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)

CRITERION - I

1.2.2 Details of Programmes offered through Choice Based Credit System (CBCS) / Elective Course System

> **Syllabus copies with highlights of contents focusing on Elective Course System**

To be Noted:

HIGHLIGHTED	COURSE
	Elective

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DEPARTMENT OF MATHEMATICS- PG
TANSCHE – CBCS WITH OBE

(w.e.f. 2023 – 2024 onwards)

VISION

To mold the students to have strong Mathematical and Analytical skills to meet the challenges open to them.

MISSION

To provide the students with a strong Mathematical Foundation through courses which cater to the needs of Industry, Research and Higher Education

Programme Educational Objectives (PEOs)
M.Sc.,

PEO	On completion of the Programme the student will be able to
PEO1	Apply their knowledge in modern industry or teaching, or secure acceptance in high quality graduate programs in mathematics.
PEO2	Keep on discovering new avenues in the chosen field and exploring areas that remain conducive for research and development.
PEO3	Promote the culture of interdisciplinary research among all disciplines and Applied Mathematics.
PEO4	Handle the problems faced by industry through Mathematical knowledge and scientific computational techniques
PEO5	To develop teaching skills, subject knowledge in the course of their study which will help them to shine in various field including Education ,IT etc.,

Programme Outcomes (POs) with Graduate Attributes

PO	Graduate Attributes	On completion of the Programme the student will be able to
PO1	**Problem Solving Skill**	Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context
PO2	**Decision Making Skill**	Foster analytical and critical thinking abilities for data-based decision-making
PO3	**Ethical Value**	Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.
PO4	**Communication Skill**	Ability to develop communication, managerial and interpersonal skills
PO5	**Employability Skill**	Inculcate contemporary business practices to enhance employability skills in the competitive environment
PO6	**Individual and Team Leadership Skill**	Capability to lead themselves and the team to achieve organizational goals. .

Programme Specific Outcomes (PSOs) with Graduate Attributes

PSO	Graduate Attributes	On completion of the Programme the student will be able to
PSO1	**Placement**	To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions
PSO 2	**Entrepreneur**	To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.
PSO 3	**Research and Development**	Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.
PSO 4	**Contribution to Business World**	To produce employable, ethical and innovative professionals to sustain in the dynamic business world.
PSO 5	**Contribution to the Society**	To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Eligibility for Admission: Pass in B.Sc., Mathematics

Duration of the Course:
The students shall undergo prescribed courses of study for the period of two academic years under CBCS semester pattern with Outcome Based Education.

Medium of Instruction: English

System: TANSCHE - Choice Based Credit System with Outcome Based Education.

Nature of the Course
Courses are classified according to the following nature
1. Knowledge & Skill
2. Employability Oriented
3. Entrepreneurship Oriented

Outcome Based Education (OBE) & Assessment

Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

1. Based on purpose:
- Formative (Internal tests, Assignment, Seminar, Quiz, Documentation, Case lets, ICT based Assignment, Mini Projects administered during the learning process)
- Summative (Evaluation of students learning at the end of instructional unit)

2. Based on Domain knowledge: (Post Graduate Up to K5 Levels)
- Assessment through K1, K2,K3, K4 & K5

Evaluation

Continuous Internal Assessment Test (CIA)	: 25 Marks
Summative Examination	: 75 Marks
Total	: 100 Marks

CIA-Continuous Internal Assessment: 25 Marks

Components	Marks
Test (Average of two tests) (Conduct for 120 marks and converted into 12 marks)	12
Application-oriented/Innovation/Creativity Assignment	3
Assignment	5
Seminar	5
Total	**25**

- Centralized system of Internal Assessment Tests
- There will be a two Internal Assessment Tests
- Duration of Internal Assessment Test I and II will be 2 1/2 hours.
- Students shall write retest on the genuine grounds if they are absent in either Test I & Test II with the approval of Head of the Department.

Question Paper Pattern for Continuous Internal Assessment Test I and Test II

Section	Marks
A – Multiple Choice Questions (8x1Mark)	8
B – Short Answer (6 x 2 Marks)	12
C – Either Or type (4/8 x 5 Marks)	20
D – Open Choice type (2/4 x 10 Marks)	20
Total	**60**

Conducted for 120 marks and converted into 12 marks

Question Paper Pattern for Summative Examination

Section	Marks
A – Multiple Choice Questions without choice (10x 1Mark)	10
B – Short Answer Questions without choice (5 x 2 Marks)	10
C – Either Or type (5/10 X 5Marks)	25
D – Open Choice type(3out of 5 X 10Marks)	30
Total	**75**

● In respect of external examinations passing minimum is **45%** for Post Graduate Courses and in total, aggregate of **50%.**

Latest amendments and revisions as per UGC and TANSCHE Norms are taken into consideration in curriculum preparation.

Distribution of Marks in % with K levels CIAI, II & Externa Assessment

Blooms Taxonomy	Internal Assessment		External Assessment
	I	II	
Knowledge (K1	8 %	8 %	5 %
Understanding (K2)	8 %	8 %	14 %
Apply (K3)	24 %	24 %	27%
Analyze (K4)	30 %	30 %	27%
Evaluate (K5)	30%	30%	27%

BLUEPRINTFOR INTERNALASSESSMENT–I

Articulation Mapping –K Levels with Course Learning Outcomes(CLOs)

Sl.No	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO1	Upto K5	1 2	K1 K2	1 1	K1 K3	1(K3) 1(K5)	1(K4)	
2	CLO2	Upto K5	2 1	K1 K2	1 1	K1 K2	1(K3) (Each set of questions must be in the same level)	1(K4) 1(K5)	
3.	CLO3	Upto K5	1 1	K1 K2	1 1	K2 K3	1(K4)	1(K5)	
	No. of Questions to be asked		8		6		8	4	26
	No .of Questions to Be answered		8		6		4	2	20
	Marks for each question		1		2		5	10	
	Total Marks for each section		8		12		40	40	100

BLUEPRINT FORINTERNALASSESSMENT– II
Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

SlNo	CLOs	K-Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO3	Upto K5	1 2	K1 K2	1 1	K1 K3	1(K1) 1(K2)	1(K3)	
2	CLO4	Upto K5	2 1	K1 K2	1 1	K1 K2	1(K3) (Each set of questions must be in The same level)	1(K4) 1(K5)	
3.	CLO5	Upto K5	1 1	K1 K2	1 1	K2 K3	1(K4)	1(K5)	
No. of Questions to be asked			8		6		8	4	26
No. of Questions to Be answered			8		6		4	2	20
Marks for each question			1		2		5	10	
Total Marks for each section			8		12		40	40	100

Distribution of Marks with choice K Levels CIA I – CIA and II-CIA

CIA	K Levels	Section-A MCQ (No choice)	Section –B (Short Answer(No choice)	Section-C(Either or Type)	Section-D (Open Choice)	Total Marks	% of Marks
I	K1	4	4			8	8
	K2	4	4			8	8
	K3		4	20		24	24
	K4			10	20	30	30
	K5			10	20	30	30
	Marks	**8**	**12**	**40**	**40**	**100**	**100**
II	K1	4	4			8	8
	K2	4	4			8	8
	K3		4	20		24	24
	K4			10	20	30	30
	K5			10	20	30	30
	Marks	**8**	**12**	**40**	**40**	**100**	**100**

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs) for Internal Assessment (SEC)

Sl.No	CLOs	K-Level	Section A MCQs (No choice) No. of Questions	Section A K-Level	Section B Short Answers (No choice) No. of Questions	Section B K-Level	Section C (Either/ or Type)	Section D (open choice)	Total
1	CLO1	Upto K4	2	K1			2(K3&K3)	1(K3)	
2	CLO2	Upto K4	2	K1			2(K3&K3	1(K4)	
3	CLO3	Upto K4			2	K2	2(K4&K4)	1(K4)	
4	CLO4	Upto K5			2	K2	2(K5&K5)	1(K5)	
5	CLO5	Upto K5			2	K2		1(K5)	
No. of Questions to be asked			4		3		8	5	20
No. of Questions to be answered			4		3		4	2	13
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		20	20	50 (Marks)

Distribution of Section-wise Marks with K Levels for Internal Assessment (SEC)

K Levels	Section A (MCQ'S) (No choice)	Section B(Short Answer) (No choice)	Section C(Either or Type)	Section D (Open Choice)	Total Marks	% of Marks
K1	4				**4**	**4**
K2		6			**6**	**6**
K3			20	10	**30**	**30**
K4			10	20	**30**	**30**
K5			10	20	**30**	**30**
Total Marks	**4**	**6**	**40**	**50**	**100**	

K1-Rememberingandrecallingfactswithspecificanswers.

K2- Basic understanding off acts and stating main ideas with general answers.

K3-Application oriented Solving Problems, Justifying the statement and deriving inferences

K4- Examining, analyzing, presentation and make inferences with evidences.

K5-Evaluating, making Judgments based on criteria

Articulation Mapping –K Levels with Course Learning Outcomes(CLOs) for External Assessment

Sl.No	CLOs	K-Level	Section A MCQs (No choice) No. of Questions	Section A K-Level	Section B Short Answers (No choice) No. of Questions	Section B K-Level	Section C (Either/or Type)	Section D (open choice)	Total
1	CLO1	Upto K4	2	K1&K2	1	K1	2(K2&K2)	1(K3)	
2	CLO2	Upto K4	2	K1&K2	1	K2	2(K3&K3)	1(K4)	
3	CLO3	Upto K4	2	K1&K2	1	K3	2(K3&K3)	1(K4)	
4	CLO4	Upto K5	2	K1&K2	1	K4	2(K4 &K4)	1(K5)	
5	CLO5	Upto K5	2	K1&K2	1	K5	2(K5 &K5)	1(K5)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each section			10		10		25	30	75 (Marks)

Distribution of Section-wise Marks with K Levels for External Assessment

K Levels	SectionA (MCQ'S) (No choice)	Section B(Short Answer) (No choice)	Section C(Either or Type)	Section D(Open Choice)	Total Marks	% of Marks
K1	5	2	-	-	**7**	**5**
K2	5	2	10	-	**17**	**14**
K3	-	2	20	10	**32**	**27**
K4	-	2	10	20	**32**	**27**
K5	-	2	10	20	**32**	**27**
Total Marks	**10**	**10**	**50**	**50**	**120**	**100**

K1-Remembering and recalling facts with specific answers.

K2- Basic understanding of facts and stating main ideas with general answers.

K3-Application oriented Solving Problems, Justifying the statement and deriving inferences

K4- Examining, analyzing, presentation and make inferences with evidences.

K5-Evaluating, making Judgments based on criteria

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DEPARTMENT OF MATHEMATICS- PG

(w.e.f. 2023 – 2024 Batch onwards)

COURSE STRUCTURE –SEMESTER WISE

TANSCHE-CBCS with OBE

Sem	Part	Course Code	Course Title	Teaching Hours (per Week)	Duration of Exam hrs.	Marks Allotted			
						CIA	SE	Total	Credits
I		23OPMA11	**Core I:** Algebraic Structures	7	3	25	75	100	5
	III	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
Total				**30**					**20**
II		23OPMA21	**Core IV :** Advanced Algebra	6	3	25	75	100	5
	III	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 :** Office Automation and ICT Tools	2	3	25	75	100	2
Total				**30**					**22**

DSEC – Discipline Specific Elective Course
SEC - Skill Enhancement Course

DSEC (Discipline Specific Elective Course)

Semester – I (Choose any one)
DSEC - I

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

DSEC – II (Choose any one)

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

Semester – II
DSEC – III (Choose any one)

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

DSEC – IV (Choose any one)

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

		Department of Mathematics					I M.Sc.,	
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
1	DSEC	23OPMADSE1A	Number Theory And Cryptography	3	5	25	75	100

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

Course Objectives:

To provide an introduction to analytic number theory and recent topics or Cryptography with applications

Course Content:

Unit	Course Content	75 Hours	K Level	CLO
I	Introduction –Conjectures - Well Ordering and Induction – Sigma notation and product notation - Binomial Coefficients – Greatest Integer functions – Divisibility – Greatest Common Divisor (GCD) – Euclid Algorithm.	15	Up toK4	CLO1
II	Introduction – primes counting function – prime number theorem –canonical factorization – fundamental theorem of arithmetic – Seive of Eratosthenes – Determining factorization	15	Up toK4	CLO2
III	Congruence – equivalence relations- linear congruences – linear Diophantine equations and Chinese remainder theorem – Polynomial Congruences – modular arithmetic and Fermat's theorem – Wilson's theorem and Fermat number	15	Up toK4	CLO3
IV	Arithmetic functions – Sigma function - tau functions – Dirichlet product – quadratic reisdues and Legendre symbols .	15	Up toK5	CLO4
V	Cryptography: Introduction – Character Ciphers – Block Ciphers – One time Pods – Public – Key Cryptography	15	Up toK5	CLO5

Books for study:

Neville Robbins; *Beginning   Number Theory,* Second Edition, Narosa, 2006

Chapters:

UNIT	CHAPTER(S)	SECTIONS
I	1,2	1.1 - 1.6 & 2.2
II	3	3.1- 3.3
III	4	4.2- 4.7
IV	5, 7	5.1-5.2 & 7.2
V	12	12.1 - 12.5

Books for Reference:

1. Tom Apostol, Introduction to Analytic Number theory, Narosa Publications, New Delhi
2. Neal Koblitz, A Course in Number Theory and Cryptography,Springer-Verlag, New York,1987.
3. David M.Burton, Elementary Number Theory, Wm.C.Brown Publishers, Dubuque, Iowa, 1989.

Web Resources:

1. http://mathforum.org,
2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org,
4. https://onlinecourses.nptel.ac.in/noc20_ma42/preview

Pedagogy:

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

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:

No.	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Understand the properties of divisibility and congruence.	Up to K4
CLO2	Use arithmetic functions in area of mathematics	Up to K4
CLO3	Understand and use the theorems ,Chinese reminder theorem and Lagrange's theorem	Up to K4
CLO4	Know the applications of reciprocity law and Diophantine equation	Up to K5
CLO5	Apply elementary number theory concepts in cryptography.	Up to 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

Lesson Plan:

UNIT	DESCRIPTION	75 Hours		PEDAGOGY
I	Divisibility - Division algorithm	2	**15**	Chalk and Talk, Problem Solving, Tutorial
	GCD, Euclidean algorithm	2		
	LCM and Properties	2		
	Congruence's - Euler's Theorem	2		
	Fermat's theorem – Wilson's theorem	3		
	Solutions of congruence's – The Chinese Remainder Theorem	4		
II	Quadratic residues – Lemma of Gauss	8	**15**	Chalk and Talk, Problem Solving, Tutorial
	Gaussian reciprocity law – Jacobi symbol.	7		
III	Greatest integer function	5	**15**	Chalk and Talk, Problem Solving,quiz
	Arithmetic functions	5		
	The Moebius Inversion formula	5		
IV	Diophantine Equation – The linear equation – Pythagorean Triangle	8	**15**	Chalk and Talk, Problem Solving
	The equation $x^2\ y^2\ z^2$	7		
V	Discrete logarithm– Principles of public key	5	**15**	Chalk and Talk, Problem Solving
	Cryptosystem – RSA algorithm	5		
	Elliptic curve cryptography.	5		
	Total		**75**	

I M.Sc.,								
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
1	DSEC	23OPMADSE1C	Mathematical Programming	3	5	25	75	100

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

Course Objectives:

- To introduce the Revised simplex method and to make them performparametric analysis.
- To make them understand the limitations of simplex method in derivinginteger solution to linear programming problems.
- To illustrate various dynamic programming models and theirapplications in solving a decision-problem.
- To introduce the concept of classical optimization techniques.
- To appreciate the use of some of the non-linear programming techniquessuch as quadratic and separable programming.

Course Content:

Unit	Course Content	75 Hours	K Level	CLO
I	**Network Models:** Network Definitions – Minimal Spanning tree Algorithm – Shortest Route Problem – Examples of the Shortest Route Applications – Shortest Route Algorithms – Maximal flow Model – Maximum flow algorithm - CPM – PERT – CPM Computations – Construction of the Time Schedule.	15	Up toK3	CLO1
II	**Deterministic Inventory Models:** General Inventory Model - Role of demand in the development of Inventory models - Static Economic order Quantity EOQ Models – Classic EOQ Model – EOQ Problems with Price Breaks – Multiitem EOQ with storage limitation- Dynamic EOQ models – No- Setup model – Set up model	15	Up toK4	CLO2
III	**Queuing Systems:** Elements of Queuing model - Role of Exponential Distribution – Pure Birth and Death Models – Pure Birth models _ Pure Death Model – Generalized poisson Queuing model – Specialized poisson Queues – Steady State Measures of Performance – Single Server Models – Multiple server models – Machine Servicing Model (M/M/R) (GD/K/K); R<K	15	Up toK4	CLO3

IV	**Classical Optimization Theory:** Unconstrained Problems: Necessaryand Sufficient Conditions – The Newton-Raphson Method – Constrained Problems: Equality Constraints – Inequality Constraints (Karush-Kuhn-Tucker Conditions)	15		Up toK5	CL O4
V	**Nonlinear Programming Algorithms:** Unconstrained Algorithms: Direct search method – Gradient method – Constrained Algorithms: Separable Programming – Quadratic Programming.	15		Up toK5	CL O5

Book for study:

Hamdy A. Taha, *Operations Research*, (Seventh edition) Pearson Prentice Hall of India Private Limited, New Delhi, 1997.

Chapters:

UNIT	CHAPTER(S)	SECTIONS
I	6	6.1,6.2, 6.3 – 6.3.1, 6.3.2, 6.4 – 6.4.2, 6.5 – 6.5.1,6.5.2,6.5.3
II	11	11.1, 11.2, 11.3 – 11.3.1, 11.3.2, 11.3.3 11.4 – 11.4.1, 11.4.2
III	15	15.2, 15.3, 15.4- 15.4.1,15.4.2 15.5,15.6 – 15.6.1, 15.6.2,15.6.3, 15.6.4
IV	18	18.1- 18.1.1, 18.1.2 18.2- 18.2.1, 18.2.2
V	19	19.1 – 19.1.1, 19.1.2 19.2 – 19.2.1, 19.2.2

Books for Reference:

1. J.K.Sharma, *Operations Research Theory and Applications* (Fourth Edition),Macmillan India Ltd, New Delhi, 2009.
2. F.S. Hillier & J.Lieberman *Introduction to Operation Research* (7th Edition)Tata McGraw Hill Company, New Delhi, 2001.
3. Beightler. C, D.Phillips, B. Wilde, *Foundations of Optimization* (2nd Edition)Prentice Hall Pvt Ltd., New York, 1979
4. S.S. Rao, *Optimization Theory and Applications*, Wiley Eastern Ltd. New Delhi. 1990

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, Powerpoint presentations, Group Discussions, Quiz, Assignment and Semina
  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:

CLO	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Know how Feasibility conditions Parametric changes in c, Parametric changes in b	Up to K3
CLO2	Determine the Then Constraints – Integer Programming Algorithms Traveling Salesperson Problem	Up to K4
CLO3	Illustrate the effect of Dynamic Programming Applications Inventory Model	Up to K4
CLO4	To be able to Unconstrained Problems: Necessary and Sufficient Conditions – The Newton-Raphson Method	Up to K5
CLO5	To be able to understand the concept of Separable Programming – Quadratic Programming	Up to 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

Lesson Plan

Unit	Description	75 Hours		Mode
I	Network Definitions - Minimal Spanning tree Algorithm – Shortest Route Problem	2	**15**	Lecture, Discussion, Tutorial, Quiz
	Examples of the Shortest Route Applications	5		
	Shortest Route Algorithms – Maximal flow Model – Maximum flow algorithm	4		
	CPM – PERT – CPM Computations – Construction of the Time Schedule.	4		
II	General Inventory Model - Role of demand in the development of Inventory models	4	**15**	Lecture, Quiz Group Discussion, Tutorial
	Static Economic order Quantity EOQ Models	4		
	Classic EOQ Model – EOQ Problems with Price Breaks – Multi item EOQ with storage limitation	4		
	Dynamic EOQ models – No- Setup model – Set up model	3		
III	Elements of Queuing model - Role of Exponential Distribution	2	**15**	PPT, Lecture,Quiz, Tutorial
	Pure Birth and Death Models – Pure Birth models _ Pure Death Model	3		
	Generalized poisson Queuing model – Specialized poisson Queues	2		
	Steady State Measures of Performance – Single Server Models – Multiple server models	5		
	Machine Servicing Model (M/M/R) (GD/K/K); R<K	3		
IV			**15**	PPT, Lecture
	Unconstrained Problems: Necessary and Sufficient Conditions Equality Constraints –	5		
	The Newton-Raphson Method – Constrained Problems:	2		
	Inequality Constraints (Karush-Kuhn-Tucker Conditions)	8		
V	Unconstrained Algorithms: Direct search method –Constrained Algorithms:–	5	**15**	Assignment, Seminar
	Gradient method	3		
	Separable Programming	5		
	Quadratic Programming.	2		
	Total		**75**	

Department of Mathematics						I M.Sc.,		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
1	DSEC	23OPMADSE1B	Graph Theory and its Applications	3	5	25	75	100

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

Course Objectives:

- To enable the students to apply Graph Theritical Techniques in Applications.
- To demonstrate knowledge of Connectivity.
- To study relationship between Euler Tours and Hamilton Cycles.
- To make familiarity with Directed Graphs.
- To assist the students to explore social network analysis software.

Course Content:

Unit	Course Content	75 Hours	K Level	CLO
I	**Graphs and Subgraphs** Definition and Examples of a Graph – Simple Graphs - Graphs Isomorphism- The Incidence and Adjacency Matrices - Subgraphs – Vertex Degrees – Paths and Connection– Cycles - Trees - Cut Edges and Bonds – Cut Vertices – Cayley's Formula(Applications) -The Connector Problem.	15	Up to K4	CLO1
II	**Connectivity** Connectivity – Blocks (Applications) - Construction of Reliable Communication Networks	15	Up to K4	CLO2
III	**Euler Tours and Hamilton Cycles** Euler Tours - Hamilton Cycles (Applications) - The Chinese Postman Problem – The Travelling Salesman Problem.	15	Up to K4	CLO3
IV	**Directed Graphs** Directed Graphs - Directed Paths - Directed Cycles (Applications) – A Job sequencing Problem - Designing an Efficient Computer Drum - Making a Road System One–way - Ranking the Participants in Tournament.	15	Up to K5	CLO4
V	**Networks** Flows-Cuts-The Max-Flow Min-Cut Theorem (Applications)–Menger's Theorems - Feasible Flows	15	Up to K5	CLO5

Book for study:

        J.A. Bondy and U.S.R. Murty.(1982), *Graph Theory with Applications*. 5th print,North Holland .

Chapters:

UNIT	CHAPTER(S)	SECTIONS
I	1and 2	1.1 to 1.7 &2.1 to 2.5
II	3	3.1 to 3.3
III	4	4.1 to 4.4
IV	10	10.1 to 10.7
V	11	11.1 to 11.5

Books for Reference:

1. John Clark. Derek Allan Holton. *Graph Theory*. University of Otago (1995).
2. Frank Harary, (1969), *Graph theory*, Addition-Wesley Publishing Company , First Edition.
3. Murugan.M.,(2003),*Topics in Graph theory and Algorithms*, Muthal Publishing House,
4. S.A. Choudum. *A First Course in Graph Theory*.Macmillan Publishers India Limited (2011).
5. Narasing Deo (2007), *Graph Theory with Applications to Engineering and Computer science*,Pretice .

Web Resources:

1. https://www.shahucollegelatur.org.in/Department/Studymaterial/sci/it/BCS/FY/book.pdf
2. https://www.flowsurfv3.net/c.php?cu=https%253A%252F%252Fwww.shahucollegelatur.org.in%252FDepartment%252FStudymaterial%252Fsci%252Fit%252FBCS%252FFY%252Fbook.pdf&sh=www.shahucollegelatur.org.in%2F...%2Fit%2FBCS%2FFY%2Fbook.pdf&l=IN&po=2&u=mbeh-20210420-ccmnet-flga33&a=3100&tr=1712umd71g10&keyword=Graph%2Btheory%2Bwith%2Bapplication%2Bpdf&aid=61a88bda894f1&t=8&bc=0&rt=1638435802.1301&n=3&loc=normal

E – Books:

1. http://www.freebookcentre.net/maths-books-download/Descriptive-Complexity,-Canonisation and-Definable-Graph-Structure-Theory.html
2. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf

Pedagogy:

Chalk and Talk, Group Discussions, Quiz, Assignment and Seminar

Rationale for nature of Course: Knowledge and Skill:

Provides a helpful tool to quantity & simplify the many moving parts of dynamic systems

Activities to be given:

Tocreate social graphs for their own social networks. Group Discussion, Seminar & Project

Course Learning Outcome (CLOs)

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

CLO	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Examine the Graphs and Subgraphs .	Up to K4
CLO2	Understand the Connectivity	Up to K4
CLO3	Investigating the relationship between Euler Tours and Hamilton Cycles.	Up to K4
CLO4	Explain the Directed Graphs.	Up to K5
CLO5	Compute the Analysis of Networks.	Up to 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	2	3	3	2	3
CLO2	3	3	3	2	3	3
CLO3	3	2	2	3	3	3
CLO4	3	3	2	2	3	3
CLO5	3	2	3	2	2	3

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

Lesson Plan

Unit	Course Content	75 Hours		Mode of Teaching
I	Definition and Examples of a Graph – Simple Graphs - Graphs Isomorphism- The Incidence and Adjacency Matrices – Subgraphs.	5	15	Chalk & Talk, Quiz, Exercise
	Vertex Degrees – Paths and Connection–Cycles	5		
	Trees - Cut Edges and Bonds – Cut Vertices – Cayley's Formula (Applications) -The Connector Problem.	5		
II	Connectivity.	5	15	Chalk & Talk, PPTs, Quiz, Exercise
	Blocks (Applications).	5		
	Construction of Reliable Communication Networks.	5		
III	Euler Tours and Hamilton Cycles.	5	15	Chalk & Talk, PPTs, Exercise, Quiz
	The Chinese Postman Problem.	5		
	The Travelling Salesman Problem.	5		
IV	Directed Graphs - Directed Paths - Directed Cycles (Applications)	5	15	Chalk & Talk, Exercise PPTs, Quiz, seminar
	A Job sequencing Problem-Designing an Efficient Computer Drum	5		
	Making a Road System One–way Ranking the Participants in Tournament..	5		
	Flows-Cuts-The Max-Flow Min-Cut Theorem (Applications).	5	15	Chalk & Talk, Exercise Quiz Assignment PPTs, seminar
	Menger's Theorems	5		
	Feasible Flows.	5		
	Total		**75**	

Department of Mathematics							I M.Sc.,	
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
1	DSEC	23OPMADSE1D	Fuzzy Sets and their Applications	3	5	25	75	100

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

Course Objectives:

1. To understand fundamental of fuzzy set.
2. To learn fuzzy set, Arithmetic operation on fuzzy set.
3. To understand fuzzy notation
4. To know about fuzzy relation.
5. To apply fuzzy logic in real world problem.

Course Content:

Unit	Course Content	75Hours	K-Level	CLO
I	Introduction ,Crisp Sets: An Overview, The Notation of Fuzzy Sets, Basic Concepts of Fuzzy Sets, Classical Logic: An Overview, Fuzzy Logic	15	Up to K4	CLO1
II	General Discussion, Fuzzy Complement, Fuzzy Union, Fuzzy Intersection, Combinations of Operations, General Aggregation Operations.	15	Up to K4	CLO2
III	Crisp and Fuzzy Relations, Binary Relations, Binary Relations On a Single Set, Equivalence and Similarity Relations.	15	Up to K4	CLO3
IV	Compatibility or Tolerance Relations, Orderings	15	Up to K5	CLO4
V	Morphisms, Fuzzy Relation Equations	15	Up to K5	CLO5

Book for Study:

Fuzzy Sets, Uncertainty and Information, George J.Klir,Tina A. Folger.

Chapters:

UNIT	CHAPTER(S)	SECTIONS
I	1	1.1 to 1.6
II	2	2.1 to 2.6
III	3	3.1 to 3.4
IV	3	3.5 & 3.6
V	3	3.7 & 3.8

Books for Reference:
1) Bhargava A.K *Fuzzy Set Theory Fuzzy Logic and Their Applications,* S.Chand& Company Pvt. Ltd.2013.
2) Chennakesava,R.Alavala, *Fuzzy Logic and Neural Network Basic Concepts& Applications,* New Age International Publishers 2008.
3) George J.Klir and Boyuan*, Fuzzy sets Fuzzy Logic, Theory and Applications,* Prentice Hall of India , 2002.
4) George Bojadziev and Maria Bojadziev, *Fuzzy Sets, Fuzzy Logic, Applications*, 1996.
5) Bhargava A.K.*Fuzzy Set Theory Fuzzy Logic and their Applications,* 2013.

Web Resources :
 1.https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf
 2. https://link.springer.com/book/10.1007/978-3-642-35221-8
 3. https://www.b-farhadinia.ir/bfarhadiadmin/file/stdfile/Klir.pdf

E-books :
1. https://bookauthority.org/books/beginner-fuzzy-logic-ebooks
2. https://www.phindia.com/Books/ShowBooks/NzI/Fuzzy-Sets-and-Fuzzy-Logic
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119193210

Pedagogy :
Chalk and Talk, Group Discussion, Student Seminar, Spot Test, Assignments, Quiz.

Rationale for Nature of the Course:

 Knowledge and Skill
To understand the concept of fuzzy and its application in various field

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 resource

Course Learning Outcomes (CLO):

On successful Completion of the course Students will be able to

CLO	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Understand to Examine the Basic Concepts of Crisp sets and Fuzzy sets	Up to K4
CLO2	Describe Fuzzy Operations	Up to K4
CLO3	Understand the concept of Fuzzy Arithmetic	Up to K4
CLO4	Determine the difference between Crisp and Fuzzy Relation	Up to K5
CLO5	Use Fuzzy Relation as tools to Visualize and Simplify	Up to K5

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3– Application oriented – Solving Problems

K4 –Examining, analyzing, presentation and make inferences with evidences

K5- Evaluating, making Judgments based on criteria

Mapping of Course Learning Outcome(CLOs) with Program Outcomes(Pos)

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

1 – Basic Level   **2 – Intermediate Level**   **3- Advance Level**

Lesson Plan:

Units	Course Contents	75 Hours		Mode of Teaching
I	Introduction , Crisp Sets	5		Chalk & Talk
	An Overview: The Notation of Fuzzy Sets.	5	15	
	Basic Concepts: Fuzzy Sets, Classical Logic: An Overview, Fuzzy Logic.	5		
II	General Discussion, Fuzzy Complement, Fuzzy Union , Fuzzy Intersection	5	15	Chalk & Talk
	Fuzzy Intersection, Combinations of Operations Combinations of Operations, General Aggregation Operations.	10		
III	Crisp and Fuzzy Relations	5		Chalk & Talk, Spot Test Group Discussion
	Relations, Binary Relations On a Single Set	5		
	Equivalence and Similarity Relations	5	15	
IV	Compatibility	5		Chalk & Talk
	Tolerance Relations	5		
	Orderings	5	15	
V	Morphisms	10		Chalk & Talk
	Fuzzy Relation and Equation	5	15	Students Seminar
	Total		**75**	

Department of Mathematics						I M.Sc.,		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
2	DSEC	23OPMADSE2A	Modelling And Simulation With Excel	3	5	25	75	100

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

Course Objectives:

- To introduce the concepts and to develop working knowledge on Excel, Calculation in Excel, Formatting the Spread sheet, working with tables andCharts.

Course Content:

Unit	Course Content	75 Hours	K Level	CLO
I	**First look at Excel**: The screen and its Elements – Navigating the spreadsheet – Writing the cells – Adaptation of cell size – Selecting Cells.	15	Up toK3	CLO1
II	**Calculations**: Formulas – Formulas with references – Functions –Copying cells: Simple copying – Series – Copying Formulas.	15	Up toK4	CLO2
III	**Formatting**: Text and colours – Number Formats – Date andTime – Formatting Tables – Conditional Formatting – Themes and Styles.	15	Up toK4	CLO3
IV	**Working with Tables**: Create a Table – Filtering – Auto filter –Advanced Filter – Advanced Filter with Formulas – Sorting – Pivot tables – Preserving Results.	15	Up toK5	CLO4
V	**Charts**: Bar Charts – Line Charts – Charts with both Columns andLines – Circle Charts – Scatter Charts – Chart Sheet – Viewing and Printing – Viewing – Adjust Print Range	15	Up toK5	CLO5

Book for study:

Pc Software for Windows 98 made simple, R.K.Taxali, McGraw HillEducation, 2001

Books for Reference:

1. Microsoft Office Excel 2007, Torben Lage Frandsen, Torben LageFrandsen & Ventus Publishing Aps,
2.Guerrero, H. Excel Data Analysis Modelling and Simulation, Springer,London (2010)

Web Resources:

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

Pedagogy:

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

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:

CLO	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Illustrate the concepts of excel screen, navigating spreadsheet, Selecting cells	Up to K2
CLO2	Analyze the formulas, functions in excel, copying the cells, series and formulas	Up to K3
CLO3	Determine the text and colours, date and time, formatting tables and themes andstyles	Up to K3
CLO4	Apply to create a table, Filtering, sorting pivot tables and preserving results	Up to K4
CLO5	Enhance the knowledge in creating bar charts, line charts, circle charts, scattercharts and adjust print range	Up to K4

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

Lesson Plan

Unit	Description	75 Hours		Pedagogy
I	The screen and its Elements – Navigating the spreadsheet	10	15	Lecture, Chalk and talk
	Writing the cells – Adaptation of cell size – Selecting Cells.	5		Lecture, Assignment
II	Calculations: Formulas – Formulas with references – Functions	10	15	Lecture, Group Discussion
	Copying cells: Simple copying – Series – Copying Formulas.	5		Lecture, Assignment
III	Formatting: Text and colours – Number Formats – Date and Time	5	15	Lecture, Seminar
	Formatting Tables – Conditional Formatting – Themes and Styles.	10		Lecture, Quiz
IV	Working with Tables: Create a Table – Filtering – Auto filter – Advanced Filter	10	15	Lecture, Chalk and talk, Seminar
	Advanced Filter with Formulas – Sorting – Pivot tables – Preserving Results.	5		Lecture, Assignment
V	Charts: Bar Charts – Line Charts – Charts with both Columns and Lines	5	15	Lecture, PPT, Seminar
	Circle Charts – Scatter Charts – Chart Sheet – Viewing and Printing – Viewing – Adjust Print Range.	10		Lecture, Chalk andTalk
	Total		**75**	

I M.Sc.,								
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
2	DSEC	23OPMADSE2B	Fluid Dynamics	3	5	25	75	100

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

Course Objectives

1. To develop an application for properties of Newtonian Fluid.
2. To Study analytical solution to variety of simplified problems.
3. To understand the dynamics of fluid flows and governing the non-dimensional   parameters.
4. To give fundamental knowledge of fluid, its properties and   behavior under various conditions of   internal and external flows.

Course Content:

Unit	Course Content	75 Hours	K Level	CLO
I	Real fluids and Ideal fluids- Velocity of a fluid at a point – streamlines path lines- velocity potential –Vorticity Vector – Equation of continuity – acceleration of a fluid	15	Up to K4	CLO1
II	Equation of motion of a fluid: Pressure at a point in a fluid at rest – pressure at a point in a moving fluid-Euler's equations of motion – Bernoulli's Equation, Bernoulli's theorem.	15	Up to K4	CLO2
III	Some two-dimensional flows: meaning of two- dimensional flow –stream function – two dimensional image systems- Milne – Thomson circle theorem –Theorem of Blasius.	15	Up to K4	CLO3
IV	Elements of Thermodynamics: The equation of state of a substance – the first law of thermodynamics- internal energy of a gas – specific heats o f a gas- function of state; Entropy-Maxwell's thermodynamics relation	15	Up to K5	CLO4
V	Shock waves: formation of shock waves – elementary analysis of normal shock waves –elementary analysis of oblique shock waves-the method of characteristics for two – dimensional ,homentropic, irrational flow.	15	Up to K5	CLO5

Book for study:

F.Chorlton: *Text book of Fluid Dynamics*, CBS publishers and Distributors Pvt.Limited,2004.

Books for Reference:

1. M.D.Raisinghania: *Fluid Dynamics*, S.Chand,2003.
2. Michel Rieutord: *Fluid Dynamics*, Springer International Publishing,2015.
3. Geoffrey K. Vallis *Essentials of Atmospheric and Oceanic Dynamics* 1st dition,2019.
4. Richard W. Johnson *: Handbook of Fluid Dynamics* 2nd Edition.
5. George EmKarniadakis , Spencer J. SherwinSpectral/hp *Element Methods for Computational Fluid Dynamics (Numerical Mathematics and Scientific Computation)* 2nd Edition

Web Resourses:

1.https://www.meteo.physik.unimuenchen.de/lehre/roger/manuskripte/Fluid_Dynamics.pdf

2. http://www.ccpo.odu.edu/~klinck/Reprints/PDF/groschBook2011.pdf

3.https://www.engineerclassroom.com/2019/01/a-textbook-of-fluid-mechanics-and_18.html

E-books:

1.http://www.issp.ac.ru/ebooks/books/open/Advanced_Fluid_Dynamics.pdf

2.https://www.u-cursos.cl/usuario/5d90bc31eadb7b756f4a0d3fd9789c4f/mi_blog/r/1205763481Batchelor.-Introduction-to-Fluid-Dynamics.pdf

Pedagogy:

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

Rationale for nature of Course:

Knowledge and Skill:

- Students will get the knowledge of basic principles of fluids mechanics
- To get the ability to analyze the fluid flow problems with the application of Bernoulli's theorem.

Activities to be given: We will be providing students with intellectual problems, theory application problems, group discussions 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:

No.	Course Learning Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Describe the principles of motion for fluids	Up to K4
CLO2	Formulate the motion of fluid element	Up to K4
CLO3	Use the dimensional analysis and derive dimensional numbers	Up to K4
CLO4	Understanding of thermo dynamics properties and processes	Up to K5
CLO5	Be able to analyze shock waves	Up to 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	2	1	3	2	3	3
CLO2	1	2	2	2	1	3
CLO3	1	1	3	3	1	3
CLO4	2	2	2	2	2	3
CLO5	2	2	3	2	3	3

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

Lesson Plan

Unit	Course Content		75 Hours	Mode of Teaching
1	Real fluids and Ideal fluids- Velocity of a fluid at a point	5	15	Chalk and Talk
	streamlines path lines- velocity potential	5		
	Vorticity Vector – Equation of continuity – acceleration of a fluid.	5		
II	Equation of motion of a fluid: Pressure at a point in a fluid at rest	5	15	Chalk and Talk
	pressure at a point in a moving fluid-Euler's equations of motion	5		
	Bernoulli's Equation, Bernoulli's theorem.	5		
III	Some two-dimensional flows: meaning of two-dimensional flow	5	15	Chalk and Talk
	stream function – two dimensional image systems	5		
	Milne – Thomson circle theorem –Theorem of Blasius.	5		
IV	Elements of Thermodynamics: The equation of state of a substance – the first law of thermodynamics	5	15	PowerPoint Presentation &Seminar
	internal energy of a gas – specific heats of a gas-function of state; Entropy	5		
	Maxwell's thermodynamics relation	5		
V	Shock waves: formation of shock waves – elementary analysis of normal shock waves	5	15	PowerPoint Presentation &Seminar
	elementary analysis of oblique shock waves-the method of characteristics for two	5		
	dimensional, homentropic, irrational flow.	5		
	Total		**75**	

Department of Mathematics						I M.Sc.,		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
2	DSEC	23OPMADSE2C	Mathematical Statistics	3	5	25	75	100

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

Course Objectives:

- To know the desirable qualities for an estimator and learn a number oftechniques for finding minimum variance
- To understands the elements of hypothesis test and be able to carry outa number of different hypothesis test.
- To Formulate, test and interpret various hypothesis tests.
- To Characterize, compare, and contrast different nonparametrichypothesis tests.

Unit	Course Content	75 Hours	K Level	CLO
I	**Distribution of Functions of Random Variables:** Sampling Theory – Transformations of Variables of the Discrete Type – Transformations of Variables of the Continuous Type – The t and F Distributions.	15	Up toK3	CLO1
II	**Order Statistics:** Distributions of Order Statistics - The MomentGenerating Function Technique. The Distributions of X and ns^2/σ^2 – Expectations of Functions of Random Variables.	15	Up toK4	CLO2
III	**Estimation Theory:** Point Estimation – Measures of Quality ofEstimators – Confidence Intervals for Means – Confidence Intervals for Differences of Means - Confidence Intervals for Variances – Bayesian Estimates.	15	Up toK4	CLO3
IV	**Statistical Hypothesis**: Some Examples and Definitions – Certain Best Tests – Uniformly Most Powerful Tests – Likelihood Ratio Tests.	15	Up toK5	CLO4
V	**Nonparametric Methods**: Confidence Intervals for Distribution Quantiles – Tolerance Limits for Distributions – The sign Test – A Test of Wilcoxon – The Equality of Two Distributions – The Mann Whitney – Wilcoxon Test.	15	Up toK5	CLO5

Book for study:

Robert V. Hogg and Allen T. Craig,"Introduction to MathematicalStatistics"(Fourth Edition), Mcmillan publishing Co., Inc., New York.

Chapters

UNIT	CHAPTER(S)	SECTIONS
I	4	4.1 to 4.4
II	4	4.6 to 4.9
III	6	6.1 to 6.6
IV	7	7.1 to 7.4
V	9	9.1 to 9.6

Books for Reference:

1. M. Fisz, Probability theory and Mathematical Statistics, John Wiley &Sons New York, 1963.
2. E.J. Dudewiczn and S.N.Mishra,   Modern Mathematical Statistics, JohnWiley & Sons, New York, 1988.
3. V.N. Rohatgi, An Introduction to Probability theory and MathematicalStatistics, Wiley Eastern Limited, New Delhi, 1988.

Web Resources:

- http://mathforum.org,
- http://ocw.mit.edu/ocwweb/Mathematics,
- http://www.opensource.org
- https://stat.ethz.ch/~geer/mathstat.pdf

Pedagogy:

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

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:

CO	Course learning outcome	K-level
CO1	To determine transformations of variables of discrete and continuous typesand t and F distributions.	Upto K3
CO2	To compute order statistics, moment generating function and expectation of function of random variables	Upto K4
CO3	To construct point and interval estimators and evaluate their goodness.	Upto K4
CO4	To decide as to which test of significance is to be applied for any given large sample problem.	Upto K5
CO5	To analyze the different nonparametric methods in estimation, testing, model fitting, and in analyses.	Upto K4

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

Lesson Plan

Unit	Topics	75 Hours		Mode
I	Sampling Theory – Transformations of Variables of the Discrete Type	5	15	Lecture, Quiz.
	Transformations of Variables of the Continuous Type	5		
	The t and F Distributions.	5		
II	Distributions of Order Statistics - The Moment Generating Function Technique.	5	15	Lecture, Quiz.
	The Distributions of $\bar{X}$ and ns^2/σ^2	5		
	Expectations of Functions of Random Variables.	5		
III	Point Estimation – Measures of Quality of Estimators .	5	15	PPT,Lecture, Quiz, GD
	Confidence Intervals for Means – Confidence Intervalsfor Differences of Means	5		
	Confidence Intervals for Variances – Bayesian Estimates.	5		
IV	Some Examples and Definitions – Certain Best Tests –	5	15	PPT Lecture, Quiz.
	Uniformly Most Powerful Tests –.	5		
	Likelihood Ratio Tests.	5		
V	Confidence Intervals for Distribution Quantiles – Tolerance Limits for Distributions.	5	15	Assignment and Seminar.
	The sign Test – A Test of Wilcoxon.	5		
	The Equality of Two Distributions – The MannWhitney – Wilcoxon Test.	5		
	Total hours		**75**	

Department of Mathematics						I M.Sc.,		
Sem	Category	Course Code	Course Title	Credits	Contact Hours/week	CIA	SE	Total
2	DSEC	23OPMADSE2D	Stochastic Process	3	5	25	75	100

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

Course Objectives:

- Acquire intense knowledge on the underlying concepts of Stochastic processes
- Familiarize with Markov chain and system
- Obtain in-depth understanding of birth and death process
- Develop the acquaintance with applications of Markov process
- Comprehend the concept of renewal process

Course Content:

Unit	Course Contents	75 Hours	K Level	CLO
I	Stochastic Processes -Specification of stochastic processes – Stationary processes – Martingales - MarkovChains: Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials.	15	Up toK3	CLO1
II	Markov Chains: Classification of States andChains – Determination of Higher transitionprobabilities – Stability of Markov system –Graph theoretic approach – Markov chain with denumerable number of states – Reducible chains.	15	Up toK4	CLO2
III	Poisson process: Poisson process and related distributions – Generalizations of Poisson process – Birth and death process – Markov process with discrete state space (Continuous time Markov chain).	15	Up toK4	CLO3
IV	Markov Process with continuous state space – Brownian motion – Weiner process – Differential equations for Weiner Process – Kolmogorov equations.	15	Up toK4	CLO4
V	Renewal process and renewal equation – Stopping time – Wald's equation – Renewal theorems.	15	Up toK4	CLO5

Book for Study:

Medhi.J, "*Stochastic Processes*", New Age International, Cochin, 2nd edition 2017.

UNIT	CHAPTER(S)	SECTIONS
I	2& 3	2.1 to 2.4 & 3.1 to 3.3
II	3	3.4 to 3.9
III	4	4.1 to 4.5
IV	5	5.1 to 5.4
V	6	6.1 to 6.5

Books for Reference:

1) Leo Breiman., *Probability and Stochastic Processes*, Houghton Mifflin,2008
2) Athanasios Papoulis., *Probability Random Variable & Stochastic Process*, McGraw Hill, International, IIEdition, 2004.
3) Peter Watts Jones &Peter Smith "*Stochastic Processes An Introduction,* Third Edition 2018

4) *Stochastic Processes and Applications:* Diffusion Processes, the Fokker-Planck and Langevin Equations(Texts in Applied Mathematics, 60) 2014th Edition
5) Edward P.C Kao " *An Introduction to stochastic processes"* Dover Publication 2019.

Web Resources

1. https://wwwf.imperial.ac.uk/~pavl/PavliotisBook.pdf
2. https://www.mdpi.com/books/pdfdownload/book/1855
3. http://www.ma.ic.ac.uk/~pavl/lecture_notesM4A42.pdf

E-books

1. **https://link.springer.com/chapter/10.1007/978-1-4939-1323-7_1**
2. **https://link.springer.com/content/pdf/10.1007/978-3-030-22297-0.pdf**

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 Stability of Markov system – Graph theoretic approach

- Apply stochastic problems

Activities to be given:

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

Course Learning Outcome (CLOs)

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CLO1	Correlate the concepts of stochastic processes with illustrations	Up to K3
CLO2	Illustrate Markov chain and its applications	Up to K4
CLO3	Compare the conceptualization of pure birth and deathprocess	Up to K4
CLO4	Apply Markov process in solving problems	Up to K4
CLO5	Summarize the concepts of renewal process and its applications	Up to K4

K1- Remembering facts with specific

K2- Basic understanding of facts.

K3- Application oriented

K4- Analyzing, examining and making presentations with evidences

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

	PO1	PO2	PO3	PO4	PO5	PO6
CL O1	3	2	3	2	3	3
CL O2	3	2	2	2	1	3
CL O3	3	3	2	2	2	3
CL O4	3	3	2	2	1	3
CL O5	3	3	2	2	1	3

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

Lesson Plan

Unit	Course Content	Hours	Total Hours	Mode of Teaching
1	Stochastic Processes -Specification of stochastic processes – Stationary processes	5	15	Chalk & Talk
	Martingales - Markov Chains: Definitions and Examples	5		
	Higher transition probabilities – Generalization of independent Bernoullitrials.	5		
II	Markov Chains: Classification of States and Chains – Determination ofHigher transition probabilities	10	15	Chalk & Talk
	Markov chain with denumerable number of states – Reducible chains.	5		
III	Poisson process: Poisson process and related distributions	5	15	Chalk & Talk
	Generalizations of Poisson process – Birth and death process	5		
	Markov process with discrete state space (Continuous time Markov chain).	5		
IV	Markov Process with continuous state space – Brownian motion	5	15	PowerPoint Presentation&Seminar
	Weiner process – Differential equations for Weiner Process	5		
	Kolmogorov equations.	5		
V	Renewal process and renewal equation	5	15	PowerPoint Presentation & Seminar
	Stopping time – Wald's equation	5		
	Renewal theorems.	5		
Total hours			**75**	