptography -Symmetric and Asymmetric Ciphers –Complexity -Public Key Ciphers	**12**
V	Discrete Logarithm Ciphers –*Signatures* -Bit Commitment -Quantum Cryptography	**12**

…….. Self Study

Text Books:

T.K.Carne., "Codes & Cryptography", Applications & Algorithms, Department Of Mathematics., University of Cambridge**,** Notes Michaelmas ,2007.

UNIT I Chapter 1 to 5
UNIT II Chapter 8 to 10
UNIT III Chapter 11 to 14
UNIT IV Chapter 15 to 18
UNIT V Chapter 19 to 22

Reference Books:

1. W.W. Adams and L.J. Goldstein, "Introduction to Number Theory*",* Englewood Cliffs, N.J. Prentice-Hall of India ,1976.
2. G.AKL, "On the security of Compressed Encoding,'' Advance in Cryptology: Proceedings of Cryptology: Proceedings of Crypto 83, Plenum Press ,1984.
3. Bruce Schneier, "Applied Cryptography", Second Edition, John Wiley & Sons, Inc ,2001.
4. Johannes. A. Buchmann, "Introduction to Cryptography", Springer, Second Edition , 2004.

Web Resources:

1. **https://nptel.ac.in/courses/108102117**
2. **https://onlinecourses.nptel.ac.in/noc23_cs04/preview**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the study on the entropy and Efficient codes.	**K2**
CO2	apply and solve Fano's inequality and Shannons's noisy coding theorem	**K3**
CO3	analyse and classify of linear codes, Cyclic codes and BCH codes.	**K4**
CO4	evaluate and classify cryptography, Symmetric and Asymmetric Ciphers.	**K5**
CO5	create the discrete logarithm ciphers	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**0**	**3**	**3**	**3**	**0**	**0**	**3**	**3**	**2.1**
CO2	**3**	**3**	**3**	**0**	**3**	**3**	**0**	**3**	**0**	**3**	**2.1**
CO3	**0**	**0**	**3**	**3**	**3**	**0**	**3**	**3**	**3**	**0**	**1.8**
CO4	**3**	**0**	**3**	**3**	**3**	**3**	**0**	**3**	**0**	**3**	**2.1**
CO5	**3**	**3**	**0**	**3**	**3**	**3**	**3**	**0**	**3**	**3**	**2.4**
										Mean Overall Score	**2.1**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. M. Mohammed Jabarullah

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Network Optimization & Genetic Algorithms

SYLLABUS		
Unit	**Contents**	**Hours**
I	Various classes of network optimization problems-*Various classes of shortest path problems*-Notations-Terminology-Generalization of modified Yen's algorithm- New MOSPP Algorithm.	**12**
II	Polynomial time algorithms for an MOSPP using various mean concepts - *Arithmetic mean concept* - Solving an MOSPP in a network by Dijkstra's algorithm using non - dominated arithmetic mean vector concept - Solving an MOSPP in a network by Yen's algorithm using non-dominated arithmetic mean vector concept - Solving an MOSPP by single objective version of new MOSPP algorithm using non - dominated arithmetic mean vector concept - Numerical illustrations	**12**
III	Non-linear mean concepts-Introduction- Best compromise vector based on non-linear means- Best compromise vector based on centroidal mean- Best compromise vector based on contra harmonic mean- Theorem - Principle of optimality- Numerical illustrations.	**12**
IV	Genetic algorithms: History- Basic concepts- Creation of Off springs- Working principle- Encoding- Fitness function- Reproduction.	**12**
V	Inheritance operators - Cross over - Inversion and deletion- Mutation operator - Bit-wise operators- Bit-wise operators used in GA- Generational cycle- Convergence of genetic algorithm- Applications- Multi-level optimization- Real life problem- Differences and similarities between GA and other traditional methods- Advances in GA.	**12**

…….. Self Study

Text Books:

1. S. Ismail Mohideen, A Text Book of Network Optimization Problems, First Edition, 2011.

2. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, Prentice-Hall of India Pvt Ltd , 2007.

UNIT I	Chapter 2	Sections 2.1 - 2.4	**T.B-1.**
	Chapter 5	Sections 5.1 - 5.8 and 6.1 - 6.9	**T.B-1.**
UNIT II	Chapter 7	Sections 7.1 - 7.6	**T.B-1.**
UNIT III	Chapter 8	Sections 8.1 - 8.8	**T.B-1.**
UNIT IV	Chapter 8	Sections 8.1 - 8.7	**T.B-2.**
UNIT V	Chapter 9	Sections 9.1 - 9.13	**T.B-2.**

Reference Book:
Mitsuo Gen, Runwei Cheng , Lin Lin , Network Models and Optimization: Multiobjective Genetic Algorithm Approach (Decision Engineering), Springer; 2008 th Edition ,31 July 2008.
Web Resources:
1. https://archive.nptel.ac.in/courses/108/108/108108148/ 2. https://www.youtube.com/watch?v=Z_8MpZeMdD4

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the various classes of network optimization problems	**K2**
CO2	apply the solution of Polynomial time algorithms for an MOSPP using various mean concepts	**K3**
CO3	analyse the solution of non-linear mean, centroidal mean and contra harmonic mean	**K4**
CO4	recognize and evaluate the concept of Genetic algorithms	**K5**
CO5	create the Inheritance operators.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**1.8**
CO2	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**3**	**2.1**
CO3	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO4	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**		**3**	**2.4**
CO5	**-**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**2.1**
										Mean Overall Score	**2.22**
										Correlation	**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. S. Ismail Mohideen

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Numerical Solution of Boundary Value Problems						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Ritz finite element method –*Least square finite element method *-Galerkin finite element method-Convergence analysis	**12**
II	*First order initial value problems* -Second order initial value problems	**12**
III	Parabolic equation - First order hyperbolic equation-second order hyperbolic equation- Bibliographical note -Problems	**12**
IV	Assembly of element equations - Mixed boundary conditions - Galerkin method	**12**
V	Assembly of element equations -Mixed boundary conditions-Boundary points - Galerkin method	**12**

…….. Self Study

Text Book:

M.K. Jain, Numerical Solution of Differential Equations, Wiley Eastern Limited, Second Edition, New Delhi.

UNIT I Chapter 8 Section 8.5

UNIT II Chapter 8 Section 8.9

UNIT III Chapter 8 Section 8.10

UNIT IV Chapter 8 Section 8.6

UNIT V Chapter 8 Section 8.7

Reference Books:

1. G.Evans , J.Black leeger and P. Yardley, Numerical Methods for Partial Differential Equation,
   Springer International Edition ,2010.
2. Curtis. F. Gerald, Applied Numerical Analysis, Addison -Wesley Publishing Company, Second Edition, 1970.

Web Resources:

1. https://archive.nptel.ac.in/courses/112/104/112104116/
2. https://archive.nptel.ac.in/courses/112/104/112104193/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the finite element methods.	**K2**
CO2	apply the solution of first and second order initial value problems.	**K3**
CO3	analyse and illustrate parabolic and hyperbolic equations with examples	**K4**
CO4	evaluate Galerkin method for Mixed boundary conditions	**K5**
CO5	create and study the assembly of element equations	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**2.4**
CO2	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**2.1**
CO3	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**2.1**
CO4	**3**	**-**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**1.8**
CO5	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**3**	**1.8**
Mean Overall Score											**2.04**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. U. Abuthahir

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Stochastic Processes

SYLLABUS		
Unit	**Contents**	**Hours**
I	*General theory of continuous process* – Kolmogorov's Forward and Backward Equation – Fokker – Plank equation – An alternative approach to the diffusion equation – Wierner levey process – Uhlenbeck – Ornstein stochastic process – Diffusion processes in n dimensions – Wiener process as a continuous approximation to simple random walk – First passage problems in diffusion process- Purely Discontinuous Markov processes.	**12**
II	Definitions – Examples – Stationary and orderliness – *Distribution of Forward and Backward Recurrence Times* – Palm – Khintchine Functions – Khintchine's Limit Theorem – Palm's Theorem – Point processes on the real line: Intensity Functions, Moments and correlation – Doubly stochastic poisson Processes.	**12**
III	Coveriance Function – continuity, Differentiability, Integrals of Second Order Processes in the mean square sense- Stationary processes – Herglotz theorem- Bochner's theorem – Spectral Representation of a wide sense stationary process – Spectral Representation Theorem – Karhunen – Loeve expansion of a second order process.	**12**
IV	Wiener process and wiener integrals –Ito Integral – Ito equation – Mc Shane Integrals and Models –Examples.	**12**
V	Definition – Examples –Discrete Branching Process- Generating Function of the Process –The probability of extinction – Fundamental theorem of Branching processes –Total population size – Cumulant Generating function – Continuous Parameter Branching process (Markov Branching Process) –Age dependent branching process.	**12**

…….. Self Study

Text Book:

S.K. Srinivasan and Mehata, Stochastic Processes, Tata McGraw Hill Ltd., Second Edition.

UNIT I	Chapter 5	Sec 5.1 - 5.6
UNIT II	Chapter 6	Sec 6.2 - 6.5
UNIT III	Chapter 7	Sec 7.1 - 7.6
UNIT IV	Chapter 8	Sec 8.1 - 8.5
UNIT V	Chapter 9	Sec 9.1 - 9.4

Reference Books:

1. N.V.Prabhu, Macmilan, Stochastic Processes ,NEW YORK.
2. Somuel korlin, Howard, M.Taylor, A first course in stochastic processes Second Edition.
3. Narayan Bhat, Elements of Applied Stochastic processes.
4. J.Medhi ,Stochastic Processes–Wiley eastern Ltd., Second Edition.

5. E.Wong, Mc Graw Hill ,Stochastic Processes in information and Dynamical system, New York,.
Web Resources:
1.**https://nptel.ac.in/courses/111102014** 2.**https://freevideolectures.com/course/4777/nptel-stochastic-processes/123**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the Kolmogorov's Forward and Backward Equation and Wierner levey process.	**K2**
CO2	apply the solution of Khintchine's Limit Theorem and Palm's theorem	**K3**
CO3	analyse the concept of Covariance Function for continuity, Differentiability, Integrals of Second Order Processes in the mean square sense.	**K4**
CO4	evaluate the Wiener process and wiener integrals with examples.	**K5**
CO5	create and describe the concepts of Generating Function and Fundamental theorem of Branching processes	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**1.8**
CO2	**-**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**1.2**
CO3	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO4	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**1.8**
CO5	**3**	**-**	**3**	**-**	3	**-**	**3**	**3**	**-**	**3**	**1.8**
										Mean Overall Score	**1.80**
										Correlation	**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. P. Muruganantham

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Advanced Graph Theory						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Digraphs- Types of diagraphs - *Directed paths and connected diagraph *- Incidence matrix of a diagraph - Cycle matrix of a digraph.	**12**
II	Enumeration - *Labeled graphs* – Polya's enumeration theorem – Enumeration of graphs – Enumeration of trees.	**12**
III	Independent domination number – total domination number – Connected domination number - connected total domination number – clique domination number	**12**
IV	Paired domination number - Induced paired domination number – Global domination number - Total global domination number – Connected global domination number – Multiple domination number	**12**
V	Edge domination number – Total edge domination number –Connected edge domination number - Entire domination number and other related parameters.	**12**

…….. Self Study

Text Books:

1. V.R.KULLI,, College graph theory, vishwa international publications, first edition, 2012.

2. Frank Harary, Graph Theory, Narosa Publishing House, New Delhi, Reprint 2001.

3. V.R.KULLI,Theory of Domination in Graphs, Vishwa international publications, first edition ,2010.

UNIT I	Chapter 9	Sections 9.2 to 9.6	**T.B.1**
UNIT II	Chapter 15	Page No. 178 to 191	**T.B.2**
UNIT III	Chapter 3	Sections 3.2to3.6	**T.B.3**
UNIT IV	Chapter 3	Sections 3.7to3.12	**T.B.3**
UNIT V	Chapter 4	Sections 4.1to4.4	**T.B.3**

Reference Books:

1. Douglas B. West Introduction to graph theory, Prentice Hall of India Pvt.Ltd, Second edition,2009.
2. Narasingh Deo, Graph theory with application to Engineering and computer science, Prentice Hall of India Pvt. Ltd, 2008.

Web Resources:

1.**https://onlinecourses.nptel.ac.in/noc21_cs48/preview#:~:text=This%20course%20provides%20an%20in,be%20covered%20for%20significant%20impact.**

2.**https://www.youtube.com/watch?v=xi_f8TfH_qM**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand and Recall the concept of digraphs.	**K2**
CO2	apply State on Polya's enumeration theorem with examples.	**K3**
CO3	demonstrate the concept of domination and independent domination.	**K4**
CO4	evaluate the concepts domination numbers.	**K5**
CO5	create the concept of domination numbers in Edge domination number and Total edge domination number.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO2	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**1.8**
CO3	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO4	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**-**	**-**	**1.5**
CO5	**3**	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**1.5**
Mean Overall Score											**1.98**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. R. Jahir Hussain

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Topological Vector Spaces						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Introduction-Separation-properties-Linear mapping-*Finite dimensional spaces*.	**12**
II	Metrization-*Boundedness and continuity*-Semi norms and local convexity-Quotient spaces and examples.	**12**
III	Baire category- The Banach-Steinhaus theorem-The open mapping theorem- The closed graph theorem-Bilinear mappings.	**12**
IV	The Hahn-Banach theorems-Weak topologies-Compact convex sets-Vector-valued integration-Holomorphic functions.	**12**
V	The normed dual of normed space – Adjoints – Compact operators.	**12**

…….. Self Study

Text Book:

Walter Rudin, Functional analysis, Tata McGraw-Hill Edition 2006, second edition, 4th Reprint 2008.

UNIT I Sec 1.1-1.23
UNIT II Sec 1.24-1.47
UNIT III Sec 2.1-2.17
UNIT IV Sec 3.1-3.32
UNIT V Sec 4.1-4.25

Reference Books:

1. Sterling K.Berberian, Lectures in Functional Analysis and operator theory, Springer International student Edition, 1974.
2. Balmohan V.Limaye, Functional Analysis, New Age International Publishers, Revised Second Edition, 1996.
3. S. Kesavan, Functional Analysis, TRIM Hindustan Book Agency, 2009.

Web Resources:

1. **https://onlinecourses.nptel.ac.in/noc22_ma25/preview**
2. **https://www.youtube.com/watch?v=FkJMfsNg2cM**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concept of finite dimensional spaces with examples.	**K2**
CO2	apply the Metrication and Quotient spaces with examples.	**K3**
CO3	analyze The Hahn-Banach theorems for Weak topologies.	**K4**
CO4	evaluate the Baire category, The Banach-Steinhaus theorem and the open mapping theorem.	**K5**
CO5	create the concept of compact operators.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**3**	**-**	**1.5**
CO3	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**2.1**
CO4	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**2.1**
CO5	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**2.1**
Mean Overall Score											**2.16**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Nagoor Gani

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Fuzzy Algebra						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Fuzzy sets- Height of Fuzzy set – *Nomal and Subnormal fuzzy sets*- Support level sets – Fuzzy points - Cuts	**12**
II	Standard fuzzy operations- Union, intersection and complement – Properties – *DeMargan's Laws*	**12**
III	α cuts of fuzzy operations – Representations of fuzzy sets – Image and inverse of fuzzy sets	**12**
IV	Various definitions of fuzzy operations – Generalizations – Fuzzy relations – α cuts of fuzzy relations	**12**
V	Fuzzy sub groups- Intersection and α cuts of fuzzy subgroups	**12**

…….. Self Study

Text Book:

M. Mrugalingam, S. Palaniammal, Fuzzy Algebra, Sivam Publications, Vickramasingapuram,2006.

UNIT I Chapter I

UNIT II Chapter II

UNIT III Chapter III

UNIT IV Chapter IV

UNIT V Chapter V

Reference Book:

George J.Klir and Bo Yuan, Fuzzy Sets and fuzzy Logic Theory and Applications, Prentice Hall of India 2004.

Web Resources:

1. **https://onlinecourses.nptel.ac.in/noc19_ma31/preview**
2. **https://www.youtube.com/watch?v=n9eNXs76VVM**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	recognize the concept of fuzzy sets and their properties.	**K2**
CO2	apply the domain knowledge for Standard fuzzy operations and DeMargan's Laws in fuzzy sets.	**K3**
CO3	analyze the various definitions of fuzzy operations and fuzzy relations.	**K4**
CO4	evaluate the domain knowledge for the Representations of fuzzy sets, Image and inverse of fuzzy sets	**K5**
CO5	create the concept of Fuzzy sub groups.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**2.4**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**1.2**
CO4	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO5	**3**	**-**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**2.1**
Mean Overall Score											**2.28**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Prasanna

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Fuzzy Graph Theory

SYLLABUS

Unit	Contents	Hours
I	Introduction – *Fuzzy sets and fuzzy set operations* – Fuzzy relations – Composition of fuzzy relations – Properties of fuzzy relations - Introduction to Fuzzy graph – Operations on fuzzy graphs – Complement of a fuzzy graph – Cartesian product and composition – Union and join.	12
II	Geodesic, distance, covers and bases – Fuzzy end nodes and fuzzy trees – Medians and fuzzy trees – Triangle and Parallelogram laws.	12
III	Fuzzy independent set and fuzzy bipartite graph – Fuzzy bipartite part and maximal bipartite part – *Maximal fuzzy bipartite part algorithm*.	12
IV	Dominating set – Fuzzy Independent set – Bounds for $\gamma(G)$ – More adjacency in Fuzzy graph	12
V	Automorphism of fuzzy graphs – metric in fuzzy graphs – Center of a fuzzy tree - Regular Fuzzy Graphs	12

…….. Self Study

Text Book:

A. Nagoor Gani and V.T.Chandrasekaran, A first look at fuzzy Graph Theory, Allied Publishers Pvt.Ltd. Chennai, First Edition ,2010.

UNIT I	Chapter 1	Sections 1.1 to 1.5,
	Chapter 2	Sections 2.1 to 2.2.3
UNIT II	Chapter 3	Sections 3.4 to 3.5
UNIT III	Chapter 4	Sections 4.1 to 4.3
UNIT IV	Chapter 5	Sections 5.1 to 5.4
UNIT V	Chapter 6	Sections 6.1 to 6.2

Reference Book:

J.N.Moderson & P.S. Nair, Fuzzy graphs and fuzzy hypergraphs. Livro da série: Studies in Fuzziness and Soft Computing, Physica-Verlag, 2000.

Web Resources:

1. **https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ma48/**
2. **https://nptel.ac.in/courses/111102130**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concept of fuzzy graphs and their properties with examples.	**K2**
CO2	examine and apply the concept of Geodesic, distance, covers, bases and Triangle, Parallelogram laws	**K3**
CO3	analyse the concept of Fuzzy independent set and fuzzy bipartite graph with algorithm.	**K4**
CO4	evaluate and classify the Dominating set and fuzzy independence set.	**K5**
CO5	create the idea of Automorphism of fuzzy graphs and metric in fuzzy	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**2.4**
CO2	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**		**2.4**
CO3	**3**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**1.5**
CO4	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**1.8**
CO5	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**3**	**2.1**
Mean Overall Score											**2.04**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Nagoor Gani

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Fuzzy Optimization						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Interval Confidence - Fuzzy Number - Some Types of Fuzzy Numbers and its Operations - *Intuitionistic Fuzzy Numbers* - Distance formula for Fuzzy Numbers - Some Metric Properties - Lattice of fuzzy number.	**12**
II	Introduction - Mathematical Model - Improving a Basic Feasible Solution – Unbounded solutions - Optimality Conditions - *Fuzzy Variable Linear Programming* - Fuzzy Basic Feasible Solution - Simplex Method for FVLP problem – Example.	**12**
III	Fuzzy Number Linear Programming - Fuzzy Basic Feasible Solution - Simplex Method for FVLP problem – Example - Duality in FNLP problem - A Fuzzy Dual Simplex Method – Algorithm – Example.	**12**
IV	Introduction- Fuzzy Multi- Objective linear programming problem - Layer Ranking Method - Superiority and Inferiority Between Triangular Numbers – Some Application to Multi- Objective Fuzzy linear programming problem -Multi-Objective Fuzzy linear programming problem with Interval Number - Ranking Interval Numbers - Fuzzy Simulation Analysis Method.	**12**
V	Introduction- Fuzzy General Transportation Problem (FGTP) - A parametric study on problem - Stability notions for the parametric problem - Solution Algorithm - Numerical Examples.	**12**

…….. Self Study

Text Book:

A.Nagoor Gani, Fuzzy Optimization – Materials Prepared

Reference Books:

1.George Bojadziev & Maria Bojadziev, Fuzzy sets, Fuzzy Logic, Applications –World Scientific Advances in Fuzzy Systems-Applications and Theory Vol.5.

2. Bernadette Bouchon-Meunier, Ronald R.Yager and Lofti A.Zadeh, Fuzzy Logic and Soft Computing –World Scientific Advances in Fuzzy Systems - Applications and Theory Vol.4.

3. George J.Klir / Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, Prentice Hall of India Private Limited, New Delhi ,2005.

Web Resources:

1. https://www.youtube.com/watch?v=JRaZAYuKURU
2. https://www.youtube.com/watch?v=Q31jKiEXxdc

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the examples of interval confidence of fuzzy number and some types of fuzzy numbers.	**K2**
CO2	apply the information on mathematical Model in Fuzzy Variable Linear Programming	**K3**
CO3	analyse and examine in detail Fuzzy Number Linear Programming and find Fuzzy Basic Feasible Solution with example.	**K4**
CO4	evaluate the properties of Fuzzy Multi- Objective linear programming problem and Layer Ranking Method.	**K5**
CO5	analyse and create Fuzzy General Transportation Problem (FGTP) with Numerical example.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**	**3**	**1.5**
CO3	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**2.1**
CO4	**-**	**3**	**3**		**-**	**3**	**-**	**3**	**3**	**-**	**1.5**
CO5	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**2.4**
Mean Overall Score											**2.02**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Prasanna

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Functional Analysis

SYLLABUS		
Unit	**Contents**	**Hours**
I	Riesz Theory For Compact Operators: A type of integral equation- Operators of finite rank- Compact operators-* Adjoint of a compact operator*.	**12**
II	Fredholm Operators: Orientation- Further properties- Perturbation theory- Adjoint operator- A special case- Semi-Fredholm operators- Product of operators.	**12**
III	Unbounded operators: Unbounded Fredholm operators- Further properties- Operators with closed ranges- Total subsets-Essential spectrum- *Unbounded semi-Fredholm operators*- Adjoint of a product of operators.	**12**
IV	Selfadjoint Operators: Orthogonal projections- Square roots of operators- A decomposition of operators- Spectral resolution- Some consequences - Unbounded selfadjoint oerators.	**12**
V	Measure of Operators: A seminorm- Perturbation classes- Related measures- Measures of compactness- The quotient space- Strictly singular operators- Norm perturbations- Perturbation functions- Factored perturbation functions.	**12**

…….. Self Study

Text Book:

Martin Schechter, Principles of Functional Analysis, American Mathematical Society, Second Edition ,2009.

UNIT I	Chapter 4	Sec 4.1 to 4.4
UNIT II	Chapter 5	Sec 5.1 to 5.7
UNIT III	Chapter 7	Sec 7.1 to 7.7
UNIT IV	Chapter 13	Sec 13.1 to 13.6
UNIT V	Chapter 14	Sec 14.1 to 14.9

Reference Books:

1. B. V. Limaye, Functional analysis, New Age Int. Publishers, Revised Second Edition,1996.
2. K. Yosida, Functional Analysis, Springer Verlog ,1974.
3. Bela- Bellobas, Linear Algebra, Introductory Course, Cambridge University Press,1990.
.

Web Resources:

1. **https://archive.nptel.ac.in/courses/111/105/111105037/**
2. **https://www.digimat.in/nptel/courses/video/111101005/L01.html**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand and study the concept of Riesz Theory for Compact Operators	**K2**
CO2	apply the concept of Fredholm Operators and Perturbation theory.	**K3**
CO3	analyse unbounded operators and Adjoint of a product of operators.	**K4**
CO4	evaluate the Self-adjoint Operators and properties.	**K5**
CO5	create the concept of measure Of Operators in seminorm and Perturbation	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**2.1**
CO2	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**2.4**
CO3	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**1.8**
CO4	**3**	**-**	**-**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**1.5**
CO5	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**1.8**
Mean Overall Score											**1.92**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Mohamed Ismayil

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Topology

SYLLABUS		
Unit	**Contents**	**Hours**
I	Basis-Subspace -Product topology - *Separation axioms* - Urysohn lemma - Urysohn Metrization theorem.	**12**
II	Connected spaces -Connected sets in the real line -Components and path components-Local connectedness -Compact spaces-*Compact sets in the real line* -Limit point compactness-Local compactness.	**12**
III	Local finiteness -The Nagata Smirnov Metrization theorem (Sufficiency& Necessity)-Paracompactness -The Smirnov Metrization theorem.	**12**
IV	Fundamental group of the circle- Fundamental group of the punctured plane-Fundamental group of S -Fundamental groups of surfaces.	**12**
V	Essential and inessential maps -Fundamental theorem of algebra -Vector fields and fixed points -Homotopy type.	**12**

…….. Self Study

Text Book:

James R.Munkers, Topology A First Course, Prentice Hall of India, 1998.

UNIT I	Chapter 2	Sections 2.2, 2.4, 2.5, 2.8
	Chapter 4	Sections 4.2 to 4.4
UNIT II	Chapter 3	Sections 3.1 to 3.8
UNIT III	Chapter 6	Sections 6.1 to 6.5
UNIT IV	Chapter 8	Sections 8.4 to 8.7
UNIT V	Chapter 8	Sections 8.8 to 8.11

Reference Books:

1. V.Guillemin and A.Pollack, Differential Topology, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1974.
2. Kelley, J.L.General Topology, Van Nostrand Reinhold Co., New York, 1955.

Web Resources:

1. **https://www.youtube.com/watch?v=cuCU1Htkxrw**
2. **https://www.youtube.com/watch?v=KoANvlSdZLI**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concepts of Urysohn lemma and Urysohn metrization theorem.	**K2**
CO2	apply the concepts of connected spaces and compact spaces in real line.	**K3**
CO3	analyse the Nagata Smirnov metrization theorem	**K4**
CO4	evaluate and construct the concept of fundamental group of the circle, punctured plane and surfaces with examples	**K5**
CO5	create the fundamental theorem of algebra and Homotopy type.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**1.8**
CO2	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**1.8**
CO3	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**--**	**-**	**1.2**
CO4	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**2.4**
CO5	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**1.8**
Mean Overall Score											**1.8**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Prasanna

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Intuitionistic Fuzzy Graph

SYLLABUS		
Unit	**Contents**	**Hours**
I	Fuzzy sets and fuzzy set operators – *Fuzzy relations* – Composition of fuzzy relations – Properties of fuzzy relation.	**12**
II	Intuitionistic Fuzzy sets – Properties of Intuitionistic Fuzzy sets – Operations and relations over Intuitionistic Fuzzy sets.	**12**
III	Intuitionistic Fuzzy Graph – Basic Definitions - *Paths and Connectedness* – Intuitionistic Fuzzy Bridge in IFG.	**12**
IV	Operations on Intuitionistic Fuzzy Graph – Complement – Union and Join – Cartesian product and Composition.	**12**
V	Degree of a vertex – Properties of various types of degrees – Order and size of and Intuitionistic Fuzzy Graphs – Complete and Regular Intuitionistic Fuzzy Graphs.	**12**

…….. Self Study

Text Book:

A. Nagoor Gani, V.T. Chandrasekaran, A First Look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd., 2010.

Unit I Chapter 1, Sections 1.1 to 1.5 (Page No. 1 – 19) : T.B - 1

Unit II Krassimir T. Atanassov, “Intuitionistic Fuzzy Sets”, Fuzzy sets and systems 20, p 87-96 1986.

Unit III R. Parvathi and M.G. Karunambigai, “Intuitionistic Fuzzy Graphs”, Computational Intelligence, Theory and Applications ,part 6, 139-150, 2006.

Unit IV R. Parvathi, M.G. Karunambigai and Krassimir T. Atanassov, “Operations on IntuitionisticFuzzyGraphs”, FUZZ- IEEE 2009, Korea, 20-24 ,2009.

Unit V A. Nagoor Gani and S. Shajitha Begum, “Degree, Order and Size in Intuitionistic Fuzzy Graphs”, International Journal of Algorithms, Computing and Mathematics, Volume 3, Number 3, 2010.

Reference Book:

Krassimir T. Atanassov, Intuitionistic fuzzy sets: Theory and Applications, Physica Verlag, 1999.

Web Resources:

1. **https://www.youtube.com/watch?v=XE5JZZX-sXA**
2. **https://www.digimat.in/nptel/courses/video/111106102/L08.html**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concept of fuzzy sets, fuzzy set operators and Fuzzy relations with Properties of fuzzy relation with examples.	**K2**
CO2	apply and illustrate the concepts of intuitionistic fuzzy sets.	**K3**
CO3	discuss and analyse the Intuitionistic fuzzy graph and fuzzy bridge in IFG.	**K4**
CO4	evaluate the concepts on operations on intuitionistic fuzzy graph with examples	**K5**
CO5	create the concept of degree of a vertex and Intuitionistic Fuzzy Graphs – Complete and Regular Intuitionistic Fuzzy Graphs with examples.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO3	**3**	**3**	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**3**	**1.8**
CO4	**-**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**1.5**
CO5	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**2.1**
Mean Overall Score											**2.16**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. S. Shajitha Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Control Theory						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Observability: Linear Systems – Observability Grammian – *Constant coefficient systems* –Reconstruction kernel – Nonlinear Systems.	**12**
II	Controllability: Linear systems – Controllability Grammian – *Adjoint systems* – Constant coefficient systems – steering function – Nonlinear systems.	**12**
III	Stability: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear timevarying systems – Perturbed linear systems – Nonlinear systems.	**12**
IV	Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace –Stabilization with restricted feedback.	**12**
V	Optimalcontrol: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems.	**12**

…….. Self Study

Text Book:

K. Balachandran and J.P.Dauer ,Elements of Control Theory, Narosa, New Delhi, 1999.

UNIT I Chapter 2

UNIT II Chapter 3 Sections 3.1 - 3.3

UNIT III Chapter 4

UNIT IV Chapter 5

UNIT V Chapter 6

Reference Books:

1. R.Conti Linear Differential Equations and Control, Academic Press, London, 1976.
2. R.F.Curtain and A.J.Pritchard Functional Analysis and Modern Applied Mathematics, Academic Press, New York, 1977.
3. J.Klamka,Controllability of Dynamical Systems Kluwer Academic Publisher, Dordrecht, 1991.
4. D.L.Russell, MarcelDekker,Mathematics of Finite Dimensional Control Systems New York, 1979.
5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley,New York, 1967.

Web Resources:

1. **https://www.youtube.com/watch?v=RcuGxWc0HyQ**
2. **https://archive.nptel.ac.in/courses/107/106/107106081/**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concepts of observability.	**K2**
CO2	apply the concept of controllability in linear and non-linear	**K3**
CO3	analyse the concept of asymptotic stability of linear systems and perturbed linear systems with examples.	**K4**
CO4	evaluate the concept of stabilization via linear feedback control and stabilization with restricted feedback.	**K5**
CO5	create the matrix Riccati equation and nonlinear Systems	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**-**	**1.8**
CO2	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**3**	**2.1**
CO3	**3**	**-**	**3**	**-**	**3**	**-**	**3**	**3**	**-**	**3**	**1.8**
CO4	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**1.8**
CO5	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**3**	**-**	**1.5**
Mean Overall Score											**1.8**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. S. Mohamed Yusuff Ansari

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Mathematical Modelling

SYLLABUS		
Unit	**Contents**	**Hours**
I	Regression and model building – Simple linear regression model – *Least squares estimation of the parameters* – Prediction of new observations - Coefficient of determination –Estimation by maximum likelihood.	**12**
II	Multiple regression models – *Estimation of the model parameters*– Hypothesis testing in multiple linear regression – Prediction of new observations – Hidden extrapolation in multiple regression – Standardized regression coefficients.	**12**
III	Residual analysis – The PRESS statistics – Detection and treatment of outliers – Lack of fit of the regression model – Variance-Stabilizing transformations – Transformation to linearize the model – Analytical methods of selecting a transformation – Generalized and weighted least squares.	**12**
IV	Importance of detecting influential observations – Leverage – Measures of influence: Cook's D and DFFITS AND DFBETAS – A measure of model performance – Detecting groups of influential observations – Treatment of influential observations – Polynomial models in one variable –Nonparametric regression – Polynomial models in two or more variables.	**12**
V	Computational techniques for variable selection – Validation techniques– Data from planned experiments – Linear and nonlinear regression model – Nonlinear least squares –Transformation to a linear model – Parameter estimation in a nonlinear system – Statistical inference in nonlinear regression.	**12**

…….. Self Study

Text Book:

Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, "INTRODUCTION TO LINEAR REGRESSION ANALYSIS", Wiley Interscience Publication, fifth edition, 2004.

UNIT I	Chapter 1	Section 1.1
	Chapter 2	Section 2.1, 2.2, 2.5, 2.6, 2.11
UNIT II	Chapter 3	Sections 3.1, 3.2, 3.3, 3.5, 3.8, 3.9
UNIT III	Chapter 4	Sections 4.2, 4.3, 4.4, 4.5
	Chapter 5	Sections 5.2, 5.3, 5.4, 5.5
UNIT IV	Chapter 6	Sections 6.1, 6.2, 6.3, 6.4, 6.5
	Chapter 7	Sections 7.2, 7.3, 7.4
UNIT V	Chapter 10	Sections 10.2;
	Chapter 11	Sections 11.2, 11.3
	Chapter 12	Sections 12.1, 12.3, 12.4, 12.5, 12.6

Reference Books:

1. Damodar N. Gujarati and Sangeetha, "BASIC ECONOMETRICS", fourth edition, Tata Mc Graw Hill Edition 2007.

2. William H. Greene, "ECONOMETRIC ANALYSIS", , Pearson Education Pte. Ltd., Delhi, fifth edition 2005.
Web Resources:
1. **https://www.digimat.in/nptel/courses/video/111107113/L01.html** 2.**https://www.digimat.in/nptel/courses/video/111107113/L19.html**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	discuss and understand the technique of linear regression model.	**K2**
CO2	apply the multiple linear regression model to find the solutions.	**K3**
CO3	analyze the model adequacy checking and correct the model.	**K4**
CO4	evaluate the diagnostics for leverage & influence for the polynomial regression model	**K5**
CO5	create the solution of real life problem using nonlinear regression model.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**3**	**3**	**-**	**1.2**
CO4	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**3**	**2.4**
CO5	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
Mean Overall Score											**2.28**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. U. Abuthahir

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Fixed Point Theory						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Banach's contraction principle – *Further extensions*- Caristi – Ekeland principle - Equivalance of Caristi- principles.	**12**
II	Tarsiki's Fixed-point theorem - Hyperconvex spaces – Properties – *fixed-point theorems *– intersection of hyper convex spaces – Isbell's convex hull.	**12**
III	Uniformly convex Banach spaces – Fixed-point theorem of Browder, Gohde and Kirk. Reflexive Banach spaces –Normal structure- Fixed point theorems.	**12**
IV	Generalized Banach Fixed-point theorem- Upper and lower semi continuity of multivalued maps –Generalized Schauder Fixed point theorem – Variational Inequalities and the Browder Fixed-Point theorem – Extremal Principle – Applications to Game Theory – Michael's selection theorem	**12**
V	Fixed point theorem for continuous functions- Brouwer's theorem -Schauder's theorem - applications - Hairy ball theorem - pancake problems- Kyfan's best approximation theorem.	**12**

…….. Self Study

Text Books:

1. M. A. Khamsi& W. A. Kirk, An introduction of Metric spaces and Fixed point theory, John
2. Wiley & sons, 2001.
3. E. Zeidler, Nonlinear Functional Analysis and its applications, Vol. I Springer – Verlag New York ,1986.

UNIT – I	Chapter 3	Sections 3.1 - 3.4	**T.B-1**
UNIT – II	Chapter 4		**T.B-1**
UNIT – III	Chapter 5	Sections 5.1 -5.4	**T.B-1**
	Chapter 10	Section 10.1 -10.3	**T.B-2**
UNIT – IV	Chapter 9		**T.B-2**
UNIT – V	Chapter 2		**T.B-2**

Reference Books:

1. D.R. Smart, Fixed point theory, Cambridge University Press, 1974.
2. V.I. Istratescu, Fixed point theory, D. ReidelPublsihing Company, Boston ,1979.

Web Resources:

1. **https://www.digimat.in/nptel/courses/video/111108081/L21.html**
2. **https://www.youtube.com/watch?v=s02PzP0ECNA**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the study of fixed point theory helps to solve problems which are theoretical as well as practical and Realize contraction, contractive maps have elegant results on the existence and uniqueness of fixed points.	**K2**
CO2	apply the properties of fixed points through the theory of non-expansive fixed point theorems and understand the geometry of the spaces involved.	**K3**
CO3	analyse the generalizations of Brouwer's fixed point theorem, viz., Schauder and the use of it in analysis and differential equations.	**K4**
CO4	evaluate the ideas behind Applications to Michael's selection theorem.	**K5**
CO5	create the Kyfan's best approximation theorem and its consequences and Application to Pancake problems.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**2.1**
CO3	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**-**	**2.1**
CO4	**3**	**-**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**2.4**
CO5	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**2.4**
Mean Overall Score											**2.4**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. R. Jahir Hussain

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100
Course Title	Fuzzy Probability						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Fuzzy Sets: Introduction – Fuzzy sets – Fuzzy Arithmetic – Fuzzy Functions – Finding a minimum of a Fuzzy Number – *Ordering Fuzzy Numbers* – Fuzzy Probabilities – Fuzzy Numbers from Confidence intervals – Computing Fuzzy Probabilities.	**12**
II	Fuzzy Probability Theory: Introduction–* Fuzzy Probability* – Fuzzy conditional Probability – Fuzzy Independence – Fuzzy Bayes' Formula – Applications.	**12**
III	Discrete & Continuous Fuzzy Random Variables: Introduction – Fuzzy Binomial – Fuzzy Poisson – Applications – Fuzzy Uniform – Fuzzy Normal – Fuzzy Negative Exponential – Applications.	**12**
IV	Joint Fuzzy Probability Distributions & Fuzzy Random Variables: Introduction – Continuous Case – Political Polls – Fuzzy Reliability Theory – Discrete Fuzzy Random Variables – Continuous Fuzzy Random Variables – One-to-One Transformation – Other Transformations.	**12**
V	Fuzzy Queuing Theory & Fuzzy Markov Chains: Introduction – Regular, Finite, Markov Chains – Fuzzy Queuing Theory – Applications – Regular Markov Chains – Absorbing Markov Chains – Applications: Decision Model.	**12**

…….. Self Study

Text Book:

James J. Bucklaey, Fuzzy Probabilities New Approach and Applications, Springer, 2005.

Reference Books:

1. James J. Bucklaey, Fuzzy Probability and Statistics, Springer, The Netherlands 2006.
2.ReinhardViertl, Statistical Methods for Fuzzy Data, John Wiley & Sons. Ltd., 2011.

Web Resources:

1.**https://www.youtube.com/watch?v=RXThpkgba7w**
2.**https://www.youtube.com/watch?v=ks5-9i2fI6g**

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concept of fuzzy set, fuzzy arithmetic and fuzzy functions with the examples.	**K2**
CO2	apply the domain knowledge for fuzzy probabilities and study fuzzy baye's formula.	**K3**
CO3	analyse and classify the discrete and continuous fuzzy random variables with illustrate the examples.	**K4**
CO4	evaluate the ideas behind Political Polls and Fuzzy Reliability Theory with the examples.	**K5**
CO5	create and discuss fuzzy queuing process and fuzzy markov chains.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**-**	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**2.1**
CO2	**3**	**3**	**3**	**-**	**3**	**3**	**-**	**3**	**-**	**3**	**2.1**
CO3	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**1.5**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**3**	**2.4**
CO5	**3**	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**2.4**
Mean Overall Score											**2.1**
Correlation											**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. A. Prasanna

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23MPMA1CC4	CORE – IV	4	4	25	75	100

Course Title	Algorithmic Graph Theory

SYLLABUS

Unit	Contents	Hours
I	Graph Theoretic Foundations: Basic Definitions and Notations - Intersection Graphs-*Interval Graphs* - A Sneak Preview of the Notions Coming Up. The Design of Efficient Algorithms: The Complexity of Computer Algorithms- Data Structures- How to Explore a Graph -Transitive Tournaments and Topological Sorting.	12
II	Perfect Graphs: The perfect graphs theorem – P-critical and partitionable graphs – A polyhedral characterization of perfect graphs and P-critical graphs – the strong perfect graph conjecture and recent theorem.	12
III	Triangulated Graphs: Introduction - Characterizing Triangulated Graphs - *Recognizing Triangulated Graphs by Lexicographic Breadth*-First Search- The Complexity of Recognizing Triangulated Graphs-Triangulated Graphs as Intersection Graphs-Triangulated Graphs Are Perfect-Fast Algorithms for the COLORING, CLIQUE, STABLE SET, and CLIQUE-COVER Problems on Triangulated Graphs.	12
IV	Comparability Graphs: Γ-Chains and Implication Classes – Uniquely Partially Orderable Graphs – The Number of Transitive Orientations – Schemes and G-Decompositions—An Algorithm for Assigning Transitive Orientations – The Γ^*Matroid of a Graph – The Complexity of Comparability Graph Recognition - Coloring and Other Problems on Comparability Graphs - The Dimension of Partial Orders.	12
V	Split Graphs: Introduction - Characterizing Split Graphs – Degree Sequences and Split Graphs. Permutation Graphs: Introduction– Characterizing Permutation Graphs – Permutation Labelings- Applications - Sorting a Permutation Using Queues in Parallel. Interval Graphs: Some Characterizations of Interval Graphs - The Complexity of Consecutive 1's Testing - Applications of Interval Graphs - Preference and Indifference – Circular Arc Graphs.	12

…….. Self Study

Text Books:

Martin Charles Golumbic, Algorithmic Graph Theory and Perfect graphs, Elsevier Publication, Edition 2004.

Unit I Chapters 1 and 2
Unit II Chapter 3
Unit III Chapter 4
Unit IV Chapter 5
Unit V Chapters 6, 7 and 8

Reference Books:

1.Alan Gibbons, Algorithmic Graph theory, Cambridge University Press, 1985.
2. Martin Charles Golumbic, Algorithmic Graph theory and its applications, 2003.

Web Resources:

1.https://onlinecourses.nptel.ac.in/noc22_cs17/preview
2.https://nptel.ac.in/courses/106104170

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the basic concepts of Graph theory and design of efficient algorithms.	**K2**
CO2	apply and illustrate the algorithms for characterizing the Perfect graphs.	**K3**
CO3	analyse algorithms for coloring, clique, stable set and clique-cover problems.	**K4**
CO4	evaluate the algorithms for coloring and maximum weighted clique of comparability graphs.	**K5**
CO5	create the algorithms for characterizing the Split graphs, Permutation graphs and Interval graphs.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**-**	**3**	**-**	**3**	**-**	**3**	**3**	**-**	**-**	**3**	**1.5**
CO2	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**3**	**2.7**
CO4	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
CO5	**3**	**-**	**3**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2.4**
										Mean Overall Score	**2.34**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:
Dr. S. Mohamed Yusuff Ansari