E.M.G. YADAVA WOMEN'S COLLEGE, MADURAI – 625 014.

(*An Autonomous Institution – Affiliated to Madurai Kamaraj University*)

Re-accredited **(3rd Cycle)** with Grade **A+** & **CGPA 3.51** by NAAC

DEPARTMENT OF MATHEMATICS

TANSCHE-CBCS with OBE

MASTER OF SCIENCE

PROGRAMME CODE - PM

COURSE STRUCTURE

(w.e.f. 2023– 2024 Batch onwards)

Annexure -1

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DEPARTMENT OF MATHEMATICS- PG

(w.e.f. 2023 – 2024 Batch onwards)

COURSE STRUCTURE

TANSCHE-CBCS with OBE

Sem	Part	Subject Code	Title of the Course	Teaching Hours (per Week)	Duration of Exam hrs.	Marks Allotted			Credits
						CIA	SE	Total	
I	III	**23OPMA11**	**Core I:** Algebraic Structures	7	3	25	75	100	5
		23OPMA12	**Core II:** Real Analysis I	7	3	25	75	100	5
		23OPMA13	**Core III:** Ordinary Differential Equations	6	3	25	75	100	4
			DSEC I	5	3	25	75	100	3
			DSEC II	5	3	25	75	100	3
II	III	**23OPMA21**	**Core IV :** Advanced Algebra	6	3	25	75	100	5
		23OPMA22	**Core V:** Real Analysis II	6	3	25	75	100	5
		23OPMA23	**Core VI:** Partial Differential Equations	6	3	25	75	100	4
			DSEC III	5	3	25	75	100	3
			DSEC IV	5	3	25	75	100	3
	IV	**23OPMASEC2**	**SEC I :** Office Automation and ICT Tools	2	3	25	75	100	2
III	III	**23OPMA31**	**Core VII:** Complex Analysis	6	3	25	75	100	5
		23OPMA32	**Core VIII:** Probability Theory	6	3	25	75	100	5
		23OPMA33	**Core IX:** Topology	6	3	25	75	100	5
		23OPMA34	**Core X(IM):** Linear Algebra	6	3	25	75	100	4
			DSEC V	4	3	25	75	100	3
	IV	**23OPMASEC3P**	**SEC II:** Mathematical Documentation Using Latex	2	3	40	60	100	2
		23OPMAIN3	Internship / Industrial Activity						2
IV	III	**23OPMA41**	**Core XI :** Functional Analysis	6	3	25	75	100	5
		23OPMA42	**Core XII:** Differential Geometry	6	3	25	75	100	5
		23OPMAPR4	Project	10	3	20	80	100	7
			DSEC VI	4	3	25	75	100	3
	IV	**23OPMASEC4**	**SEC III :** Mathematics for NET/UGC-CSIR/SET/ TRB Competitive Examination	4	3	25	75	100	2
	V	**23OP5EA4**	Extension Activity						1
TOTAL									**91**

IM - Industry Modules

DSEC - Discipline Specific Elective Course

SEC - Skill Enhancement Course

Semester I : Elective I and Elective II

DSEC - I (Choose any one)

1. Number theory and Cryptography -23OPMADSE1A
2. Graph Theory and Applications – 23OPMADSE1B

DSEC -II

1. Mathematical Programming – 23OPMADSE1C
2. Fuzzy Sets and their Applications- 23OPMADSE1D

Semester II: Elective III and Elective IV

DSEC- III

1. Modeling and Simulation with Excel -23OPMADSE2A
2. Fluid Dynamics – 23OPMADSE2B

DSEC –IV

1. Mathematical Statistics – 23OPMADSE2C
2. Stochastic Process- 23OPMADSE2D

Semester – III Elective V and Elective VI

DSEC – V (Choose any one)

1. Resource Management Techniques - 23OPMADSE3A
2. Stochastic Process - 23OPMADSE3B

Semester – IV

DSEC – VI (Choose any one)

1. Mathematical Python - 23OPMADSE4A
2. Discrete Mathematics - 23OPMADSE4B

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Core	23OPMA31	Complex Analysis	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. To learn Cauchy's Integral Formula
2. To Study the Chains, cycles and The General statement of Cauchy's Theorem
3. To Evaluate the Definite Integrals and Harmonic Functions
4. To Describe the Power Series Expansions
5. To learn Partial Fractions and Entire Functions

Course Content:

Unit	Course Content	90Hours	K Level	CLO
I	**Cauchy's Integral Formula:** The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions :Removable Singularities- Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.	18	Up to K4	CLO 1
II	**The general form of Cauchy's Theorem :** Chains and cycles- Simple Connectivity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.	18	Up to K4	CLO 2
III	**Evaluation of Definite Integrals and Harmonic Functions** Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.	18	Up to K4	CLO 3
IV	**Harmonic Functions and Power Series Expansions:** Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .	18	Up to K5	CLO 4
V	**Partial Fractions and Entire Functions:** Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem	18	Up to K5	CLO 5

Book for study:

Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979

Chapters:

Unit	Chapters	Sections
I	4	Section 2 : 2.1 to 2.3 Section 3 : 3.1 to 3.4
II	4	Section 4 : 4.1 to 4.7 Section 5: 5.1 and 5.2
III	4	Section 5 : 5.3 Section 6 : 6.1 to 6.3
IV	4,5	Section 6: 6.4 and 6.5 Section1: 1.1 to 1.3
V	5	Section:2 :2.1 to 2.4 Section:3 :3.1 and 3.2

Books for Reference:

1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, *Analytic function Theory*(2 vols.), Gonm & Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.

Web Resources:

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for nature of Course:

Knowledge and Skill:

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill

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Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works. We also guide them to refer books and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Analyze and evaluate local properties of analytical functions and definite integrals.	Up to K4
CO2	Describe the concept of definite integral and harmonic functions.	Up to K4
CO3	Demonstrate the concept of the general form of Cauchy's theorem	Up to K4
CO4	Develop Taylor and Laurent series .	Up to K5
CO5	Explain the infinite products, canonical products and Jensen's formula .	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	1	3	3
CLO2	3	1	3	2	3	3
CLO3	2	1	3	1	3	3
CLO4	3	2	3	1	3	3
CLO5	1	2	3	2	3	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Annexure -1

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	The Index of a point with respect to a closed curve, The Integral formula, Higher derivatives. Local Properties of analytical Functions	9	18	Chalk & Talk
	Removable Singularities, Taylors's Theorem , Zeros and poles , The local Mapping , The Maximum Principle	9		
II	Chains and cycles, Simple Continuity , Homology , The General statement of Cauchy's Theorem , Proof of Cauchy's theorem .	9	18	Chalk & Talk
	Locally exact differentials, Multiply connected regions , Residue theorem , The argument principle.	9		
III	Evaluation of definite integrals , Definition of Harmonic function and basic properties .	9	18	PowerPoint Presentation & Seminar
	Mean value property , Poisson formula.	9		
IV	Schwarz theorem ,The reflection principle .	9	18	PowerPoint Presentation, Seminar, Assignment
	Weierstrass theorem , Taylor's Series	5		
	Laurent series .	4		
V	Partial fractions , Infinite products Canonical products ,Gamma Function.	9	18	PowerPoint Presentation & Seminar
	Jensen's formula ,Hadamard's Theorem	9		
		Total	**90**	

Course Designer: S.Selvi

Annexure -1

Department of Mathematics						I M.Sc.,		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Core	23OPMA32	Probability Theory	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. To introduce the axiomatic approach of probability theory, some statistical characteristics, discrete and continuous distribution functions and their properties,
2. To learn more about the characteristic function and basic limit theorems of Probability

Course Content:

Unit	Course Content	90 Hours	K Level	CLO
I	**UNIT-I : Random Events and Random Variables:** Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.	18	Up toK4	CLO1
II	**UNIT-II : Parameters of the Distribution :** Expectation-Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.	18	Up toK4	CLO2
III	**UNIT-III: Characteristic functions :** Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions	18	Up toK4	CLO3
IV	**UNIT-IV : Some Probability distributions:** One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.	18	Up toK5	CLO4
V	**UNIT-V: Limit Theorems :** Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem –Lindberg Theorem – Lapunov Theroem- Poisson, Chebyshev, Khintchine law of large numbers – Strong Law of large numbers	18	Up toK5	CLO5

Annexure -1

Book for study:

1.M. Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons, New York, 1963

Chapter:

UNIT	CHAPTER(S)	SECTIONS
I	1&2	1.1 to 1.7 & 2.1 to 2.9
II	3	3.1 to 3.8
III	4	4.1 to 4.7
IV	5	5.1 to 5.10
V	6	6.1 to 6.4,6.6 to 6.9, 6.11 & 6.12

Books for Reference:

1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3. R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996.
4. V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi,1988(3rd Print).
5. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.
6. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

Web Resources:

1.http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
2.http://www.opensource.org, http://www.probability.net

Pedagogy:

- Chalk and Talk, Powerpoint presentations, Group Discussions, Quiz, Assignment and Seminar

Rationale for nature of Course:

Knowledge and Skill:

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works.We also guide them to refer books and web resources.

Annexure -1

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

CO	Course learning outcome	K-level
CO1	Identify the concept of Random Events and Random Variables	Upto K4
CO2	Analyze the concept of Distribution	Upto K4
CO3	Understand and describe the basic concept of Characteristic Functions	Upto K4
CO4	Understand the concept of Probability Distribution	Upto K5
CO5	Understand the concept of Limit Theorems	Upto K5

K1- Remembering facts with specific answers
K2- Basic understanding of facts.
K3- Application oriented
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	1	3	3
CLO2	3	3	2	2	1	3
CLO3	3	3	2	2	2	3
CLO4	3	2	2	2	1	3
CLO5	3	3	2	2	1	3

1-Basic Level 2- Intermediate Level 3- Advanced Level

Annexure -1

Lesson Plan

Unit	Description	Hours		Mode
I	Random Events	6	18	Lecture,Quiz.
	Random Variables	6		
	Fuctions of Random Variable	6		
II	Parameters of Distribution	6	18	Lecture , Quiz.
	The Chebyshev Inequality	6		
	Regression of the first and second types	6		
III	Properties of Characteristic functions	6	18	PPT, Lecture,Quiz
	Determination of distribution function by the Characteristic function	6		
	Probability generarating fuctions	6		
IV	Some Probability Distribution	6	18	PPT, Lecture ,Quiz.
	Poisson (discrete) Diistribution	6		
	Cauchy and Laplace (Continuous) Distrubution	6		
V	Limit Theorems	6	18	Assignments and Seminar
	Levy Cramer Theorems,Demoivre -Laplace Theorem	6		
	Khintchine law of large numbers – Strong Law of large numbers	6		
	Total		**90**	

Course Designer:Mrs.T.Thivya

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Core	23OPMA33	Topology	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1.To introduce the fundamental ideas of topological spaces.

2.To construct a continuous function and the concepts of connectedness

3.To study the concept of compactness, apply the techniques of count ability axioms and Urysohn lemma.

Course Content:

Unit	Course Content	Hours	K Level	CLO
I	**Topological Spaces:** Topological Spaces - Basis for a Topology – The Order Topology – The Product Topology on X x Y – The Subspace Topology – Closed Sets and Limit Points.	18	Up to K4	CLO 1
II	**Continuous Functions:** Continuous Functions – The Product Topology – The Metric Topology.	18	Up to K4	CLO 2
III	**Connectedness:** Connected Spaces – Connected Subspaces of the Real Line ,Components and local connectedness.	18	Up to K4	CLO 3
IV	**Compactness**: Compact Spaces – Compact Subspaces of the Real Line – Limit Point Compactness.	18	Up to K5	CLO 4
V	**Countability and Separation Axioms:** The Countability Axioms – The Separation Axioms – Normal Spaces -The Urysohn Lemma – The Urysohn Metrization Theorem.	18	Up to K5	CLO 5

Book for study:

James R. Munkres, *Topology* – Second Edition, Prentice- Hall of India Private Limited, 2011.

Chapters:

Unit	Chapters	Sections
I	2	12 to 17
II	2	18 to 20
III	3	23 to 25
IV	3	26 to 28
V	4	30 to 34

Books for Reference:

1. Colin Adams, Robert Franzosa, *"Introduction to Topology*, *Pure and Applied* " Published by Dorling Kindersley Pvt.,Ltd, 2009.
2. Khanna M.L, "*Topology,"* 8th Edition, Jai Prakash Nath & Co.,Merrut,1995.
3. Simmons G.F, "*Introduction to Topology and Modern Analysis,"* Tata Graw Hill Education Pvt.,Ltd-2010.
4. Fred H.Croom, "*Principles of Topology,"* Cengage India Pvt Ltd, New Delhi (2009)
5. Seymour Lipschutz, *"Theory and Problems of General Topology*", McGraw-Hill Edition, New Delhi (2006)

Web Resources:

1. https://postgis.net/docs/Topology.html
2. https://www.maths.ed.ac.uk/~v1ranick/papers/seifthreng.pdf

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar

Rationale for nature of Course:

Knowledge and Skill:

Demonstrate an understanding of the concepts of metric space and topological spaces and pure basic results about completeness, compactness and connectedness within their structure.

Activities to be given:

We assign intellectual problems for solving and train them to refer e books and other web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

Annexure -1

COs	Course Outcomes	K-level
CO1	Understand topological space	Up to K4
CO2	Analyze continuous functions and Product Topology	Up to K4
CO3	Identify the connected topological spaces	Up to K4
CO4	To be able to understand the concept of compactness and limit point compactness	Up to K5
CO5	To know about countability axioms and Urysohn lemma	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	1	3	3
CLO2	3	3	2	2	1	3
CLO3	3	3	2	2	2	3
CLO4	3	2	2	2	1	3
CLO5	3	3	2	2	1	3

1.Basic level 2. Intermediate level 3. Advanced level

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	Topological Spaces , Basis for a Topology , The Order Topology	9	18	Chalk & Talk
	The Product Topology on X x Y , The Subspace Topology , Closed Sets and Limit Points .	9		Chalk & Talk
II	Continuous Functions , The Product Topology	9	18	Chalk & Talk
	The Metric Topology	9		Chalk & Talk
III	Connected Spaces	9	18	Chalk & Talk
	Connected Subspaces of the Real Line.	9		Seminar
IV	Compact Spaces, Compact Subspaces of the Real Line	9	18	Chalk & Talk Seminar
	Limit Point Compactness.	9		Chalk & Talk Seminar
V	The Countability Axioms , The Separation Axioms, Normal Spaces,	9	18	Chalk & Talk Seminar
	The Urysohn Lemma , The Urysohn Metrization Theorem.	9		Lecture, Quiz
Total			**90**	

Course Designer: Dr.Mrs.G.Alarmelu Mangai

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Core	23OPMA34	Linear Algebra	4	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. To study the subspaces and Linear Transformations.
2. To understand the inner Product spaces and Orthonormal set
3. To acquire the knowledge of Eigen Values and Eigen Vectors

Unit	Course Content	Hours	K Level	CLO
I	**Unit I: Vector Spaces :** Sub spaces –Algebra of Subspaces-Quotient Spaces – Linear spans- Row and Columns spaces of a matrix .	18	Up to K4	CLO 1
II	**Unit II: Linear Transformation :** Definitions and examples-Some basic properties of Linear Transformation-Matrices as linear transformation-Rank and Nullity of Linear Transformation	18	Up to K4	CLO 2
III	**Unit III: Linear Transformation:** Singular and non-singular Linear Transformation-Invertible Linear Transformation –Dual Spaces	18	Up to K4	CLO 3
IV	**Unit IV: Unitary Spaces:** Unitary spaces-Norm of a vector-Orthogonality and Orthonormality – Hernitian Inner Products and Matrices	18	Up to K5	CLO 4
V	**Unit V: Bilinear and Quadratic Form:** Bilinear Form – Bilinear Forms and Matrices – Change of basis-Rank of Bilinear Form-symmetric and skew symmetric bilinear forms	18	Up to K5	CLO 5

Book for study:

R.D Sharma .Ritu Jain., "*Theory and Problems of Linear Algebra*",
I.K .International Publication House Private Limited, New Delhi and Bangalore.

Chapters:

Unit	Chapters	Sections
I	2	2.4,2.4.1, 2.5,2.7,2.7.1
II	3	3.2 ,3.3, 3.3.1,3.5
III	3	3.8, 3.9,3.10
IV	8	8.2 ,8.3, 8.4,8.5
V	10	10.2, 10.4,10.4.1, 10.4.2, 10.5

Books for Reference:

1. Herstein. N.,(1975), *Topics in Algebra*, Wiley Eastern Limited, New Delhi.
2. David C.Lay, (2005), *Linear Algebra and its Applications*, Pearson Education Pvt.Ltd, India, Third Edition, Fifth Indian Reprint.
3. Jacobson.N., (1980), Basic Algebra, Vols. I&II, Freeman, Hindustan Publishing Company, New Delhi.
4. Kenneth Hoffman and Ray Kunze, (2011), Linear Algebra, Prentice – Hall of India Private Limited, New Delhi, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/111/106/11110651/
2. https://nrich.maths.org/1422
3. https://www.math.brown.edu/dabramov/MA/f1314/251/Zijian-notes.pdf

Pedagogy:

Chalk and talk, Power point presentation, Group Discussion, Quiz, Assignment and Seminar

Rationale for nature of Course:

Knowledge and Skill:

1. Demonstrate accurate and efficient use of linear algebra techniques as they relate to the concepts like linear transformation, polynomial etc.,
2. Apply problem solving using linear algebra techniques applied to diverse situations in physics, computer science and other mathematical contexts.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussions and other practical works and also insists them to check the reference books and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Apply the concepts of vector spaces and linear transformations.	Up to K4
CO2	Analyze the linear dependence and linear independence of vector spaces and inner product.	Up to K4
CO3	Analyze the algebra of linear transformations and matrix of a linear transformation.	Up to K4
CO4	Categorize the characteristic polynomials and minimal polynomials.	Up to K5
CO5	Demonstrate the primary decomposition and Projections.	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	3	3	3
CLO2	2	2	1	3	3	3
CLO3	3	3	2	2	1	3
CLO4	3	3	2	2	1	3
CLO5	2	2	2	3	3	3

1.Basic level 2. Intermediate level 3. Advanced level

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	**Vector Spaces :** Sub spaces –Algebra of Subspaces-Quotient Spaces – Linear spans-Row and Columns spaces of a matrix .	6	18	Chalk and talk
	Quotient Spaces	6		
	Linear spans- Row and Columns spaces of a matrix	6		
II	Definitions and examples-Some basic properties of Linear Transformation	6	18	Chalk and talk
	Matrices as linear transformation	6		
	Rank and Nullity of Linear Transformation	6		
III	. **Linear Transformation:** Singular and non-singular Linear Transformation	6	18	Chalk and talk
	Invertible Linear Transformation	6		
	Dual Spaces	6		
IV	**Unitary Spaces:** Unitary spaces	6	18	Chalk and talk, Power point presentation
	Norm of a vector-Orthogonality and Orthonormality	6		
	Hernitian Inner Products and Matrices	6		
V	**Bilinear and Quadratic Form:** Bilinear Form – Bilinear Forms and Matrices – Change of basis-Rank of Bilinear Form-symmetric and skew symmetric bilinear forms	6	18	Chalk and talk, Power point presentation
	Change of basis-Rank of Bilinear Form	6		
	symmetric and skew symmetric bilinear forms	6		
		Total	**90**	

Course Designer:Mrs.R.Shanmugam

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Elective V	23OPMADSE3A	Resource Management Techniques	3	4	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objective: To enable the students to become aware of and appreciate the potential of the theory of optimization and to introduce various decision making tools and techniques based on optimization.

.**Course Content:**

Unit	Course Content	Hours	K Level	CLO
I	**Revised Simplex Method** Introduction, Standard forms for Revised Simplex Method, Computational Procedure for Standard Form I, Comparison of Simplex Method and Revised Simplex Method.	12	Up to K4	CLO 1
II	**Integer Linear Programming** Introduction, Types of Integer Programming Problems, Enumeration and Cutting Plane Solution Concept, Gomory's All Integer Cutting Plane Method , Branch and Bound Method.	12	Up to K4	CLO 2
III	**Dynamic Programming** Introduction, Dynamic Programming Terminology, Developing Optimal Decision Policy, Dynamic Programming Under Certainty,	12	Up to K4	CLO 3
IV	**Deterministic Inventory Control Model** Introduction, The Meaning of Inventory Control, Functional Role of Inventory, Reasons of Carrying Inventory, Factors Involved in Inventory Problem Analysis, Inventory Model building, Inventory Control Models without Shortage,	12	Up to K5	CLO 4
V	**Sequencing Problem** Introduction – Notations, Terminology and Assumptions-Processing n jobs through Two machine- Processing n jobs through Three machine- Processing n jobs through m machine.	12	Up to K5	CLO 5

Book for study: J.K. Sharma, *Operations Research Theory and Applications*, Second Edition, Macmillan (India) New Delhi 2005

Chapters:

Unit	Chapter	Sections
I	26	26.1 to 26.4
II	7	7.1, to 7.4 & 7.6
III	22	22.1 to 22.4
IV	14	14.1 to 14.7
V	20	20.1 to 20.5

Books for Reference:

1.J. Lieberman, F.S. Hiller, *Introduction to Operations Research*, 7th Edition, Tata- McGraw Hill Company, New Delhi, 2001.

2.Kanti Swarup, Manmohan, P.K. Gupta,*Operations Research*, , Sultan & Chand Publications, 2003.

3.Hamdy A. Taha, *Operations Research*, , (Edition 7), Prentice - Hall of India

Private Limited, New Delhi, 1997.

Web Resources:

1. https://web.mit.edu/15.053/www/AppliedMathematicalProgramming.pdf
2. http://www.dl.behinehyab.com/Ebooks/LP/LP015_800845_www.behinehyab.com.pdf
3. https://coral.ise.lehigh.edu/~ted/teaching/ie406/

Pedagogy: Chalk and talk, Power Point Presentation, Group Discussion

Rationale for nature of Course:

Knowledge and Skill:

This Course deals with the Revised Simplex Methods and relate the Integer Linear programming and Dynamic Programming Problems. It also focuses on Deterministic Inventory Control Model and Sequencing Problem

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussions and other practical works and also insists them to check the reference books and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Understand the Standard forms for Simplex Method	Up to K4
CO2	Analyze the Integer Linear Programming Problems,	Up to K4
CO3	Describe Dynamic Programming Terminology,	Up to K4
CO4	Understand the deterministic inventory control model	Up to K5
CO5	Analyze sequencing problem	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	2	3	3	2
CLO2	3	3	2	3	3	3
CLO3	1	2	2	3	3	3
CLO4	2	2	3	3	2	3
CLO5	2	2	3	2	2	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	Introduction, Standard forms for Revised Simplex Method, Computational Procedure for Standard Form I,	**4**	**12**	Chalk and talk, Power Point Presentation
	Comparison of Simplex	**4**		
	Method and Revised Simplex Method.	**4**		
II	Introduction, Types of Integer Linear Programming Problems, ,	**4**	**12**	Chalk and talk, Power Point Presentation
	Enumeration and Cutting Plane Solution Concept	**4**		
	Gomory's All Integer Cutting Plane Method , Branch and Bound Method.-	**4**		
III	Introduction, Dynamic Programming Terminology,	**4**	**12**	Chalk and talk, Power Point Presentation
	Developing Optimal Decision Policy,	**4**		
	Dynamic Programming Under Certainty,	**4**		
IV	Introduction, The Meaning of Inventory Control, Functional Role of Inventory,	**4**	**12**	Chalk and talk, Power Point Presentation
	Reasons of Carrying Inventory, Factors Involved in Inventory Problem Analysis,	**4**		
	Inventory Model building, Inventory Control Models without Shortage,	**4**		
V	Introduction – Notations, Terminalogy and Assumptions.	**4**	**12**	Chalk and talk, Power Point Presentation
	Processing n jobs through Two machine- Processing n jobs through Three machine.	**4**		
	Processing n jobs through m machine.	**4**		
		Total	**60**	

Course Designer :Dr.Mrs.R.Mangayarkarasi

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	Elective	23OPMADSE3B	Stochastic Processes	3	4	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. Acquire intense Knowledge on the underlying concepts of stochastic processes.
2. Familiarize with Markov chain and system.
3. Obtain in-depth understanding of birth and death process.
4. Develop the acquaintance with applications of Markov process.
5. Gain understanding the knowledge of renewal process and theory.

Course Content:

Unit	Course Content	Hours	K Level	CLO
I	Stochastic Processes Introduction - Specification of Stochastic Processes – Stationary Processes –Martingales. Markov Chains: Definitions and Examples – Higher Transition Probabilities – Generalization of independent Bernoulli trials: Sequence of Chain-Dependent Trials	**12**	Up to K4	CLO 1
II	Markov Chains Stability of Markov System – Graph Theoretic Approach – Markov Chain with Denumerable Number of States – Reducible Chains – Statistical Inference for Markov Chains.	**12**	Up to K4	CLO 2
III	Markov Process with discrete state space Poisson Process: Poisson Process and Related Distributions – Generalizations of Poisson Process – Birth and death Process – Markov Process with Discrete S tate Space (Continuous time Markov chains).	**12**	Up to K4	CLO 3
IV	Markov Process with continuous state space Introduction: Brownian M otion – Weiner P rocess – Differential E quations for Weiner Process – Kolmogorov Equations – First Passage Time Distribution for Weiner Process.	**12**	Up to K5	CLO 4
V	Renewal Process and Theory Renewal Process and Renewal Equation – Stopping Time – Wald's Equation – Renewal theorems – Delayed and Equilibrium Renewal Process.	**12**	Up to K5	CLO 5

Book for study:

J. Medhi, Stochastic Processes (2nd Edition), New Age International, 1992.

Chapters:

Unit	Chapters	Sections
I	2,3	2.1 to 2.4 and 3.1 to 3.3
II	3	3.6 to 3.10
III	4	4.1 to 4.5
IV	5	5.1 to 5.5
V	6	6.1 to 6.6

Books for Reference:

1.S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press,1958.
2.U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972.
3.E. Cinlar, Introduction to Stochastic Processes, PHI, 1975
4.S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa, 2003.

Web Resources:

1. **https://z-lib.io/author/J.%20Medhi**
2. **https://youtu.be/i3AkTO9HLXo?si=SY8edeQBbh0v2x67**
3. **https://youtu.be/MSBxSxap7_U?si=ASFFypcNG-x7lJAk**

Pedagogy:

Chalk and Talk, Power Point Presentation, Group Discussion.

Rationale for nature of Course:

Knowledge and Skill:

The purpose of this course is to equip students with theoretical knowledge and practical skill which are necessary for the analysis of stochastic dynamical systems in economics, engineering and other fields. More precisely, the objectives are study of the basic concepts of the theory of stochastic processes; study of various properties and characteristics of processes; study of the methods for describing and analyze complex stochastic models. The course provides a necessary theoretical basis for studying the course in stochastic, such as financial mathematics, quantitative finance, stochastic modelling.

Activities to be given:

We will Providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the books for references and web resources.

Annexure -1

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

Cos	Course Outcomes	K-level
CO1	Correlate the concepts of stochastic processes with illustrations	Up to K4
CO2	Illustrate Markov chain and its applications	Up to K4
CO3	Compare the conceptualization of pure birth and death process	Up to K4
CO4	Infer the concepts of Markov Process with continuous state space	Up to K5
CO5	Study the concepts of Renewal Process and Theory	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	2	2	2	1
CLO2	1	2	3	2	2	1
CLO3	2	2	2	1	1	1
CLO4	1	1	3	2	2	1
CLO5	2	2	2	1	1	1

1.Basic level **2. Intermediate level** **3. Advanced level**

Annexure -1

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	**Stochastic Processes** Introduction - Specification of Stochastic Processes – Stationary Processes – Martingales.	**6**	**12**	Chalk and Talk
	Markov Chains: Definitions and Examples – Higher Transition Probabilities – Generalization of independent Bernoulli trials: Sequence of Chain-Dependent Trials	**6**		
II	**Markov Chains**Stability of Markov System – Graph Theoretic Approach	**6**	**12**	Chalk and Talk
	Markov Chain with Denumerable Number of States – Reducible Chains – Statistical Inference for Markov Chains.	**6**		
III	**Markov Process with discrete state space** Poisson Process: Poisson Process and Related Distributions – Generalizations of Poisson Process	**6**	**12**	Chalk and Talk
	Birth and death Process – Markov Process with Discrete S tate Space (Continuous time Markov chains).	**6**		
IV	**Markov Process with continuous state space** Introduction: Brownian M otion – Weiner P rocess – Differential E quations for Weiner Process	**6**	**12**	Chalk and Talk & PPT
	Kolmogorov Equations – First Passage Time Distribution for Weiner Process.	**6**		
V	**Renewal Process and Theory** Renewal Process and Renewal Equation – Stopping Time	**6**	**12**	Chalk and Talk & PPT
	Wald's Equation – Renewaltheorems – Delayed and Equilibrium Renewal Process.	**6**		
		Total	**60**	

Course Designer:Mrs.R.Revathi

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
III	SEC	23OPMASEC3P	Mathematical Documentation using Latex	2	2	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	Entrepreneurship oriented

Course Objectives:

Customize Document Layout, Organization. and Master the Mathematical Formulas.

Course Content:

Unit	Course Content	Hours	K Level	CLO
I	**Introduction:** Introduction to LaTeX- Installation of MikTex- Required Components of a LaTeX Document- Error Messages. **Document Structure:** Page Numbering and Headings- Creating a Title Page- Creating a Title Page, Continued-Sections-Cross-References- Table of Contents- Abstracts.	6	Up to K4	CLO 1
II	**Spacing:** Spacing Between Words- Fine-Tuning Spacing in Math-Mode- Double Spacing- Sloppy Line Breaks- Enlarging Pages -**Font Style:** Hyphenation- The LATEX Logo- Quotation Marks- Changing the Appearance of Words.	6	Up to K4	CLO 2
III	**Mathematical Formulas:** Greek Letters- Exponents and Subscripts- Above and Below- Fractions- Functions- Sums, Integrals, and Limits- Roots- Text in Math Displays- Operators- Relations- Negated Symbols- More Symbols- **Tables, Arrays, and Lists:** Constructing Arrays- Constructing Tables- **Multiline Equations:** Multi-line Equations- Bracket Symbols- Dots- Indenting.	6	Up to K4	CLO 3
IV	**Text Formatting:** Centering Text- Special Headers- Extended Quotation- Bulleted Lists- Numbered Lists- Filling a Line- Line Breaks.	6	Up to K5	CLO 4
V	**Bibliography and Compound Expressions:** Bibliographies- **Slides:** The Slide Class- How to Use the Slides Class- **Including Graphics in Your Document:** Graphic File Formats- Graphics Package- Including Graphics Within Your Document.	6	Up to K5	CLO 5

Book for study:

Guide to LATEX, fourth edition, helmut kopka, Patrick W.Daly

Chapters:

Unit	Page .No
I	4-10
II	22-24
III	11-21,25-30
IV	31-33
V	34-36

Books for Reference

1. The LaTeX Companion by Frank Mittelbach, Michel Goossens, Johannes Braams, David Carlisle, Chris Rowley, 2004, Addison-Wesley Professional
2. LaTeX: A Document Preparation System by Leslie Lamport, 1994, Addison-Wesley Professional
3. LaTeX Beginner's Guideby Stefan Kottwitz,2011, Packt Publishing

Web Resources:

1. https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
2. https://www.latex-project.org/help/books/bookpart_tlc2-ch0.pdf\
3. https://www.heinrichfleck.net/latex/Lamport%20.pdf

Pedagogy: Chalk and Talk, PPT, Group discussion.

Rationale for nature of Course:

LaTeX proficiency requires understanding syntax, professional formatting, mathematical typesetting, package use, citation management, version control integration, error troubleshooting, layout customization, and workflow optimization, honed through practice and engagement.

Entrepreneurial:

Encourage students to explore opportunities for offering LaTeX typesetting and document preparation services to researchers, academics, and professionals, leveraging their expertise for freelance or consulting work**.**

Activities to be given:

1.Create a document template incorporating various LaTeX features such as sections, equations, tables, and citations, then ask learners to populate it with content to practice formatting and typesetting.

2.Assign a collaborative writing task where students use LaTeX with version control to collectively draft and edit a document, fostering teamwork and proficiency in collaborative workflows.

Annexure -1

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

Cos	Course Outcomes	K-level
CO1	Be Mastery over LaTeX.	Up to K4
CO2	Understand Document Layout and Organization	Up to K4
CO3	Manage operators Mathematical Formulas	Up to K4
CO4	Expertise in Text Formatting	Up to K5
CO5	Create Slides, Graphics Package	Up to K5

K1- Remembering facts with specific answers.

K2- Basic understanding of facts.

K3- Application oriented -Solving Problems.

K4- Analyzing, examining and making presentations with evidence.

K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	3	-
CLO2	3	3	1	2	2	-
CLO3	3	2	2	3	3	-
CLO4	3	3	2	1	2	-
CLO5	3	3	3	3	3	-

1.Basic level **2. Intermediate level** **3. Advanced level**

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	Introduction to LaTeX- Installation of MikTex- Required Components of a LaTeX Document- Error Messages.	3	**6**	Chalk and Talk &PPT
	Document Structure: Page Numbering and Headings- Creating a Title Page- Creating a Title Page, Continued-Sections-Cross-References- Table of Contents- Abstracts.	**3**		
II	Spacing: Spacing Between Words- Fine-Tuning Spacing in Math-Mode- Double Spacing- Sloppy Line Breaks- Enlarging Pages	**3**	**6**	Chalk and Talk
	Font Style: Hyphenation- The LATEX Logo- Quotation Marks- Changing the Appearance of Words.	**3**		
III	Mathematical Formulas: Greek Letters- Exponents and Subscripts- Above and Below- Fractions- Functions- Sums, Integrals, and Limits- Roots- Text in Math Displays- Operators- Relations- Negated Symbols- More Symbols.	**3**	**6**	Chalk and Talk& PPT
	Tables, Arrays, and Lists: Constructing Arrays- Constructing Tables- Multiline Equations: Multi-line Equations- Bracket Symbols- Dots- Indenting.	**3**		
IV	Text Formatting: Centering Text- Special Headers- Extended Quotation- Bulleted Lists-	**3**	**6**	Chalk and Talk & PPT
	Numbered Lists- Filling a Line- Line Breaks	**3**		
V	Bibliography and Compound Expressions: Bibliographies- **Slides:** The Slide Class- How to Use the Slides Class-	**3**	**6**	Chalk and Talk & PPT
	Including Graphics in Your Document: Graphic File Formats- Graphics Package- Including Graphics Within Your Document.	**3**		
		Total	**30**	

Course Designer:Mrs.R.Revathi

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
IV	Core	23OPMA41	Functional Analysis	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1.To understand the Concept of Banach Spaces,to study the open mapping theorem and operators.
2.To understand the concepts of orthonormal Sets, and to study some operators like adjoint and unitary.
3.To acquire the knowledge of Banach algebras leading to the spectral theory of operators.

Course Content:

Unit	Course Content	Hours	K Level	CLO
I	**Banach Spaces:** The definition and some examples – Continuous linear transformation – The Hahn –Banach Theorem	18	Up to K4	CLO 1
II	**Banach Spaces:(continued)** The natural imbedding of N in N^{**} The open mapping theorem – The conjugate of an operator	18	Up to K4	CLO 2
III	**Hilbert Spaces :** The definition and some simple properties - Orthogonal complements – Orthonormal sets**.**	18	Up to K4	CLO 3
IV	**Hilbert Spaces(continued) :** The Conjugate $\mathbf{H}^*$. The adjoint of an operator - Self adjoint operators .Normal and unitary operators. Projections	18	Up to K5	CLO 4
V	**Finite – Dimensional Spectral Theory :** Matrices – Determinants and the spectrum of an operator - The spectral theorem	18	Up to K5	CLO 5

Book for study:

Simmons G.F., *Introduction to Topology and Modern Analysis,* Tata McGraw Hill Publishing Company Limited, New Delhi (2004B)

Chapters:

Unit	Chapters	Sections
I	9	46, 47, 48
II	9	49, 50, 51
III	10	52,53, 54
IV	10	55, 56, 57, 58, 59
V	11	60, 61, 62

Books for Reference:

1. Balmohan Vishnu Limaye, *Functional Analysis*, 3rd Edition, Wiley Eastern Limited (1986)
2. Choudhary Sudarsan Nanda.B *Functional Analysis with Application*, New Age International Publication.
3. Ponnusamy S. *Foundation of Functional Analysis*. Narosa Publishing House Pvt., Ltd 2012

Web Resources:

1. http://www.pdfdrive.com/functionl-alanalysis-e158374735.html
2.https://www.ferrbookcentre.net/maths-books-downland/Functional-Analysis-pdf.html
3.https://examupdates.in/functional/-analysis-book/
4. https://wwwe-booksdirectory.com/listing.php?category=47
5. https://link.springer.com/book/10.1007/978-3-642-61859-8

Pedagogy:

Chalk and Talk , Power point presentation, Group Discussions, Quiz, Assignment and Seminar

Rationale for nature of Course:

Knowledge and Skill:

The student has knowledge with the concept from functional analysis including the Hahn-Banach theorem , open mapping and Hilbert spaces

Activities to be given:

We will be providing student with intellectual problem , theory application problems and other practical works and also insist them to check the books for references and web resource**.**

Annexure -1

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Acquire the fundamentals of normed , Banach & Hilbert Spaces	Up to K4
CO2	Prove standard theorems such as Open mapping theorem, Closed graph theorem, Uniform boundedness theorem and Spectral theorem	Up to K4
CO3	Recall the results in Banach Spaces & Hilbert Spaces	Up to K4
CO4	Analyze the behavior of linear operators on normed spaces	Up to K5
CO5	Elucidate the operators and find the spectrum of operators.	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	2	2	1	3
CLO2	3	2	2	2	1	3
CLO3	3	2	2	3	2	3
CLO4	3	3	1	1	1	3
CLO5	3	2	1	2	1	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Annexure -1

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	The definition and some examples	6	18	Chalk and Talk
	Continuous linear transformation	6		
	The Hahn –Banach Theorem	6		
II	The natural imbedding of N and N**	6	18	Chalk and Talk
	The Open mapping theorem	6		
	The conjugate of an opertior	6		
III	**Hilbert Spaces:** The definition and some properties	6	18	Chalk and Talk
	Orthogonal compliments	6		
	Orthonormal sets	6		
IV	The conjugate space H* -The adjoint of an operator	6	18	Power point presentation & Seminar
	Self adjoint operators	6		
	Normal and Unitary operators-Projections	6		
V	**Finite – Dimensional Spectral Theory :** Matrices	6	18	Power point presentation & Seminar
	Determinants and the spectrum of an operator	6		
	The spectral theorem	6		
Total Hours			**90**	

Course Designer: Mrs. D.Selvamathi

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
IV	Core	23OPMA42	Differential Geometry	5	6	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. To impart the knowledge of curves on surfaces, curvature and torsion.
2. To develop the concept of Surface of revolution, Helicoids, Metric space and Direction ratios
3. To demonstrate the construction of new surface like Geodesic.
4. To know the concept of second fundamental form and its principal of curvature

Unit	Course Content	Hours	K Level	CLO
I	**Space curves:** Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.	**18**	Up to K4	CLO 1
II	**Intrinsic properties of a surface:** Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.	**18**	Up to K4	CLO 2
III	**Geodesics:** Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss-Bonnet Theorem – Gaussian curvature- surface of constant curvature.	**18**	Up to K4	CLO 3
IV	**Non Intrinsic properties of a surface:** The second fundamental form- Principle curvature – Lines of curvature	**18**	Up to K5	CLO 4
V	**Non Intrinsic properties of a surface:** Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces	**18**	Up to K5	CLO 5

Book for study:

T.J.Willmore, *An Introduction to Differential Geometry*, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)

Chapters:

Unit	Chapter	Sections
I	I	1 to 9.
II	II	1 to 9.
III	II	10 to 18.
IV	III	1 to 3
V	III	4 to 8

Books for Reference:

1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Inter science Publishers, 1963.
3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag 1979.

Web Resources:

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for nature of Course:

Knowledge and Skill:

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.	Up to K4
CO2	Evaluate these concepts with related examples	Up to K4
CO3	Compose problems on geodesics.	Up to K4
CO4	Recognize applicability of developable	Up to K5
CO5	Construct and analyze the problems on curvature and minimal surfaces	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	2	3	3
CLO2	2	1	3	1	3	3
CLO3	3	2	3	1	3	3
CLO4	1	2	3	2	3	3
CLO5	3	1	2	3	3	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Annexure -1

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	Definition of a space curve ,Arc length, tangent ,normal and binormal, curvature and torsion, contact between curves and surfaces	9	18	Chalk & Talk
	tangent surface, involutes and evolutes, Intrinsic equations, Fundamental Existence Theorem for space curves, Helies.	9		
II	Definition of a surface , curves on a surface , Surface of revolution ,	8	18	Chalk & Talk
	Helicoids , Metric- Direction coefficients , families of curves, Isometric correspondence, Intrinsic properties.	10		
III	Geodesics , Canonical geodesic equations , Normal property of geodesics,	9	18	PowerPoint Presentation & Seminar
	Existence Theorems , Geodesic parallels ,Geodesics ,curvature, Gauss, Bonnet Theorem , Gaussian curvature, surface of constant curvature.	9		
IV	Non Intrinsic properties of a surface: The second fundamental form, Principle curvature, Lines of curvature,	6	18	PowerPoint Presentation, Seminar Assignment
V	Developable	6	18	PowerPoint Presentation & Seminar
	Developable associated with space curves and with curves on surface ,	8		
	Minimal surfaces , Ruled surfaces	4		
		Total	**90**	

Course Designer: Mrs. D.Selvamathi

Annexure -1

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
1V	Elective	23OPMADSE4A	Mathematical Python	3	4	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	Entrepreneurship oriented

Course Objectives:

1. To Demonstrate the basic concepts of python programming with the help of data types, operators and expressions.
2. Divide a Python program into functions and solve mathematical problems.
3. Make use of control statements for altering the sequential execution of programs in solving.
4. Develop Python lists, and dictionaries for compound data.
5. To Interpret Tuples and Files in Python.

Course Content

Unit	Course Content	Hours	K Level	CLO
I	**The Way of the Program:** What is a Program? - Running Python – The First Program – Arithmetic Operators – Values and Types – Formal and Natural Languages. **Variables Expressions and Statements:** Assignment statements – Variable Names – Expressions and Statements – Script Mode – Order of Operations – String Operations – Comments.	12	Up to K4	CLO 1
II	**Functions:** Function Calls – Math Functions – Composition – Adding New Functions – Definitions and Uses – Flow of Execution – Parameters and Arguments – Variables and Parameters Are Local – Stack Diagrams – Fruitful Functions and Void Functions – Why Functions? **Conditionals and Recursion:** Floor Division and Modulus – Boolean Expressions – Logical Operators – Conditional Execution – Alternative Execution – Chained Conditionals – Nested Conditionals – Recursion – Stack Diagram for	12	Up to K4	CLO 2

	Recursive Functions – Infinite Recursion – Keyboard Input.			
III	**Iteration:** Reassignment – Updating Variables – The While Statement – break – Square Roots – Algorithms. **Strings:** A String is a Sequence – len – Traversal with a for Loop – String Slices – Strings are Immutable – Searching – Looping and Counting – String Methods – The in Operator – String Comparison.	12	Up to K4	CLO 3
IV	**Lists:** A List Is a Sequence – Lists Are Mutable – Traversing a List – List Operations – List Slices – List Methods – Map, Filter and Reduce – Deleting Elements – Lists and Strings – Objects and Values – Aliasing – List Arguments. **Dictionaries:** A Dictionary Is a Mapping – Dictionary as a Collection of Counters – Looping and Dictionaries – Reverse Lookup – Dictionaries and Lists – Memos – Global Variables.	12	Up to K5	CLO 4
V	**Tuples:** Tuples Are Immutable – Tuple Assignment – Tuples as Return Values – Variable Length Assignment Tuples – Lists and Tuples – Dictionaries and Tuples –Sequences of Sequences. **Files:** Persistence – Reading and Writing – Format Operator – Filenames and Paths – Catching Exceptions – Databases – Pickling – Pipes – Writing Modules.	12	Up to K5	CLO 5

Book for study:

Allen B. Downey, Think Python, 2nd Edition, Shroff Publishers and Distributors Pvt. Ltd., India, Sixth Reprint, 2019.

Chapters:

Unit	Chapters/Sections
I	1 & 2 (Except Debugging)
II	3 & 5 (Except Debugging)
III	7 & 8 (Except Debugging)
IV	10 & 11 (Except Debugging)
V	12 & 14 (Except Debugging)

Books for Reference:

1. M. Lutz and D. Ascher, Learning Python: Powerful Object-Oriented Programming, 4th Edition, O'Reilly, 2009.
2. R. Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2017.
3. H.P. Langtangen, A Primer on Scientific Programming with Python, Springer- Verlag, Berlin, 2016.
4. K.V.Namboothiri, Python for Mathematics Students, Version2.1, March2013.
5. Y. Zhang, An Introduction to Python and Computer Programming, Springer, Singapore, 2015.

Web Resources:

https://www.geeksforgeeks.org/how-to-run-a-python-script/
https://www.w3schools.com/python/python_tuples.asp

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for nature of Course:

Knowledge and Skill:

Knowledge in fundamental computer programming concepts and some mathematical principles.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

Cos	Course Outcomes	K-level
CO1	Demonstrate the basic concepts of python programming with the help of data types, operators and expressions.	Up to K4
CO2	Divide a Python program into functions and solve mathematical problems.	Up to K4
CO3	Make use of control statements for altering the sequential execution of programs in solving	Up to K4
CO4	Develop Python lists, tuples and dictionaries for compound data.	Up to K5
CO5	Interpret Object Oriented Programming in Python.	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Annexure -1

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	1	3	3
CLO2	3	1	3	2	3	3
CLO3	2	1	3	1	3	3
CLO4	3	2	3	1	3	3
CLO5	1	2	3	2	3	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	The Way of the Program: What is a Program? - Running Python – The First Program – Arithmetic Operators – Values and Types – Formal and Natural Languages.	6	12	Chalk & Talk
	Variables Expressions and Statements: Assignment statements – Variable Names – Expressions and Statements – Script Mode – Order of Operations – String Operations – Comments.	6		
II	Functions: Function Calls – Math Functions – Composition – Adding New Functions – Definitions and Uses – Flow of Execution – Parameters and Arguments – Variables and Parameters Are Local – Stack Diagrams – Fruitful Functions and Void Functions – Why Functions?	6	12	Chalk & Talk
	Conditionals and Recursion: Floor Division and Modulus – Boolean Expressions – Logical Operators – Conditional Execution – Alternative Execution – Chained Conditionals – Nested Conditionals – Recursion – Stack Diagram for Recursive Functions – Infinite Recursion – Keyboard Input.	6		

III	Iteration: Reassignment – Updating Variables – The While Statement – break – Square Roots – Algorithms	6	12	PowerPoint Presentation & Seminar
	Strings: A String is a Sequence – len – Traversal with a for Loop – String Slices – Strings are Immutable – Searching – Looping and Counting – String Methods – The in Operator – String Comparison.	6		
IV	Lists: A List Is a Sequence – Lists Are Mutable – Traversing a List – List Operations – List Slices – List Methods – Map, Filter and Reduce – Deleting Elements – Lists and Strings – Objects and Values – Aliasing – List Arguments.	6	12	PowerPoint Presentation, Seminar Assignment
	Dictionaries: A Dictionary Is a Mapping – Dictionary as a Collection of Counters – Looping and Dictionaries – Reverse Lookup – Dictionaries and Lists – Memos – Global Variables.	6		
V	Tuples: Tuples Are Immutable – Tuple Assignment – Tuples as Return Values – Variable Length Assignment Tuples – Lists and Tuples – Dictionaries and Tuples – Sequences of Sequences.	6	12	PowerPoint Presentation & Seminar
	Files: Persistence – Reading and Writing – Format Operator – Filenames and Paths – Catching Exceptions – Databases – Pickling – Pipes – Writing Modules.	6		
		Total	**60**	

Course Designer: A. Manickavalli

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
IV	Elective	23OPMADSE4B	Discrete Mathematics	3	4	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	Employability Oriented	Entrepreneurship oriented

Course Objectives:

1. To construct mathematical arguments using logical connectives and quantifiers.
2. To understand how Boolean algebra can be used as a tool and mathematical model in the study of networks.
3. To learn how to work with some of the discrete structures which include sets, relations, function and recurrence relation.

Course Content:

Unit	Course Content	Hours	K Level	CLO
I	Counting: The Basics of Counting – The Pigeonhole Principle – Permutations and Combinations– Binomial Coefficients and Identities – Generalized Permutations and Combinations.	12	Up to K4	CLO 1
II	Advanced Counting Techniques Applications of Recurrence Relations – Solving Linear Recurrence Relations – Divide and Conquer Algorithms and Recurrence Relations.	12	Up to K4	CLO 2
III	Advanced Counting Techniques**:** Generating Functions – Inclusion-Exclusion – Applications of Inclusion-Exclusion.	12	Up to K4	CLO 3
IV	Relations: Relations and their properties n-ary relations and their applications – Representing relations-– Closures of Relations – Equivalence Relations.	12	Up to K5	CLO 4
V	Boolean Algebra: Boolean Functions – Representing Boolean Functions – Logic Gates.	12	Up to K5	CLO 5

Book for study:

Kenneth H. Rosen, 2022, "*Discrete Mathematics and its Applications*", McGraw Hill Education Private Limited, India.

Chapters:

Unit	Chapters	Sections
I	6	6.1 to 6.5
II	7	7.1 to 7.3
III	7	7.4 to 7.6
IV	8	8.1 to 8.5
V	11	11.1 to 11.3

Books for Reference:

1. Susanna S.Epp, 2010, "*Discrete Mathematics with Applications*", 4th Edition, Brooks/Cole Cengage Learning, Nelson Education Ltd, Canada.
2. J.P. Tremblay, R. Manohar, 2008, "*Discrete Mathematical Structures with Applications to Computer Science*", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
3. Richard Johnsonbaugh, 2018, "*Discrete Mathematics"*, 8th Edition, Pearson Education Limited, Harlow, USA.
4. Sharon C. Ross, Bernard Kolman, Robert Busby, 2015, "*Discrete Mathematical Structures*", 6th Edition, Pearson, India.
5. Grimaldi R.P and Ramana B.V, *Discrete and Combinatorial Mathematics- An Applied Introduction*, Pearson Education, 2004

Web Resources:

1.https://www.csie.ntu.tw/~sylee/courses/dm/resources.htm
2.https://www.discrete-math-hub.com/rsourcse-and-help.html
3.ttps://www.edx.org/learn/discreate-mathematics

Pedagogy:

Chalk and Talk, Power point presentations, Group Discussions, Quiz, Assignment and Seminar

Rationale for nature of Course:

Knowledge and Skill:

Develop a deeper conceptual understanding of the theoretical basis of Predicates, Quantifiers and Nest Quantifiers**,** Skill to apply the Lattices and Algebraic Systems and Switching Circuits.

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works. We also guide them to refer books and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Recall basic counting principles and generalize the ideas in permutations and combinations	Up to K4
CO2	Interpret recurrence relations and design algorithms	Up to K4
CO3	Make use of advanced counting technique to solve real life problems	Up to K4
CO4	Recall the concepts of relation and find the closures	
CO5	Apply the ideas of Boolean algebras in Logic gates	

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	1	3	3
CLO2	3	3	2	2	1	3
CLO3	3	3	2	2	2	3
CLO4	3	2	2	2	1	3
CLO5	3	3	2	2	1	3

1.Basic level **2. Intermediate level** **3. Advanced level**

Annexure -1

Lesson Plan

Unit	Description	Hours	Total Hours	Mode
I	Counting: The Basics of Counting – The Pigeonhole Principle – Permutations and Combinations	6	12	Chalk & Talk
	Binomial Coefficients and Identities – Generalized Permutations and Combinations.	6		Chalk & Talk
II	Advanced Counting Techniques**:** Applications of Recurrence Relations – Solving Linear Recurrence Relations	6	12	Chalk & Talk
	Divide and Conquer Algorithms and Recurrence Relations.	6		Chalk & Talk
III	Advanced Counting Techniques**:** Generating Functions – Inclusion-Exclusion	6	12	PPT, Chalk & Talk
	Applications of Inclusion-Exclusion.	6		Seminar
IV	Relations: Relations and their properties – n-ary relations and their applications	6	12	Chalk & Talk Seminar
	Representing relations-– Closures of Relations – Equivalence Relations.	6		Chalk & Talk Seminar
V	Boolean Algebra: Boolean Functions	6	12	Chalk & Talk Seminar
	Representing Boolean Functions – Logic Gates.	6		Lecture, Quiz
Total			**60**	

Course Designer:Dr.Mrs.G.Alarmelu Mangai

Department of Mathematics						II M.Sc.		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
IV	SEC	23OPMASEC4	Mathematics for CSIR-UGC NET/GATE/SET Competitive Examinations	2	4	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	Entrepreneurship oriented

Course Objectives:

- To facilitate the students to crack National Level Examinations like CSIR- UGC NET/GATE/IIT-JAM/NBHM/TIFR/SLET etc.
- To prepare students for facing Competitive Examinations like UPSC/TNPSC

Course Content

Unit	Course Content	Hours	K Level	CLO
I	Algebra: Groups, cyclic groups, cayle's theorem, sylow's theorem, rings, ideals, UFD, PID, polynomial ring and fields.	12	Up to K4	CLO 1
II	Linear Algebra: Vector space, subspace, linear transformations, matrices, inner product space and orthonormal basis.	12	Up to K4	CLO 2
III	Real Analysis: countability, real number system, sequences, series, metric spaces, compactness, connectedness, continuity, sequences & series of functions, Riemann integral.	12	Up to K4	CLO 3
IV	Topology: Basis, Dense sets, subspace and product topology, separation axioms, connectedness and compactness.	12	Up to K5	CLO 4
V	Complex Analysis: Complex numbers, power series, analytic functions ,Contour Integral	12	Up to K5	CLO 5

Book for study:

Akhilesh Mani Tripathi and Sunil Kushwaha, "*CSIR-UGC NET Mathematical Sciences"(*UNIT-I & UNIT-II) Danika Publishing Company, Publishers of Trueman's Specific Series.

Books for Reference:

1. Advanced CSIR-NET/JRF/Mathematics By Dr.Gajendra Purohit Invincible Publishers.
2. CSIR-NET/JRF Mathematics Previous Years Solved Papers Volume – I Pure Mathematics, Fifth Edition by Rajendra Dubey, Kittu Rani Publications pvt Ltd.

Web Resources:

1. http://pkalika.in/2019/10/14/study-material/
2. https://toppersnotes.com/csir-net-toppers-handwritten-notes-mathematical-science-samples/
3. https://www.csirhrdg.res.in/old_website/gp.pdf

Pedagogy:

Chalk and Talk, Powerpoint presentations, Group Discussions, Quiz, Assignment and Seminar.

Rationale for nature of Course:

Knowledge and Skill:

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Activities to be given:

We will be providing students with intellectual problems, theory application problems, group discussion and other practical works and also insist them to check the Books for References and web resources.

Course Learning Outcome (CLOs)

On completion of the course, behind the students would be able to:

COs	Course Outcomes	K-level
CO1	Analyze and evaluate local properties of analytical functions and definite integrals.	Up to K4
CO2	Describe the concept of definite integral and harmonic functions.	Up to K4
CO3	Demonstrate the concept of the general form of Cauchy's theorem	Up to K4
CO4	Develop Taylor and Laurent series .	Up to K5
CO5	Explain the infinite products, canonical products and Jensen's formula .	Up to K5

K1- Remembering facts with specific answers.
K2- Basic understanding of facts.
K3- Application oriented -Solving Problems.
K4- Analyzing, examining and making presentations with evidence.
K5- Evaluating, making Judgments based on criteria.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	1	3	3
CLO2	3	1	3	2	3	3
CLO3	2	1	3	1	3	3
CLO4	3	2	3	1	3	3
CLO5	1	2	3	2	3	3

1.Basic level 2. Intermediate level 3. Advanced level

Lesson plan:

Unit	Description	Hours	Total Hours	Mode
I	Algebra: Groups, cyclic groups, cayle's theorem, sylow's theorem	6	12	Chalk & Talk
	Rings, ideals, UFD, PID, polynomial ring and fields.	6		
II	Linear Algebra: Vector space, subspace, linear transformations	6	12	Chalk & Talk
	Matrices, inner product space and orthonormal basis.	6		
III	Real Analysis: countability, real number system, sequences, series, metric spaces	5	12	PowerPoint Presentation & Seminar
	Compactness, connectedness, continuity, sequences & series of functions, Riemann integral.	7		
IV	Topology: Basis, Dense sets, subspace and product topology	7	12	PowerPoint Presentation, Seminar Assignment
	Separation axioms, connectedness and compactness.	5		
V	Complex Analysis: Complex numbers, power series	6	12	PowerPoint Presentation & Seminar
	Analytic functions, complex integration.	6		
		Total	**60**	

Course Designer:Mrs.N.Uma Maheswari