**MOTHER TERESA WOMEN'S UNIVERSITY** 

## KODAIKANAL

## **DEPARTMENT OF MATHEMATICS**

## **M.Sc. MATHEMATICS**



# SYLLABUS TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2023-2024 (CHOICE BASED CREDIT SYSTEM)

## Mother Teresa Women's University, Kodaikanal Department of Mathematics Choice Based Credit System (CBCS) (2023-2024 onwards) M.Sc. Mathematics

#### 1. About the Programme:

The M. Sc Mathematics curriculum is dedicated to preparing students for productive careers after

3-5 years of graduation.

1. Apply their knowledge in modern industry or teaching or secure acceptance in High quality

graduate programs in mathematics

- 2. Development in their chosen profession and/or progress toward an advanced degree
- 3. The trust and respect of others as effective and ethical team members.
- 4. Graduates will become effective collaborators and innovators, leading or participating In efforts to address social, technical and business challenges.
- 5. Promote the culture of interdisciplinary research among all disciplines and applied Mathematics

#### **2** Programme Educational Objectives (PEOs)

## 3. Eligibility : B.Sc Mathematics , B.Sc Applied Mathematics B.Sc Mathematics with ComputerApplications

#### **General Guidelines for PG Programme:**

**1. Duration:** The programme shall extend through a period of 4 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.

#### 2. Medium of Instruction: English

**3. Evaluation:** Evaluation of the candidates shall be through Internal and External assessment. The ratio of formative and summative assessment should be 25:75 for both Core and Elective papers.

#### **Evaluation Pattern**

	The	eory	Practical		
	Min	Max	Min	Max	
Internal	13	25	13	25	
External	38	75	38	75	

- Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz (5) = 25
- External Theory: 75

### Written Examination : Theory Paper (Bloom's Taxonomy based)

**Question paper Model** 

	Maximum 75 Marks
Intended Learning Skills	Passing Minimum: 50%
	<b>Duration : Three Hours</b>
Part	$-A(10x \ 2 = 20 \ Marks)$
Ar	nswer ALL questions
Each	Question carries 2mark
Memory Recall / Example/	
Counter Example / Knowledge about	Two questions from each UNIT
the Concepts/ Understanding	
	Question 1 to Question 10
Part	– B (5 x 5 = 25 Marks)
An	swer ALL questions
Each q	uestions carries 5 Marks
Descriptions/ Application	Either-or Type
(problems)	Both parts of each question from the same UNIT

	Question 11(a) or 11(b)
	То
	Question 15(a) or 15(b)
Part	-C $(3x\ 10 = 30\ Marks)$
Answe	r any THREE questions
Each qu	uestion carries 10 Marks
Analysis /Synthesis / Evaluation	There shall be FIVE questions covering all the five
	units
	Question 16 to Question 20

Each question should carry the course outcome and cognitive level

#### **Different Types of Courses**

#### **Project Report**

A student should select a topic for the Project Work at the end of third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman 12 font size with 1.5 line space.

#### **Evaluation:**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks, Viva: 75 Marks)

Minimum credits required to pass - 91.

5. Conversion of Marks to Grade Points and letter Grade(Performence in a Course/Paper)

Range	of	Grade Points	Letter Grade	Description
Marks				
90-100		9.00-10.00	0	Outstanding
80-89		8.0-8.9	<b>D</b> <sup>+</sup>	Excellent

75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	$\mathbf{A}^+$	VeryGood
60-69	6.0-6.9	Α	Good
50-59	5.0-5.9	В	Average
00-49	0.0-4.9	U	Re-Appear
ABSENT	0.0	AAA	ABSENT

#### 5. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination, Students with 71% to 74% of attendance must apply for condonation in the prescribed form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students with attended less than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, principal and the Registrar of the University.

**6.Maternity Leave** – The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and The Registrar.

#### 7.Any Other Information:

In addition to the above regulations, any other common regulations pertaining to the PG Programmes are also applicable for this programme

#### Post Graduate Programme

#### **Programme Outcomes:**

**PO1: Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a Post graduate programme of study.

**PO2: Critical Thinking:** Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify

relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

**PO3: Problem Solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.

**PO4:** Analytical & Scientific Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

**PO5: Research related skills:** Ability to analyze, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned research perspective; Sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and affect relationships / define problems. Formulate hypothesis, Test / analyze / interpret the results and derive conclusion, formulation and designing mathematical models

**PO6: Self-directed & Lifelong Learning:** Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

#### **M.Sc Mathematics**

#### **Programme Specific Outcomes:**

**PSO1:** Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

**PSO2:** Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

**PSO3:** To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

**Mapping of Course Learning Outcomes (CLOs)** with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grids:

			POs				PSOs	
	2	3	4	5	6	 1	2	
CLO1								
CLO2								
CLO3								
CLO4								
CLO5								

#### 3. Learning and Teaching Activities

#### 3.1 Topic wise Delivery method

Hour Count	Торіс	Unit	Mode of Delivery

#### 3.2 Work Load

The information below is provided as a guide to assist students in engaging appropriately with the course requirements.

Activity	Quantity	Workload periods
Lectures	60	60
Tutorials	15	15
Assignments	5	5
Cycle Test or similar	2	4
Model Test or similar	1	3
University Exam Preparation	1	3
	Total	90 periods

#### **1. Tutorial Activities**

Tutorial Count	Торіс

#### 2. Laboratory Activities

#### **3. Field Study Activities**

#### 4. Assessment Activities

#### **Assessment Principles:**

Assessment for this course is based on the following principles

- 1. Assessment must encourage and reinforce learning.
- 2. Assessment must measure achievement of the stated learning objectives.
- 3. Assessment must enable robust and fair judgments about student performance.
- 4. Assessment practice must be fair and equitable to students and give them the opportunity to demonstrate what they learned.
- 5. Assessment must maintain academic standards.

#### **Assessment Details:**

Assessment Item	Distributed Due Date	Weightage	Cumulative
			Weightage
Assignment 1	3 <sup>rd</sup> week	2%	2%
Assignment 2	6 <sup>th</sup> Week	2%	4%
Cycle Test – I	7 <sup>th</sup> Week	6%	10%
Assignment 3	8 <sup>th</sup> Week	2%	12%
Assignment 4	11 <sup>th</sup> Week	2%	14%
Cycle Test – II	12 <sup>th</sup> Week	6%	20%
Assignment 5	14 <sup>th</sup> Week	2%	22%
Model Exam	15 <sup>th</sup> Week	13%	35%
Attendance	All weeks as per the Academic Calendar	5%	40%
University Exam	17 <sup>th</sup> Week	60%	100%

#### **TEACHING METHODOLOGIES**

**Traditional Teaching method** like Chalk and Board, Virtual Classroom, LCD projector, Smart Class, Video Conference, Guest Lectures.

Asking students to formulate a problem from a topic covered in a week's time

Assignment, Class Test, Slip test

Asking students to use state-of-the-art technologies/software to solve problems

Applications, Use of Mathematical software

Introducing students to applications before teaching the theory

Training students to engage in self-study without relying on faculty (for example – library and internet search, manual and handbook usage, etc.)

Library, Net Surfing, Manuals, NPTEL Course Materials published in the website Other university websites.

#### **Faculty Course File Structure**

#### CONTENTS

- a. Academic Schedule
- b. Students Name List
- c. Time Table
- d. Syllabus
- e. Lesson Plan
- f. Staff Workload
- g. Course Design(content, Course Outcomes(COs), Delivery method, mapping of COs with Programme Outcomes(POs), Assessment Pattern in terms of Revised Bloom's Taxonomy)
- h. Sample CO Assessment Tools.
- i. Faculty Course Assessment Report(FCAR)
- j. Course Evaluation Sheet
- k. Teaching Materials(PPT, OHP etc.)
- l. Lecture Notes
- m. Home Assignment Questions
- n. Tutorial Sheets
- o. Remedial Class Record, if any.
- p. Projects related to the Course
- q. Laboratory Experiments related to the Courses
- r. Internal Question Paper
- s. External Question Paper
- t. Sample Home Assignment Answer Sheets
- u. Three best, three middle level and three average Answer sheets
- v. Result Analysis (CO wise and whole class)
- w. Question Bank for Higher studies Preparation (GATE/Placement)
- x. List of mentees and their academic achievements

## Credit Distribution for PG Programme in Mathematics

### **M.Sc.** Mathematics

### M.Sc. Mathematics- Curriculum

PART	Course Code	Course Title	Credits	Hours per week(L/ T/P)	CIA	ESE	Total
Semeste	r I						-
PART A	P23MTT101	Core Theory – 1: Algebraic Structures	5	7(6L+1T)	25	75	100
	P23MTT102	Core Theory – 2: Real Analysis I	5	7(6L+1T)	25	75	100
	P23MTT103	Core Theory – 3: Ordinary Differential Equations	4	6(5L+1T)	25	75	100
	P23MTE11A /	Discipline Specific Elective – 1: A. Number Theory and Cryptography	3	5(4L+1T)	25	75	100
	P23MTE11B /	B. Graph Theory and Applications					
	P23MTE11C /	C. Formal Languages and Automata Theory					
	P23MTE11D	D. Programming in C++ and Numerical Methods					
	P23WSG101	Elective-2: Generic Elective - Women Empowerment)	3	5(4L+1T)	25	75	100
		Total	20	30	-	-	500
Semeste	er II						
PART A	P23MTT204	Core Theory – 4: Advanced Algebra	5	6(5L+1T)	25	75	100
	P23MTT205	Core Theory – 5: Real Analysis II	5	6(5L+1T)	25	75	100
	P23MTT206	Core Theory – 6: Partial	4	6(5L+1T)	25	75	100

	P23MTE22A /	Discipline Specific Elective – 3:	3	4(3L+1T)	25	75	100
	P23MTE22B /	A. Lie Groups and Lie					
		Algebras					
		B. Mathematical					
		Programming					
	P23MTE22C /	C. Fuzzy Sets and					
		Their Applications					
	P23MTE22D	D. Discrete					
		Mathematics					
	P23CSG202	Generic Elective – 4:	3	4(3L+2T)	25	75	100
		Cyber Security					
	P23MTN201	NME-Skill Enhancement	2	4	Inte	rnal	100
		Course -SEC 1			Asses	sment	
		Total	22	30	_	_	600
				00			000
Semeste	r III						
Dennebue.	1 111						
PART A	P23MTT307	Core Theory – 7: Complex	5	6(5L+1T)	25	75	100
PART A	P23MTT307	Core Theory – 7: Complex Analysis	5	6(5L+1T)	25	75	100
PART A	P23MTT307 P23MTT308	Core Theory – 7: Complex Analysis Core Theory – 8: Topology	5 5	6(5L+1T) 6(5L+1T)	25 25	75 75	100 100
PART A	P23MTT307     P23MTT308     P23MTT309	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9:	5 5 5	6(5L+1T) 6(5L+1T) 6(5L+1T)	25 25 25	75 75 75	100 100 100
PART A	P23MTT307     P23MTT308     P23MTT309	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics	5 5 5	6(5L+1T) 6(5L+1T) 6(5L+1T)	25 25 25	75 75 75	100 100 100
PART A	P23MTT307     P23MTT308     P23MTT309     P23MTT310	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10:	5 5 5 4	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T)	25 25 25 25	75 75 75 75	100 100 100 100
PART A	P23MTT307     P23MTT308     P23MTT309     P23MTT310	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization	5 5 5 4	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T)	25 25 25 25	75 75 75 75	100 100 100 100
PART A	P23MTT307     P23MTT308     P23MTT309     P23MTT310	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques	5 5 5 4	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T)	25 25 25 25	75 75 75 75	100 100 100
PART A	P23MTT307     P23MTT308     P23MTT309     P23MTT310	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific	5 5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307 P23MTT308 P23MTT309 P23MTT310 P23MTF334 /	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A Eluid Dynamics	5 5 5 4 3	6(5L+1T)   6(5L+1T)   6(5L+1T)   6(5L+1T)   3(2L+1T)	25 25 25 25 25 25	75 75 75 75 75	100 100 100 100 100
PART A	P23MTT307 P23MTT308 P23MTT309 P23MTT310 P23MTE33A / P23MTE33B /	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307 P23MTT308 P23MTT309 P23MTT310 P23MTE33A / P23MTE33B / P23MTE33C /	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /   P23MTE33D	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /   P23MTE33D	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes	5 5 4 3	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T)	25 25 25 25 25	75 75 75 75 75	100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /   P23MTE33D   P23MTN302	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes NME-2	5 5 4 3 2	6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T) 3(2L+1T)	25 25 25 25 25 25	75 75 75 75 75 75	100 100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /   P23MTE33D   P23MTN302	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes NME-2	5 5 4 3 2	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T) 3(2L+1T)	25 25 25 25 25 25	75 75 75 75 75 75	100 100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33D   P23MTE33D   P23MTN302   P23MTI301	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes NME-2 Internship/Industrial	5 5 4 3 2	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T) 3(2L+1T)	25 25 25 25 25 25	75 75 75 75 75 75	100 100 100 100 100
PART A	P23MTT307   P23MTT308   P23MTT309   P23MTT309   P23MTT310   P23MTE33A /   P23MTE33B /   P23MTE33C /   P23MTE33D   P23MTT302   P23MTI301	Core Theory – 7: Complex Analysis Core Theory – 8: Topology Core Theory – 9: Mechanics Core Theory – 10: Advanced Optimization Techniques Discipline Specific Elective– 5: A. Fluid Dynamics B. Probability Theory and Mathematical Statistics C. Machine Learning and Artificial Intelligence D. Stochastic Processes NME-2 Internship/Industrial Activity	5 5 4 3 2 2	6(5L+1T) 6(5L+1T) 6(5L+1T) 6(5L+1T) 3(2L+1T) 3(2L+1T)	25 25 25 25 25 25 25	75 75 75 75 75 75	100 100 100 100 100

				20			600
		Total	26	30	-	-	600
Somosto	 II		20				
Semeste	1 11						
PART	P23MTT411	Core Theory – 11:	5	6(5L+1T)	25	75	100
А		Functional Analysis					
	P23MTT412	Core Theory – 12:	5	6(5L+1T)	25	75	100
		Differential Geometry					
	P23MTPR41	Core – 13: Project with	7	10	25	75	100
		Viva					100
		Discipline Specific	3	4(1L+3P)	25	75	100
		Elective-VI:					
	P23MTE44A / P22MTE44D / P22MTE4AD / P22MTE4AD / P22MTE4D / P22MTEAD / P2	A. MAI LAB					
	P23M1E44B/	B. Mathematical					
		LATEX / other packages					
	D23MTE44C/	C Mathematical Python					
	P23MTE44C7	D. Mathematical					
	1 25W11 D++D	Application MOOC course					
		Application WOOC course					
		(Industry Entrepreneurial					
		20% Theory and 80%					
		Practical)					
		,					
	P23MTS403	Skill Enhancement course-	2	4(2L+2P)	25	75	100
		SEC3-Professional					
		Competency Skill					
		Training for Competitive					
		Examinations					
		• Mathematics for NET /					
		UGC - CSIR/ SET /					
		TRB Competitive					
		Examinations (2 hours)					
		• General Studies for					
		UPSC / TNPSC / Other					
		Competitive					
		Examinations (2 hours)					
		OR					
		Mathematics for					
		Advanced Research					
		Basaarah Tools and					
		Techniques (from From F)					
		reeninques(nom riom r)					
				1		1	1

P23EAS401	Extension Activity	1		Inte	ernal	
				Asse	ssment	
	Tota	al 23	30	-	-	500

#### **Elective Courses**

Semester I : Elective I to be chosen from Group A

#### Group A: (PM/AP/IC/ITC)

- 1..Number Theory and Cryptography
- 2. Graph Theory and Applications
- 3.Formal Languages and Automata Theory
- 4. Programming in C++ and Numerical Methods

#### Semester II : Elective III to be chosen from Group B

#### Group B:(PM/AP/IC/ITC)

- E. Lie Groups and Lie Algebras
- F. Mathematical Programming
- G. Fuzzy Sets and Their Applications
- H. Discrete Mathematics

#### Semester III :

#### Elective V to be chosen from Group D

#### Group D:(PM/AP/IC/ITC)

**1.Fluid Dynamics** 

2. Probability Theory and Mathematical Statistics

- 3. Machine Learning and Artificial Intelligence
- **4.tochastic Processes**

Semester IV : Elective VI to be chosen from Group E

#### Group E :(PM/AP/IC/ITC)

A. MAT LAB

- B. .Mathematical documentation using LATEX / other packages
- C. Mathematical Python
- D. Mathematical Application MOOC course

#### **Skill Enhancement Courses**

Skill Enhancement Courses are chosen so as to keep in pace with the latest developments in the academic / industrial front and provides flexibility of choice by the stakeholders / institutions.

Group F :Skill Enhancement Courses) SEC-3

- Computational Mathematics using Sage Math
- Office Automation and ICT Tools
- Numerical analysis using Python
- Differential equations using Python
- Industrial Statistics with MINITAB

## SEMESTER -II /SEMESTER III -NME I /NME II- SEC I / SEC II GROUP- C

#### NME -Skill Enhancement Courses -SEC-I / SEC II

Students from other Departments may also choose any one of the following as NME NME -1: Mathematics for Life Sciences/ Differential Equations NME-2: Mathematics for Social Sciences/ Numerical Methods NME -3: Statistics for Life and Social Sciences/ Statistics NME -4: Game Theory and Strategy/ Operation Research NME -5: History of Mathematics/ Mathematical Aptitude

#### **Outside class hours**

- Health, Yoga and Physical Fitness
- Library Information access and utilization
- Employability Training
- Students Social Responsibility

#### **Testing Pattern** (25+75)

#### **Internal Assessment**

**Theory Course:** For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

**Computer Laboratory Courses:** For Computer Laboratory oriented Courses, there shall be two tests in Theory part and two tests in Laboratory part. Choose one best from Theory part and other best from the two Laboratory part. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one / one and a half hour. There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

#### (v) Institution-Industry-Interaction(Industry aligned Courses)

Programmes /course work/ field study/ Modelling the Industry Problem/ Statistical Analysis / Commerce-Industry related problems / MoU with Industry and the like activities.

## SYLLABUS M.Sc. MATHEMATICS

Title of the Course	ALGEBRAIC STURUCTURES								
Paper Number	CORE I			-			-		
Category Core	Year	Ι	Credits	5	Cou	rse	P23MTT101		
	Semester	Ι			Code				
Instructional Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	ıl		
per week	6	1				7			
Pre-requisite	UG level M	lodern	Algebra						
<b>Objectives</b> of the	To introduc	To introduce the concepts and to develop working know							
Course	class equati	on, sol	lvability of	groups, fin	nite a	belian	groups, linear		
	transformati	ons, re	al quadratic	forms					
	UNIT-I:Co	UNIT-I: Counting Principle - Class equation for finite groups and							
	its applications - Sylow's theorems (For theorem 2.12.1, First proof								
	only).								
Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)									
	UNIT II - Direct products - Finite abelian groups- Modul								
	Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)								
	Chapter 4:	Section	n 4.5	diama Carrier		<b>C</b>	Tuis a seale a		
	<b>UN11-111</b> : Linear Transformations: Canonical forms – Irlangular								
	Chapter 6: Sections 6.4.6.5								
	UNIT-IV · Jordan form - Rational canonical form								
	Chapter 6 · Sections 66 and 67								
	Chapter 0.	Sectio		0.7					
	UNIT-V: Trace and transpose - Hermitian, unitary, normal								
	transformations, real quadratic form.								
	Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)								
Extended Professional	Questions r	elated	to the abo	ve topics,	trom	vario	ous competitive		
Component (is a part of	examination	IS UPS	C / TRB / M	NET / UGC	-CS	SIR / C	GATE / TNPSC		
internal component	/ others to be	e solve	d		、 、				
only, Not to be included	(To be discu	issed di	uring the Tu	itorial hour	)				
in the External									
Examination question									
paper)									
Skills acquired from this	Knowledge	, Prob	olem Solvi	ng, Analy	tical	ability	y, Professional		
course	Competency	, Profe	essional Con	nmunicatio	n and	Trans	sterrable Skill		
Recommended Text	I.N. Herstein New Delhi	n. Topi <u>2002</u> .	cs in Algeb	ora (II Editio	on) W	iley E	Eastern Limited,		

Deference Deele	1 MArtin Alashua Droptico Hall of India 1001
Reference DOOKS	1. M.Atun, Aigeora, Plenuce Hall of India, 1991.
	2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, <i>Basic Abstract</i>
	Algebra (II Edition) Cambridge University Press, 1997. (Indian
	Edition)
	3. I.S.Luther and I.B.S.Passi, <i>Algebra</i> , Vol. I –Groups(1996); Vol.
	II Rings, Narosa Publishing House, New Delhi, 1999
	4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of
	Abstract Algebra, McGraw Hill (International Edition), New
	York. 1997.
	5. N.Jacobson, <i>Basic Algebra</i> , Vol. I & II W.H.Freeman (1980);
	also published by Hindustan Publishing Company, New Delhi.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.algebra.com

Students will be able to

**CLO 1:** Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups

**CLO 2:** Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules

**CLO 3:** Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.

**CLO 4:** Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.

**CLO 5:** Define trace, define transpose of a matrix,explain the properties of trace and transpose, to find trace, to find transpose of matrix,to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint,to define Hermitian, unitary, normal transformations andto verify whether the transformation in Hermitian, unitary and normal

			PO	PSOs					
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	REAL ANALYSIS I										
Paper Nur	nber	CORE II										
Category	Core	Year	Ι		Credits	5	Cou	rse	P23MTT102			
		Semester	Ι				Cod	e				
Instruction	nal	Lecture		Tuto	orial	Lab Prac	tice	Tota	al			
Hours		6		1				7				
per week												
Pre-requis	ite	UG level 1	UG level real analysis concepts									
Objectives	of the	To work of	comfo	ortably	y with func	tions of bo	ounde	d vari	ation, Riemann-			
Course		Stieltjes In	tegra	tion, c	convergence	e of infinite	e serie	s, infi	nite product and			
		uniform c	onve	rgence	e and its	interplay	betwo	een v	various limiting			
		operations.										
Course Ou	ıtline	UNIT-I:	Func	tions	of bounde	d variatio	<b>n</b> - Int	roduc	tion - Properties			
		of monoto	onic 1	functi	ons - Fun	ctions of	bound	led v	ariation - Total			
		variation -	Add	litive	property of	total varia	tion -	Total	variation on [a,			
		x] as a fun	ction	of x -	Functions	of bounde	d vari	ation	expressed as the			
		difference of two increasing functions - Continuous functions of										
		bounded variation.										
		Chapter – 6 : Sections 6.1 to 6.8										
		Infinite Series : Absolute and conditional convergence - Dirichlet's										
		test and A	bel's	test -	Rearrangen	nent of ser	ies - 🛛	Riema	ann's theorem on			
		conditiona	lly co	nverg	ent series.							
		Chapter 8	: Sect	ions	8.8, 8.15, 8	17, 8.18						
		UNIT-II :	The <b>I</b>	Riema	nn - Stielt	jes Integra	<b>l</b> - Int	roduc	tion - Notation -			
		The definit	The definition of the Riemann - Stieltjes integral - Linear Properties -									
		Integration by parts- Change of variable in a Riemann - Stieltjes										
		integral - Reduction to a Riemann Integral - Euler's summation										
		formula - Monotonically increasing integrators, Upper and lower										
		integrals - Additive and linearity properties of upper, lower integrals -										
		Riemann's condition Comparison theorem										
		Chapter - 7 : Sections 7.1 to 7.14										
		UNIT-III	: The	e Riei	nann-Stiel	tjes Integr	al - I	ntegra	ntors of bounded			
		variation-S	uffic	ient c	onditions f	or the exis	stence	of R	iemann-Stieltjes			
		integrals-Necessary conditions for the existence of RS integrals- Mean										
		value theo	orems	-inte	egrals as a	function	of th	e int	erval – Second			
		fundamental theorem of integral calculus-Change of variabl							variable -Second			
		Mean Va	lue	Theor	rem for F	Riemann i	ntegra	ıl- R	iemann-Stieltjes			
		integrals de	epend	ling o	n a paramet	er. Differe	ntiatio	on unc	ler integral sign-			
		Lebesgue	criter	iaon f	for existence	e of Riem	ann ii	ntegra	ls Chapter - 7 :			
		7.15 to 7.26										

r	
	UNIT-IV :Infinite Series and infinite Products - Double sequences -
	Double series - Rearrangement theorem for double series - A sufficient
	condition for equality of iterated series - Multiplication of series -
	Cesarosummability - Infinite products.
	Chapter - 8 Sec, 8.20, 8.21 to 8.26
	Power series - Multiplication of power series - The Taylor's series
	generated by a function - Bernstein's theorem - Abel's limit theorem -
	Tauber's theorem
	Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23
	UNIT-V: Sequences of Functions – Pointwise convergence of
	sequences of functions - Examples of sequences of real - valued
	functions - Uniform convergence and continuity - Cauchy condition for
	uniform convergence - Uniform convergence of infinite series of
	functions - Riemann - Stieltjes integration – Non-uniform Convergence
	and Term-by-term Integration - Uniform convergence and
	differentiation- Sufficient condition for uniform convergence of a
	series - Mean convergence.
	Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10 ,9.11and 9,13
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /
Component (is a part	others to be solved
of internal	(To be discussed during the Tutorial hour)
component only,	
Not to be included in	
the External	
Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
this course	Competency, Professional Communication and Transferrable Skill
Recommended	Tom M.Apostol :Mathematical Analysis, 2 <sup>nd</sup> Edition. Addison-
Text	Wesley Publishing Company Inc. New York, 1974.

<b>Reference Books</b>	1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976.									
	2. Rudin, W. Principles of Mathematical Analysis, 3rd Edition. McGraw									
	Hill Company, New York, 1976.									
	3. Malik, S.C. and SavitaArora. Mathematical Anslysis, Wiley Eastern									
	Limited.New Delhi, 1991.									
	4. Sanjay Arora and BansiLal, Introduction to Real Analysis,									
	SatyaPrakashan, New Delhi, 1991.									
	5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis,									
	Holden day, San Francisco, 1964.									
	6. A.L.Gupta and N.R.Gupta, Principles of Real Analysis, Pearson									
	Education, (Indian print) 2003.									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org, www.mathpages.com									

Students will be able to

CLO1: Analyze and evaluate functions of bounded variation and Rectifiable Curves.

CLO2: Describe the concept of Riemann-Stieltjes integral and its properties.

**CLO3**:Demonstrate the concept of step function, upper function, Lebesgue function and their integrals.

**CLO4:**Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.

**CLO5:** Formulate the concept and properties of inner products, norms and measurable functions.

			P	PSOs					
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the C	Course	ORDINARY DIFFERENTIAL EQUATIONS											
Paper Numb	er	CORE III											
Category C	ore	Year	Ι		Credits	4	Cou	rse	P23MTT103				
		Semester	Ι			Cod		le					
Instructional	l	Lecture	,	Tuto	rial	Lab Prac	tice	Tota	al				
Hours		5		1				6					
per week													
Pre-requisite	•	UG level Calculus and Differential Equations											
<b>Objectives</b>	of the	To devel	op sti	rong	backgrou	nd on fir	nding	solu	tions to linear				
Course		differential	equat	tions	with const	ant and va	riable	coeff	ficients and also				
		with singu	with singular points, to study existence and uniqueness of the solutio										
		of first ord	er diff	ferent	tial equatio	ns							
Course Outli	ine	UNIT-I:	Linear	· equ	ations with	n constant (	coeffi	cients	5				
		Second or	der ho	omog	eneous eq	uations-Init	tial v	alue	problems-Linear				
		dependenc	e and	d in	dependenc	e-Wronskia	an a	nd a	a formula for				
		Wronskian-Non-homogeneous equation of order two.											
		Chapter 2	Chapter 2: Sections 1 to 6										
		UNIT-II:	Linea	r equ	ations wit	h constant	coeff	ficient	ts				
		Homogene	ous an	id noi	n-homogen	eous equati	ion of	order	n –Initial value				
		problems-	Annihi	ilator	method to	solve non-	homo	geneo	ous equation-				
		Algebra of	consta	ant co	oefficient o	perators.							
		Chapter 2	: Sect	ions	7 to 12.								
		UNIT-III	:Linea	ır equ	uation wit	h variable	coeffi	cients	5				
		Initial valu	e prob	lems	-Existence	e and uniqu	eness	theor	rems – Solutions				
		to solve a non-homogeneous equation – Wronskian and linear											
		dependence - reduction of the order of a homogeneous equation -											
		homogene	ous e	quati	on with	analytic o	coeffi	cients	-The Legendre				
		equation.											
		Chapter	: 3 Sec	ctions	s 1 to 8 ( O	mit sectio	n 9)						
		UNIT-IV	:Linea	ır equ	lation witl	n regular s	ingul	ar poi	ints				
		Euler equa	tion –	Seco	nd order e	quations wi	ith reg	gular s	singular points –				
		Exceptiona	al cases	s - B	essel Funct	ion.							
		Chapter 4	Se : Se	ction	<u>s 1 to 4 an</u>	<u>d 6 to 8 (</u>	<u>Omit</u> s	sectio	ns 5 and 9)				
		UNIT-V	: Exis	stence	e and uni	queness of	ss of solutions to first order						
		equations:	Equati	ion w	ith variable	e separated	$-\mathbf{E}\mathbf{x}$	act eq	uation – method				
		of successi	ive app	proxi	mations –	the Lipschi	tz coi	ndition	n – convergence				
		of the succ	essive	appr	oximations	and the ex	istenc	e theo	orem.				
		Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)											

Extended	Questions related to the above topics, from various competitive							
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /							
Component (is a part	others to be solved							
of internal	(To be discussed during the Tutorial hour)							
component only,								
Not to be included in								
the External								
Examination								
question paper)								
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional							
this course	Competency, Professional Communication and Transferrable Skill							
Recommended	E.A.Coddington, A introduction to ordinary differential equations (3rd							
Text	Printing) Prentice-Hall of India Ltd., New Delhi, 1987.							
<b>Reference Books</b>	1. Williams E. Boyce and Richard C. DI Prima, Elementary							
	differential equations and boundary value problems, John Wiley and							
	sons, New York, 1967.							
	2. George F Simmons, Differential equations with applications and							
	historical notes, Tata McGraw Hill, New Delhi, 1974.							
	3. N.N. Lebedev, Special functions and their applications, Prentice							
	Hall of India, New Delhi, 1965.							
	4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons,							
	New York, 1971							
	5. M.D.Raisinghania, Advanced Differential Equations, S.Chand&							
	Company Ltd. New Delhi 2001							
	6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary							
	Differential Equations, Narosa Publishing House, New Delhi,							
	2002.							
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,							
e-Learning Source	http://www.opensource.org, www.mathpages.com							

Students will be able to

**CLO1:**Establish the qualitative behaviour of solutions of systems of differential equations **CLO2:**Recognize the physical phenomena modelled by differential equations and dynamical systems.

**CLO3:** Analyze solutions using appropriate methods and give examples.

**CLO4:**Formulate Green's function for boundary value problems.

			PO	PSOs					
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

**CLO5:** Understand and use various theoretical ideas and results that underlie themathematics in this course.

Title of the	e Course	ADVANCED ALGEBRA									
Paper Nur	nber	CORE IV									
Category	Core	Year	Ι	Credits	5	Cou	rse	P23MTT204			
		Semester	II			Cod	e				
Instruction	nal Hours	Lecture	Tut	orial	Lab Prac	tice	Tota	ıl			
per week		5	1				6				
Pre-requis	site	Algebraic	Algebraic Structures								
Objectives	of the	To study	field exte	nsion, roots	of polynomial	mials,	Galo	is Theory, finite			
Course		fields, di	vision ri	ngs, solvat	oility by	radica	als an	nd to develop			
		computatio	onal skill i	n abstract alg	gebra.						
Course Ou	ıtline	UNIT-I :E	Extension f	ields – Tran	scendence of	of e.					
	Chapter 5: Section 5.1 and 5.2										
		UNIT-II: Roots or Polynomials More about roots									
		Chapter 5	5: Section	s 5.3 and 5.5	5						
		UNIT-III	: Element	s of Galois tl	neory.						
Chapter 5 : Section 5.6											
		UNIT-IV : Finite fields - Wedderburn's theorem on finite division									
		rings.									
		Chapter 7	: Sections	7.1 and 7	.2 (Theore	m 7.2.	1 only	y)			
		UNIT-V :	Solvabilit	y by radical	s - A theor	rem o	f Frol	penius - Integral			
		Quaternior	ns and the	Four - Squa	e theorem.						
		Chapter :	5: Section	n 5.7 (omi	t Lemma	5.7.1	, Len	nma 5.7.2 and			
		Theorem :	5.7.1)								
		Chapter 7	: Section	s 7.3 and 7.	4						
Extended		Questions	related	to the above	ve topics,	from	vario	ous competitive			
Professiona	al	examinatio	ons UPSC	/ TRB / NH	ET / UGC -	– CSI	R / G	ATE / TNPSC /			
Componen	t (is a part	others to b	e solved								
of	internal	(To be disc	cussed dur	ing the Tuto	rial hour)						
component	only, Not										
to be inclu	ded in the										
External											
Examination	on										
question pa	aper)										
Skills acqu	ired from	Knowledg	ge, Probl	em Solvin	g, Analyt	tical	abilit	y, Professional			
this course		Competence	cy, Profess	sional Comn	nunication a	and Tr	ansfer	rable Skill			
Recommen	nded	I.N. Hers	tein. Topi	cs in Algeb	ra (II Editi	on) W	/iley ]	Eastern Limited,			
Text		New De	elhi, 1975.								

Poforonco Books	1 M Artin Alashra Prentice Hell of India 1001						
Reference Dooks	1. WI.Artin, Aigeora, Frence fran of findia, 1991.						
	2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract						
	Algebra (II Edition) Cambridge University Press, 1997. (Indian						
	Edition)						
	3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II						
	Rings, Narosa Publishing House, New Delhi, 1999						
	D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract						
	Algebra, McGraw Hill (International Edition), New York. 1997.						
	5. N.Jacobson, Basic Algebra, Vol. I & II Hindustan Publishing						
	Company, New Delhi.						
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,						
e-Learning Source	http://www.opensource.org, www.algebra.com						

Students will be able to

**CLO1:**Prove theorems applying algebraic ways of thinking.

CLO2:Connect groups with graphs and understanding about Hamiltonian graphs.

**CLO3:**Compose clear and accurate proofs using the concepts of Galois Theory.

CLO4:Bring out insight into Abstract Algebra with focus on axiomatic theories.

**CLO5:** Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.

			PO	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	REAL ANALYSIS II										
Paper Nur	nber	CORE V										
Category	Core	Year	Ι		Credits	5	Cou	rse	P23MTT205			
		Semester	II				Cod	e				
Instruction	nal Hours	Lecture	]	Futo	orial	Lab Pra	ctice	Tota	ıl			
per week		5	5 1 6									
Pre-requis	site	Elements of	of Real	Ana	lysis							
Objectives	s of the	To introd	uce me	easu	re on the	real line,	Lebesg	gue m	easurability and			
Course		integrabilit	y, Fo	urie	r Series	and Inte	egrals,	in-d	epth study in			
		multivarial	ole calc	ulus								
Course Ou	ıtline	UNIT-I :	Measu	re o	on the Rea	al line -	Lebesg	gue C	Outer Measure -			
		Measurable	e sets	- F	Regularity -	- Measura	ble Fu	inctio	ns - Borel and			
		Lebesgue I	Measura	abili	ty							
		Chapter - 2 Sec 2.1 to 2.5 (de Barra)										
		UNIT-II :	Integr	atio	n of Funct	ions of a H	Real va	riabl	e - Integration of			
		Non- negat	tive fun	nctio	ns - The Ge	eneral Integ	gral - F	Riema	nn and Lebesgue			
		Integrals	Integrals									
		Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)										
		<b>UNIT-III : Fourier Series and Fourier Integrals</b> - Introduct										
		Orthogona	l syster	n of	functions	- The theo	rem or	ı best	approximation -			
		The Fouri	er serie	es of	f a function	n relative	to an	ortho	normal system -			
		Properties	of Fou	irier	Coefficien	ts - The I	Riesz-H	ische	r Thorem - The			
		convergen	ce and	repi	resentation	problems	in for	trigor	nometric series -			
		The Riema	inn - Le	ebes	gue Lemma	$1 - The D_1$	richlet	Integ	rals - An integral			
		representat	101 10	r th	e partial	sums of	Fourie	r seri	es - Riemann's			
		localization	n theore	em-	Sufficient of	conditions	for col	iverge	ence of a Fourier			
		series at	a parti		ir point –(			ty of	Fourier series-			
		Consequen	ices of	Fe	jes's theore	em - The	weie	rstras	s approximation			
		theorem										
		Chapter 11 · Sections 11 1 to 11 15(Apostol)										
			· Mult	ivar	iable Diffe	rential C	olenlu	s - In	troduction - The			
		Directiona	l deriva	ative	- Direction	al derivati	ive and	conti	nuity - The total			
		derivative	- The to	otal	derivative e	expressed i	n term	s of n	artial derivatives			
		- The matrix of linear function - The Jacobian matrix - The										
		Matrix for	n of ch	ain	rule - The r	nean - vali	ue theo	rem f	or differentiable			
		functions - A sufficient condition for differentiability $\Delta$ s										
		condition f	for equa	alitv	of mixed n	artial deriv	vatives	- Tav	lor's theorem for			
		functions of	of $\mathbb{R}^n$ to	$\mathbf{R}^1$	P			- u j	yior's theorem for			
			0									
		Chapter 1	2 : Sec	tion	12.1 to 12.	14 (Apost	ol)					

· · · · · · · · · · · · · · · · · · ·	
	UNIT-V : Implicit Functions and Extremum Problems : Functions
	with non-zero Jacobian determinants – The inverse function theorem-
	The Implicit function theorem-Extrema of real valued functions of
	severable variables-Extremum problems with side conditions.
	Chapter 13 : Sections 13.1 to 13.7 (Apostol)
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /
Component (is a part	others to be solved
of internal	(To be discussed during the Tutorial hour)
component only, Not	
to be included in the	
External	
Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
this course	Competency, Professional Communication and Transferrable Skill
Recommended	1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd.,
Text	New Delhi, 1981. (for Units I and II)
	2. Tom M Apostol : <i>Mathematical Analysis</i> , 2 <sup>nd</sup> Edition, Addison-
	Wesley Publishing Company Inc. New York 1974 (for Units III. IV
	and V)
Reference Books	1. Burkill, J.C. The Lebesgue Integral, Cambridge University Press, 1951
	2 Munroe M F Measure and Integration Addison-Wesley Mass 1971
	3 Roydon H I <i>Real Analysis</i> Macmillan Pub Company New York
	1988
	4 Rudin W Principles of Mathematical Analysis McGraw Hill
	Company New York 1979
	5 Malik S C and Savita Arora <i>Mathematical Analysis</i> Wiley Fastern
	Limited. New Delhi, 1991.
	6. Sanjay Arora and BansiLal, Introduction to Real Analysis.
	SatvaPrakashan, New Delhi, 1991
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics.
e-Learning Source	http://www.opensource.org

Students will be able to

**CLO1:**Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system.

CLO2: Analyze the representation and convergence problems of Fourier series.

CLO3: Analyze and evaluate the difference between transforms of various functions.

**CLO4:**Formulate and evaluate complex contour integrals directly and by the fundamental theorem.

**CLO5:**Apply the Cauchy integral theorem in its various versions to compute contour integration.

			PO	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the Course	PARTIAL DI	FFERENTIAL B	QUATION	NS									
Paper Number	CORE VI												
Category Core	Year I	Credits	4	Cour	rse	P23MTT206							
	Semester I		Cod		e								
Instructional Hours	Lecture	Tutorial	Lab Pract	tice	Tota	al							
per week	5	1 6											
Pre-requisite	UG level partia	l differential equa	ations										
Objectives of the	To classify the	second order par	rtial different	ntial e	quati	ons and to study							
Course	Cauchy problem	n, method of se	paration of	varia	bles,	boundary value							
	problems.												
Course Outline	UNIT-I :Math	UNIT-I :Mathematical Models and Classification of second orde											
	equation : Clas	sical equations-V	ibrating stri	ing – V	Vibrat	ting membrane –							
	waves in elastic	medium – Cond	uction of h	eat in	solid	s – Gravitational							
	potential – Sec	potential - Second order equations in two independent variables											
	canonical form	canonical forms - equations with constant coefficients - general											
	solution	solution											
	Chapter 2 : See	Chapter 2 : Sections 2.1 to 2.6											
	Chapter 3 : See	ctions 3.1 to 3.4 (	Omit 3.5)										
	UNIT-II :Cau	chy Problem :	The Ca	auchy	prob	olem – Cauchy-							
	Kowalewsky t	heorem – Hon	nogeneous	wave	equ	ation – Initial							
	Boundary value	e problem- Non-	-homogeneo	ous bo	ounda	ary conditions –							
	Finite string w	ith fixed ends –	Non-home	ogeneo	ous v	wave equation –							
	Riemann metho	od – Goursat pr	roblem – s	spheric	cal w	vave equation –							
	cylindrical wave	e equation.											
	Chapter 4 : See	$\frac{1}{1}$		1 0									
	UNIT-III :Met	hod of separatio	n of variat	iles: S	epara	ation of variable-							
	vibrating string	g problem – Exi	stence and	uniqu	ienes	s of solution of							
	vibrating string	vibrating string problem- Heat conduction problem – Existence and											
	uniqueness of s	olution of heat co	nduction p	robiem	1 - Li	aplace and beam							
	equations Chapter 6 - Sec	tions (1 to ( (	Omit gooti	<b>m ( 7</b> )	`								
	UNIT IV . B	cuons o.1 to o.o (	Unit section	Dound	) 10.000 v	ualua nuchlama							
	Maximum and	minimum prin	ciples I	Inique	uary N	and continuity							
	theorem Divio	hlet Problem for	a circla a d	rircula	ness r ann	and continuity							
	_ Dirichlet prob	lem involving Do	isson equat	ion P	u ann Neum	a rectaligit							
	a circle and a re	ctangle	risson equal	1011 – 1	, cull								
	Chapter 8 · Sec	$\frac{1}{10000000000000000000000000000000000$											
	Chapter 8: 500												

	<b>UNIT-V : Green's Function:</b> The Delta function – Green's function –
	Method of Green's function – Difficilite Problem for the Laplace and
	Helmholtz operators – Method of images and eigen functions – Higher
	dimensional problem – Neumann Problem.
	Chapter 10 : Section 10.1 to 10.9
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /
Component (is a part	others to be solved
of internal	(To be discussed during the Tutorial hour)
component only, Not	
to be included in the	
External	
Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
this course	Competency, Professional Communication and Transferrable Skill
Recommended	1. TynMyint-U and LokenathDebnath, Partial Differential Equations for
Text	Scientists and Engineers (Third Edition), North Hollan, New York,
	1987.
<b>Reference Books</b>	1. M.M.Smirnov, Second Order partial Differential Equations,
	Leningrad, 1964.
	2. I.N.Sneddon, <i>Elements of Partial Differential Equations</i> , McGraw
	Hill, New Delhi, 1983.
	3. R. Dennemeyer, Introduction to Partial Differential Equations and
	<i>A</i> M D Paisinghania Advanced Differential Equations S Chandle
	4. M.D.Raisinghama, Auvancea Dijjeremita Equations, S.C. Hand& Company Ltd., New Delhi, 2001
	5. S. SankarRao, <i>Partial Differential Equations</i> , 2 <sup>nd</sup> Edition. Prentice
	Hall of India, New Delhi. 2004
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

Students will be able to

CLO1:To understand and classify second order equations and find general solutions

CLO2: To analyse and solve wave equations in different polar coordinates

**CLO3:**To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations

**CLO4:**To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions

**CLO5:**To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem

		POs PSOs								
	1	2	3	4	5	6	1	2	3	
CLO1	3	1	3	2	3	3	3	2	1	
CLO2	2	1	3	1	3	3	3	2	1	
CLO3	3	2	3	1	3	3	3	2	1	
CLO4	1	2	3	2	3	3	3	2	1	
CLO5	3	1	2	3	3	3	3	2	1	

Title of the	e Course	COMPLEX ANALYSIS									
Paper Nun	nber	CORE VII									
Category	Core	Year	II	Credits	5	Cou	rse	P23MTT307			
		Semester	III	-		Cod	e				
Instruction	nal Hours	Lecture	Tute	orial	Lab Pract	tice	Tota	al			
per week		5	1				6				
Pre-requis	ite	UG level (	Complex A	nalysis							
Objectives	of the	To Study O	Cauchy inte	egral formul	la, local proj	perties	s of a	nalytic functions,			
Course		general for	m of Caucl	ny's theorem	n and evalua	ation o	of def	inite integral and			
		harmonic f	unctions								
Course Ou	ıtline	UNIT-I :	UNIT-I : Cauchy's Integral Formula: The Index of a point with								
		respect to	a closed c	urve – The	Integral for	rmula	– Hi	gher derivatives.			
		Local Prop	erties of an	alytical Fur	nctions:						
		Removable	Singulari	ties-Taylors	's Theorem	n – Ze	eros a	and poles – The			
local Mapping – The Maximum Principle.											
		Chapter 4 : Section 2 : 2.1 to 2.3									
		Chapter 4 : Section 3 : 3.1 to 3.4									
		UNIT-II :	The gene	ral form o	of Cauchy'	's Th	eoren	<b>n</b> : Chains and			
		cycles- Sin	nple Conti	nuity - H	omology -	The	Gene	eral statement of			
		Cauchy's '	Theorem -	Proof of	f Cauchy's	theor	em -	Locally exact			
		differential	s- Multipl	y connecte	d regions	- Res	sidue	theorem - The			
		argument p	rinciple.								
		Chapter 4	: Section 4	1: 4.1 to 4.	7						
		Chapter 4	: Section 5	5: 5.1 and 5	5.2						
		UNIT-III	Evaluatio	n of Defini	te Integrals	s and	Harn	nonic Functions			
		Evaluation	of definite	e integrals -	Definition	n of H	Iarmo	nic function and			
		basic prope	rties - Mea	in value pro	perty - Poiss	son fo	rmula	ı.			
		Chapter 4	: Section 5	5:5.3							
		Chapter 4	: Sections	6:6.1 to 6	.3						
		UNIT-IV :	Harmonic	Functions	and Power	Serie	es Exp	pansions:			
		Schwarz th	neorem - '	The reflecti	ion principl	e - V	Veiers	strass theorem –			
		Taylor's Se	eries – Lau	rent series .							
		Chapter 4	: Sections	6.4 and 6.5							
		Chapter 5	: Sections	1.1 to 1.3							
		UNIT-V: 1	Partial Fra	actions and	l Entire Fu	nctio	ns: F	Partial fractions -			
		Infinite pro	oducts – (	Canonical p	oroducts – (	Gamn	na Fu	a Function- Jensen's			
		formula – H	Hadamard'	s Theorem							
		Chapter 5	: Sections	2.1 to 2.4							
		Chapter 5	: Sections	3.1 and 3.2							

Extended	Questions related to the above topics, from various competitive									
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /									
Component (is a part	hers to be solved									
of internal	(To be discussed during the Tutorial hour)									
component only, Not	(10 be discussed during the Tutorial nour)									
to be included in the										
External										
Examination										
question paper)										
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional									
this course	Competency, Professional Communication and Transferrable Skill									
<b>Recommended Text</b>	1.Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co.,									
	New York, 1979									
<b>Reference Books</b>	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 Thorey(2 vols.), Gonm& Co, 1959.									
	4. M.Heins, Complex function Theory, Academic Press, New									
	York,1968.									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org , http://en.wikipedia.org									

Students will be able to

CLO1: Analyze and evaluate local properties of analytical functions and definite

integrals.

CLO2: Describe the concept of definite integral and harmonic functions.

CLO3:Demonstrate the concept of the general form of Cauchy's theorem

CLO4: Develop Taylor and Laurent series .

CLO5:Explain the infinite products, canonical products and Iensen's formula .

	POs PSOs								
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1

CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	TOPOLOGY								
Paper Number		CORE VIII								
Category	Core	Year	II		Credits	5	Course P23MTT		P23MTT308	
		Semester	III				Code			
Instructional		Lecture		Tutorial		Lab Practice		Total		
Hours		5		1				6		
per week										
Pre-requis	ite	Real Analysis								
Objectives	of the	To study topological spaces, continuous functions, connectedness,								
Course		compactness, countability and separation axioms.								
Course Ou	ıtline	UNIT-I : Topological spaces : Topological spaces - Basis for a								
		topology – The order topology – The product topology on $X \times Y$ – The								
		subspace topology – Closed sets and limit points.								
		Chapter 2 : Sections 12 to 17								
		<b>UNIT-II :Continuous functions:</b> Continuous functions – the product								
		topology – The metric topology.								
		Chapter 2 : Sections 18 to 21 (Omit Section 22)								
		UNIT-III :Connectedness: Connected spaces- connected subspaces								
		of the Real line – Components and local connectedness.								
		Chapter 3 : Sections 23 to 25.								
		UNIT-IV : Compactness : Compact spaces – compact subspaces of								
		the Real line – Limit Point Compactness – Local Compactness.								
		Chapter 3 : Sections 26 to 29.								
		<b>UNIT-V:</b> Countability and Separation Axiom: The Countability								
		Axioms – The separation Axioms – Normal spaces – The								
		Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz								
		extension theorem.								
		Chapter 4 : Sections 30 to 35.								
Extended	Questions related to the above topics, from various competitive									
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Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /									
Component (is a part	others to be solved									
ofinternal	(To be discussed during the Tutorial hour)									
component only,										
Not to be included										
in the External										
Examination										
question paper)										
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional									
this course	Competency, Professional Communication and Transferrable Skill									
Recommended	1.James R. Munkres, <i>Topology</i> (2 <sup>nd</sup> Edition) Pearson Education Pve.									
Text	Ltd., Delhi-2002 (Third Indian Reprint)									
Reference Books	1. J. Dugundji, <i>Topology</i> , Prentice Hall of India, New Delhi, 1975.									
	2. George F.Sinmons, Introduction to Topology and Modern Analysis,									
	McGraw Hill Book Co., 1963									
	2 II Walles C. I.T. I. Was Newtoned Detailed Co. New									
	3. J.L. Kelly, <i>General Topology</i> , van Nostrand, Reinhold Co., New									
	YOIK									
	4. L.Steen and J.Subhash, Counter Examples in Topology, Holt,									
	Rinehart and Winston, New York, 1970.									
	5. S.Willard, General Topology, Addison - Wesley, Mass., 1970									
Website and	http://mathforum.org.http://ocw.mit.edu/ocwweb/Mathematics									
e-Learning Source	http://www.opensource.org_http://en.wikipedia.org									
e Learning bource	http://www.opensource.org.									

Students will be able to

**CLO1:**Define and illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.

**CLO2**: Understand continuity, compactness, connectedness, homeomorphism and topological properties.

CLO3: Analyze and apply the topological concepts in Functional Analysis.

**CLO4:**Ability to determine that a given point in a topological space is either a limit point or not for a given subset of a topological space.

**CLO5**: Develop qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and develop tools to identify when two are equivalent(homeomorphic).

	POs							PSOs		
	1	2	3	4	5	6	1	2	3	
CLO1	3	1	3	2	3	3	3	2	1	
CLO2	2	1	3	1	3	3	3	2	1	
CLO3	3	2	3	1	3	3	3	2	1	
CLO4	1	2	3	2	3	3	3	2	1	
CLO5				3	3	3		2	1	
	3	1	2				3			

Title of the	e Course	MECHANICS							
Paper Nu	nber	CORE IX							
Category	Core	Year	II		Credits	5	Cou	rse	P23MTT309
		Semester	III				Cod	e	
Instructional Hours		Lecture		Tuto	orial	Lab Pract	tice	Tota	l
per week		5		1				6	

Pre-requisite	UG level Statics and Dynamics Knowledge.							
Objectives of the	To study mechanical systems under generalized coordinate systems,							
Course	virtual work, energy and momentum, to study mechanics developed by							
	Newton, Langrange, Hamilton Jacobi and Theory of Relativity due to							
	Einstein.							
Course Outline	UNIT-I: Mechanical Systems : The Mechanical system- Generalised							
	coordinates - Constraints - Virtual work - Energy and Momentum							
	Chapter 1 : Sections 1.1 to 1.5							
	UNIT-II: Lagrange's Equations: Derivation of Lagrange's equations-							
	Examples- Integrals of motion.							
	Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)							
	UNIT-III : Hamilton's Equations : Hamilton's Principle - Hamilton's							
	Equation - Other variational principle.							
	Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)							
	UNIT – IV : Hamilton-Jacobi Theory : Hamilton Principle function –							
	Hamilton-Jacobi Equation - Separability							
	Chapter 5 : Sections 5.1 to 5.3							
	<b>UNIT-V</b> : Canonical Transformation : Differential forms and generating							
	functions – Special Transformations– Lagrange and Poisson brackets.							
	Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)							
Extended	Questions related to the above topics, from various competitive							
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /							
Component (is a part	others to be solved							
of internal	(To be discussed during the Tutorial hour)							
component only, Not								
to be included in the								
External								
Examination								
question paper)								
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional							
this course	Competency, Professional Communication and Transferrable Skill							
Recommended	D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi,							
Text	1985.							

<b>Reference Books</b>	1. H. Goldstein, <i>Classical Mechanics</i> , (2 <sup>nd</sup> Edition) Narosa Publishing
	House, New Delhi.
	2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill,
	1991.
	3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition)
	McGraw Hill Book Co., New York, 1970.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.physicsforum.com

Students will be able to

**CLO1:** Demonstrate the knowledge of core principles in mechanics.

CLO2: Interpret and consider complex problems of classical dynamics in a systematic way.

CLO3: Apply the variation principle for real physical situations.

**CLO4:** Explore different applications of these concepts in the mechanical and electromagnetic fields.

**CLO5:** Describe and apply the concept of Angular momentum, Kinetic energy and Moment of inertia of a particle

		POs							PSOs		
	1	2	3	4	5	6	1	2	3		
CLO1	3	1	3	2	3	3	3	2	1		
CLO2	2	1	3	1	3	3	3	2	1		
CLO3	3	2	3	1	3	3	3	2	1		
CLO4	1	2	3	2	3	3	3	2	1		
CLO5	3	1	2	3	3	3	3	2	1		

Title of the	e Course	ADVANC	ED OP	TIMIZATIO	N TECHNI	QUE	S		
Paper Nur	nber	CORE X							
Category	Core	Year II		Credits	4	Course		P23MTT310	
		Semester	III			Cod	le		
Instruction	nal Hours	Lecture	ſ	<b>Tutorial</b>	Lab Pract	tice	Tota	ıl	
per week		5	1				6		
Pre-requis	ite	UG level 0	Operatio	on Research					
Objectives	of the	Ability to	underst	and and analy	ze manager	ial pr	oblem	is in industry so	
Course		that they a	re able	to use reso	urces (capit	als, r	nateria	als, staffing, and	
		machines)	more e	ffectively. Use	integer pro	gram	ming <sub>l</sub>	problem to solve	
		system of	linear	equations. Pr	rovides a q	uanti	tative	technique or a	
		scientific a	pproacl	h for making b	etter decisi	ons	for op	perations under	
		the control							
Course Ou	ıtline	UNIT-I: Integer Programming: Integer Programming introduction – Gomory's all Integer Programming Problem method - Construction of Gomory's Constraints - Fractional Cut Method - All integer- Fractional Cut Method - Mixed integer-Branch and Bound Method- Applications of Integer programming. Chapter 7 Section 7.1-7.7							
		UNIT-II: Dynamic Programming: Dynamic Programming introduction – The Recursive equation approach-Characteristics of Dynamic Programming - Dynamic Programming Algorithm- Solutions of Discrete D.P.P-Some Applications- Solutions of L.P.P by Dynamic Programming. Chapter 13- Sections 13.1-13.7							
		Queueing System –Elements of Queueing System-Operating Characteristics of Queueing System – Probability distribution in Queueing System Classification of Queueing models –Definition of Transient and Steady States-Poisson Queueing System							
		Chapter 2	20- Sect	tions 20.1-20.8					

	UNIT-IV: Non Linear Programming:
	Non Linear Programming introduction - Formulation of Non - Linear Programming Problem(NLPP)- General Non Linear Programming problem- Constraints optimization with equality Constraints- Constraints optimization with inequality Constraints-Saddle point problems-Saddle points and NLPP. .Chapter 24- Sections 24.1-24.7
	UNIT - V: Non Linear Programming Methods:
	Non Linear Programming Methods introduction – Graphical Solution- Kuhn-Tucker Conditions with Non-Negative Constraints – Quadratic Programming –Wolfe's Modified Simples Methods-Beal's Method- Separable Convex Programming –Separable Programming Algorithm.
	Chapter 25- Sections 25.1-25.8
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /
Component (is a part	others to be solved
of internal	(To be discussed during the Tutorial hour)
component only, Not	
to be included in the	
External	
Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
this course	Competency, Professional Communication and Transferrable Skill
Recommended	1.Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research",
Text	Sultan Chand & Sons, Educational Publishers, New Delhi.2013

<b>Reference Books</b>	1.Panneerselvam.R, "Operations Research", 2nd Edition, PHI
	Learning Private Limited, Delhi, 2015
	2 . <b>Prem Kumar Gupta.Er, Hira.D.S</b> . "Operations Research",7 <sup>th</sup> Edition,S.Chand& Company Pvt.Ltd.2014
	3. <b>Hiller.F.S&amp;Lieberman.J</b> "Introduction to Operation Research ",7 <sup>th</sup> Edition, Tata– MCGraw Hill Publishing Company, NewDelhi, 2001.
	<b>4G. Srinivasan,</b> "Operations Research principles and applications", Second Edition, PHI Learning Private Limited, New Delhi-110001, 2012.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, http://www.operation.net

Students will be able to

CLO1:: The students will be able to analyze the real life systems with limited constraints

**CLO2:**Identify the mathematical nature of a given optimization problem.

CLO3: Analyze a range of classes of optimization problems

CLO4:: Identify solution methods for the optimization problems studied

CLO5: The students will be able to depict the systems in a mathematical model form..

		POs							PSOs		
	1	2	3	4	5	6	1	2	3		
CLO1	3	1	3	2	3	3	3	2	1		
CLO2	2	1	3	1	3	3	3	2	1		
CLO3	3	2	3	1	3	3	3	2	1		
CLO4	1	2	3	2	3	3	3	2	1		
CLO5	3	1	2	3	3	3	3	2	1		

Title of Course	the	FUNCTIO	DNAL	ANA	LYSIS						
Paner Num	her	CORE XI									
Category	Core	Year Semester	II IV		Credits		5	Course		P23MTT411	
Instruction	 ๑l	Lecture	1,	Tut	orial	L	ah Prac	tice	 Total		
Hours	ai	5		1	oriai	L		ucc	<b>1</b> 6	otai	
ner week		5		1					0		
Pre-requisi	te	Elements c	of Real	Ana	vsis						
Objectives	of the	To provide	stude	nts w	ith a strong for	und	lation i	n functio	nal	analysis	
Course	or the	focusing or	n space	es or	erators and fu	nda	mental	theorems	Т	o develop	
course		student's s	kills a	nd co	nfidence in ma	the	ematical	analysis	. <u>-</u>	nd proof	
		techniques	unit u					unurjene		na proor	
				~							
Course Out	tline	UNIT-I : I	Banach	n Spa	ces: The defini	itio	n and sc	me exam	iple	es –	
		Continuou	s linea	r tran	sformations –	The	e Hahn-	Banach tl	hec	orem – The	
		natural imb	beddin	g of <i>l</i>	V in $N^{**}$ - The c	pei	n mappi	ng theore	m	– The	
		conjugate of	of an	Opera	ator.						
		Chapter 9	:Secti	ons 4	6-51						
		UNIT-II :	Hilber	t Spa	ces: The defini	tio	n and so	me simp	le p	properties-	
		Orthogona	l com	oleme	nts-Orthonorr	nal	sets-Th	e conjug	ate	spaceH*-The	
		adjoint of a	an ope	rator-	-self-adjoint op	pera	ators-No	ormal and	l ur	nitary	
		operators -	- Proje	ction	s						
		Chapter1(	):Secti	ions5	2-59						
		UNIT-III	:Finite	e-Dim	ensional Spec	tral	Theory	: Matrice	s –	- Determinants	
		and the spe	ectrum	of ar	operator – The	e sr	bectral t	heorem.			
		Chapter 1	1:Sect	tions	60-62	1					
		UNIT-IV	: Gene	ral Pi	eliminaries on	Ba	anach A	lgebras:	The	e definition	
		and some examples – Regular and singular elements – Topological								ological	
		divisors of zero – The spectrum – The formula for the spectral radius–								tral radius–	
		The radical and semi-simplicity.									
		Chapter 12:Sections 64-69									
		<b>UNIT-V:</b> The Structure of Commutative Banach Algebras: The Gelf and								The Gelf and	
		mapping –	Appli	catio	n of the formul	a <mark>r(</mark>	$(x) = \lim_{x \to \infty}  x ^2$	$\ x^n\ ^{1/2}$	/n_	- Involutions	
		in Banach	algebr	as-Th	eGelfand-Neu	ma	rktheore	em.			
		Chapter 1	3:Sect	tions	70-73						

Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others
Component (is a	to be colved
part of internal	
component only	(To be discussed during the Tutorial hour)
Not to be included	
in the External	
Examination	
Examination	
question paper)	
Skills acquired	Knowledge, Problem Solving, Analytical ability, Professional Competency,
from this course	Professional Communication and Transferrable Skill
Recommended	1.G.F.Simmons, Introduction to Topology and Modern Analysis
Text	,McGraw Hill Education(India)Private Limited, New Delhi, 1963.
<b>Reference Books</b>	1. W.Rudin, Functional Analysis, McGraw Hill Education
	(India)Private Limited, NewDelhi, 1973.
	2. B.V. Limaye, Functional Analysis, New Age International, 1996.
	3. C. Goffman and G. Pedrick, First course in Functional Analysis,
	Prentice Hall of India, NewDelhi, 1987.
	4. E. Krevszig, Introductory Functional Analysis with Applications,
	John Wiley & Sons, NewYork, 1978.
	5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of
	India, NewDelhi, 2002.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics.
e-I earning	http://www.opensource.org.http://en.wikiepedia.org
c-Learning	http://www.opensource.org, http://en.wikiepedia.org
Source	

Students will be able to

CLO1:Understand the Banach spaces and Transformations on Banach Spaces.

CLO2: Prove Hahn Banach theorem and open mapping theorem.

**CLO3:**Describe operators and fundamental theorems.

CLO4: Validate orthogonal and orthonormal sets.

**CLO5:**Analyze and establish the regular and singular elements.

		PSOs						
1	2	3	4	5	6	1	2	3

CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	DIFFERI	ENTI	AL G	EOMETR	Y					
Paper Nur	nber	CORE XI	I								
Category	Core	Year	II		Credits	5	Cou	rse	P23MTT412		
		Semester	IV				Cod	e			
Instruction	nal Hours	Lecture	ire Tuto		orial	Lab Practice		Total			
per week		5		1				6			
Pre-requis	site	Linear Alg	gebra	conce	epts and Cal	culus					
Objectives	s of the	This cours	se int	roduc	es space cu	rves and th	neir in	trinsio	c properties of a		
Course		surface an	d geo	odesic	s. Further	the non-int	rinsic	prope	erties of surface		
		and the dif	feren	tial ge	ometry of s	urfaces are	explo	red			
Course Ou	ıtline	UNIT-I:	<b>UNIT-I : Space curves:</b> 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.									
		Chapter I : Sections 1 to 9.									
		UNIT-II :Intrinsic properties of a surface: Definition of a surface –									
		curves on	a su	ırface	- Surface	of revolut	ion –	Heli	coids – Metric-		
		Direction coefficients – families of curves- Isometric correspondence-									
		Intrinsic properties.									
		Chapter I	I: See	ctions	1 to 9.						
		UNIT-III : Geodesics: Geodesics – Canonical geodesic equation							esic equations –		
		Normal property of geodesics- Existence Theorems – Geodesic parallels									
		- Geodesics curvature- Gauss- Bonnet Theorem - Gaussian curvature-									
		surface of constant curvature.									
		Chapter I	I: See	ctions	10 to 18.						

	<b>UNIT-IV :</b> Non Intrinsic properties of a surface:
	The second fundamental form- Principle curvature – Lines of curvature
	- Developable - Developable associated with space curves and with
	curves on surface - Minimal surfaces - Ruled surfaces.
	Chapter III: Sections 1 to 8.
	UNIT-V :Differential Geometry of Surfaces :
	Compact surfaces whose points are umblics- Hilbert's lemma -
	Compact surface of constant curvature - Complete surface and their
	characterization – Hilbert's Theorem – Conjugate points on geodesics.
	Chapter IV : Sections 1 to 8 (Omit 9 to 15).
Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /
Component (is a part	others to be solved
of internal	(To be discussed during the Tutorial hour)
component only, Not	
to be included in the	
External	
Examination	
question paper)	
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional
this course	Competency, Professional Communication and Transferrable Skill
Recommended	1.T.J.Willmore, An Introduction to Differential Geometry, Oxford
Text	University Press,(17th Impression) New Delhi 2002. (Indian Print)
<b>Reference Books</b>	1. Struik, D.T. Lectures on Classical Differential Geometry, Addison -
	Wesley, Mass. 1950.
	2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry,
	Interscience 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.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.physicsforum.com

Students will be able to

**CLO1:**Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.

**CLO2**: Evaluate these concepts with related examples.

CLO3:Compose problems on geodesics.

**CLO4:** Recognize applicability of developable.

CLO5: Construct and analyze the problems on curvature and minimal surfaces

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

COURSE	P23MTPR		L	Τ	P	С
CODE	41	Project with Viva				
PR	OJECT		-	-	10	7

**Rules And Regulation Of The Project:** 

- 1. The Project Area/title must be any one of the following
  - (i)Pure Mathematics
  - (ii)Applied Mathematics
  - (iii)Mathematical Application in Real Time Activities.
- Student allotment Method will be decided by the Department Faculties (In October 2<sup>nd</sup> week)
- 3. They are Four Project Common Meet(In Front of All Faculty) Power point presentation
  - (i). First Meet November last week. Work done Topic and Area will be decided (5 marks)
  - (ii). Second Meet January 1<sup>st</sup> week. Work done-25% work (5 marks)
  - (iii). Third Meet –February 1<sup>st</sup> week, Work done -50% work (5 marks)
  - (iv). Fourth Meet March 1<sup>st</sup> week, work done -90% work (5 marks)
- 4. Project Record Submission Third week of March

## ELECTIVE COURSES SEMESTER -I -ELECTIVE -I-GROUP A

Title of the	e Course	<b>1.NUMBER THEORY AND CRYPTOGRAPHY</b>						
Paper Nu	Paper Number ELECTIVE I							
Category	ELECTIVE	ELECTIVE Year I Credits 3 Course P2						

	COURSE	Semester	Ι			Cod	e				
Instructio	nal Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	ıl			
per week		4	1				5				
Pre-requis	site	UG level N	Number	Theory							
Objectives	s of the	To provide	e an int	roduction to	o analytic	numb	er the	ory and recent			
Course		topics of C	ryptogra	aphy with a	pplications.						
Course O	utline	UNIT I :	Introdu	ction – Cor	njectures, T	heore	ms, a	nd Proofs-Well			
		Ordering a	nd Ind	uction- Sig	ma Notatio	on an	d Pro	oduct Notation-			
		Binomial	Coeffici	ents- Grea	test Intege	r Fu	nction	s- Divisibility,			
		Greatest Common Divisor, Euclid 's algorithm; GCD via Euclid 's									
		algorithm-	Least C	ommon Mu	ltiple- Repr	resent	ation	of integers.			
		Chapter 1	: Section	ons1.1-1.6	and Chapt	ter 2:	Sect	ions 2.2-2.4 of			
		<b>Text Book</b>	1.								
		UNIT II:	Introdu	ction –Prim	nes, Prime	Count	ting F	Function, Prime			
		Number T	heorem;	Test of P	rimality by	Tria	l Divi	sion –Sieve of			
		Eratosthene	es, Can	onical Fact	torization,	Funda	ament	al Theorem of			
		Arithmetic									
		Chapter 3	Section	ns 3.1-3.3 o	of Text Boo	k 1.					
		UNIT III	: Co	ongruences	and Equi	ivalen	ce R	elations-Linear			
		Congruenc	es -Lir	ear Dioph	antine Equ	lation	s and	d the Chinese			
		Remainder	Theo	rem- Poly	nomial C	Congru	iences	s – Modular			
		Arithmetic	Ferma	at's Theore	em –Wilson	n's T	heore	m and Fermat			
		Numbers.									
		Chapter 4	: Sectio	ns 4.2-4.7 o	of Text Boo	k 1.					
		UNIT IV:	Introdu	ction-Sigm	a Function	. Tau	Func	tions. Dirichlet			
		Product –I	Dirichle	Inverse, I	Moebius Fi	unctio	n, Eu	ler's Function,			
		Euler's The	eorem.								
		Chapter 5	Section	ns 5.1 – 5.3	of Text Bo	ook 1.					
		UNIT V:	Crypto	ography: Ir	ntroduction	– S	ome	simple crypto			
		systems -	-Enciph	ering Ma	trices–The	idea	a of	Public key			
		Cryptograp	hy– RS	A.			~				
		Chapter III: Sections 1-2 and Chapter IV: Sections 1-2 of Text									
<b>F</b> 1 1		Book 2.	<u> </u>			6	<u> </u>				
Extended	Professional	Questions	related	to the abo $C / TPB / N$	ve topics,	trom	vario $IP / C$	us competitive			
internal	component	/ others to l	ns of s be solve	d		- CS		JAIL/ INISC			
only, Not	to be included	(To be disc	ussed d	uring the Tu	utorial hour	)					
in the	e External			-							
Examination	on question										
paper)											

Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	1. Neville Robbins; Beginning Number Theory, Second Edition,
	Narosa, 2006.
	2. Neal Koblitz: A Course in Number Theory and Cryptography,
	Second edition, Springer-Verlag Newyork-1994.
<b>Reference Books</b>	1. Tom. M. Apostol; Introduction to analytic Number theory,
	Narosa Publishing House, 1998.
	2. Ivan Nivan, H. S. Zuckerman and H. L. Montgomery; An
	introduction to the theory of Number,
	5th Ed paperback-International Edition, 1991.
Website and	https://www.encyclopedia.com/science/encyclopedias-almanacs-
e-Learning Source	transcripts-and-maps/applications-number-theory-cryptography,
	https://mathstats.uncg.edu/number-theory/
	https://en.wikipedia.org/wiki/Number_theory
	https://en.wikibooks.org/wiki/Cryptography

Students will be able to

CLO 1: understand the problems in elementary number theory

CLO 2: apply elementary number theory to Cryptography

**CLO 3:**develop a deep understanding of theoretical basis of number theory and cryptography.

CLO 4: identify how number theory is related and applied in Cryptography

**CLO 5:** develops the knowledge of encryption and decryption and their application in Managing the security of data.

				PSOs					
	1	2	1	2	3				
CLO1	3	3	3	2	1	2	3	3	2
CLO2	2	3	3	3	2	2	2	3	2
CLO3	3	2	2	2	1	1	3	2	1

CLO4	2	3	1	2	2	3	2	2	2
CLO5	3	1	2	2	2	1	3	2	1

# SEMESTER -I -ELECTIVE -I-GROUP A

Title of the Cours	se	2. GRAPH	THEO	RY AND	APPLICAT	ΓΙΟΝ	S				
Paper Number		ELECTIV	ΕI								
Category ELEC	CTIVE	Year	Ι	Credits	3	Cou	rse	<b>P23MTE11B</b>			
COUL	RSE	Semester	Ι			Cod	e				
Instructional Hou	urs	Lecture	Tuto	orial	Lab Prac	tice	Tota	al			
per week		4	4 1 5								
Pre-requisite		UG level Graph Theory									
<b>Objectives</b> of	the	To study th	e graph	theoretical	concepts an	nd alg	orithr	ns that help to			
Course		model real	life situ	ations.							
<b>Course Outline</b>		UNIT I: 7	Frees, 0	Cut Edges	and Bond	s, Cu	t Vei	rtices, Cayley's			
		Formula –	Applica	tions: The	Connector	Prob	lem -	- Connectivity,			
		Blocks – A	Applicat	tions: Cons	struction of	Reli	able	Communication			
		Networks.									
		Chapter 2 : Sections 2.1-2.5 and Chapter 3: Sections 3.1-3.3									
		UNIT II:	Euler '	Tours, Har	niltonian C	Cycles	–Ap	plications: The			
		Chinese Postman Problem, The Travelling Salesman Problem.									
		Chapter 4: Sections 4.1-4.4.									
		UNIT III:	Match	ning's, Ma	tching's ar	nd Co	verin	gs in Bipartite			
		Graphs, F	Perfect	Matching	– Appl	icatio	ns: [	The Personnel			
		Assignment Problem, The Optimal Assignment Problem.									
		Chapter 5: Sections 5.1-5.5									
		UNIT IV: Chromatic Number, Brook's Theorem, Hajos'									
		Conjecture, Chromatic Polynomials, Girth and Chromatic Number –									
		Application	is: A St	orage Probl	em.						
		Chapter 8:	Section	ns 8.1-8.6.							
		UNIT V:	Directe	ed Graphs,	Directed	Paths	, Dire	ected Cycles -			
		Application	is: A Jo	ob Sequenc	cing Proble	m, D	esigni	ing as Efficient			
		Computer I	Drum, N	Aaking a Ro	oad System	One-	Way.				
		Chapter 10	): Secti	ons 10.1-10	).6.						
Extended Profe	essional	Questions	related	to the abo	ove topics,	from	vario	ous competitive			
Component (1s a	part of	examination	ns UPS	C/IKB/ſ d	NET / UGC	- CS	IR / C	JATE / INPSC			
only Not to be in	ncluded	(To be disc	ussed di	u uring the Ti	utorial hour	•)					
in the E	External	(10 be unse	ubbeu u	aring the r	atoriar nour	,					
Examination q	uestion										
paper)											
Skills acquired fro	om this	Knowledge	e, Prob	olem Solvi	ng, Analy	tical	abilit	y, Professional			
course		Competenc	y, Profe	essional Con	mmunicatio	n and	Tran	sferrable Skill			

Recommended Text	J.A Bondy and U.S.R Murty, Graph Theory with Applications,
	North Holland, 1976.
<b>Reference Books</b>	1. John Clark and D. Allan Holton; Graph theory World Scientific
	Publishing Co. Pvt.Ltd, 1991.
	2. NarsinghDeo; Graph Theory with Applications to Engineering
	and Computer Science, Prentice Hall, 1974.
Website and	https://www.zib.de/groetschel/teaching/WS1314/BondyMurtyGTW
e-Learning Source	<u>A.pdf</u> ,
	http://ignited.in/I/a/252519,
	https://www.mygreatlearning.com/blog/application-of-graph
	theory/https://in.coursera.org/learn/graphs,
	https://neo4j.com/blog/top-13-resources-graph-theory-algorithms/

Students will be able to

CLO 1:study the properties of Trees, Connectivity and Blocks with its applications.

CLO 2: discuss Euler tour, Hamiltonian cycles and its suitable applications.

CLO 3:understand the concepts of Matching's, Coverings and Perfect Matching's.

CLO 4:apply domain knowledge in Chromatic number, Brook's Theorem, Hajos'

Conjecture

and Chromatic polynomials.

**CLO 5:**define Directed graphs, Directed paths and Directed cycles and apply results to Practical problems.

		POs							PSOs		
	1	2	3	4	5	6	1	2	3		
CLO1	3	1	2	2	1	2	2	1	1		
CLO2	3	2	3	2	1	2	2	1	2		
CLO3	3	1	2	1	1	2	1	2	2		
CLO4	2	3	3	2	2	2	2	3	3		
CLO5	3	3	3	2	2	1	3	2	2		

# **SEMESTER -I -ELECTIVE -I-GROUP A**

Title of the	e Course	3. FORMAL LANGUAGES AND AUTOMATA THEORY					THEORY
Paper Nu	nber	ELECTIVE I					
Category	ELECTIVE	Year	Ι	Credits	3	Course	P23MTE11C
	COURSE	Semester	Ι			Code	

Instructional Hours	Lecture	Tutorial	Lab Practice	Total				
per week	4	1		5				
Pre-requisite	UG level Discrete Mathematics .							
<b>Objectives of the</b>	To understand the notion of effective computability by studying							
Course	Finite Auton	nata, Regular Exp	pressions, Regula	r Languages and Free				
	Grammars.							
Course Outline	UNIT I: W	hy Study Auton	nata Theory? -In	ntroduction to Formal				
	Proof- Addit	ional Forms of Pr	oof-Inductive Pro	oofs.				
	Chapter 1: S	Sections 1.1 – 1.4	ļ					
	UNIT II: A	n Informal Pict	ure of Finite A	utomata-Deterministic				
	Finite A	utomata-Non-Det	erministic Fi	nite Automata-An				
	Application:	Text Search.						
	Chapter 2: S	Sections 2.1 – 2.4	ļ.					
	UNIT III:	Regular Expres	ssions-Finite Au	tomata and Regular				
	Expressions-	Application of R	egular Expressio	ns-Algebraic Laws of				
	Regular Exp	ressions.						
	Chapter 3: S	Sections <b>3.1</b> – <b>3.</b> 4	ļ					
	UNIT IV: P	roving Languages	s are Not Regular	-Closure Properties of				
	Regular La	nguages-Decision	Properties of	Regular Languages-				
	Equivalence	and Minimization	n of Automata.					
	Chapter 4: S	Sections 4.1 – 4.4	ļ					
	UNIT V:	Context-Free G	rammars-Parse	Trees-Application of				
	Context-Free	Grammar-Ambi	guity in Gramma	rs and Languages.				
	Chapter 5: S	Sections 5.1 – 5.4	ļ					
Extended Professional	Questions re	elated to the abo	ove topics, from	n various competitive				
Component (is a part of	examinations	s NET / UGC –	CSIR / GATE /	TNPSC / others to be				
internal component	solved							
only, Not to be included	(To be discussed during the Tutorial hour)							
in the External								
naper)								
Skills acquired from this	Knowledge	Problem Solv	ing Analytical	ability Professional				
course	Competency.	, Professional Con	mmunication and	Transferrable Skill				

Recommended Text	J. E. Hopcroft, R. Motwani and J.D. Ullman; Introduction to
	Automata Theory, Languages, and Computation. Second Edition,
	Pearson Edition, 2001.
<b>Reference Books</b>	1. P.K. Srimani and S.F.B. Nasir; A text book on Automata theory,
	Cambridge University press, 2007.
	2. J.P. Tremblay and R. Manohar; Discrete Mathematical Structures
	with Applications to Computer Science, McGraw Hill Education
	(India) Pvt Ltd, 2017.
Website and	https://en.wikipedia.org/wiki/Automata_theory,
e-Learning Source	https://en.wikiversity.org/wiki/Automata_theory,

Students will be able to

CLO 1: understand the basic properties of formal languages and grammars.

CLO 2: make grammars to produce strings from a specific language..

**CLO 3:** design sample Automata

CLO 4: minimize Finite Automata and grammar of context-free languages.

CLO 5: differentiate regular, context-free and recursively enumerate languages.

		POs							PSOs		
	1	2	3	4	5	6	1	2	3		
CLO1	3	1	1	1	2	1	2	2	1		
CLO2	2	3	3	2	2	1	2	3	1		
CLO3	1	3	3	3	2	2	2	3	2		
CLO4	1	3	3	3	2	2	3	2	2		
CLO5	3	3	3	2	2	1	1	3	1		

#### **SEMESTER - I - ELECTIVE - I-GROUP A**

Title of	the Course	4.PROGR	4.PROGRAMMING IN C++ AND NUMERICAL METHODS					
Paper	·Number	ELECTIV	ELECTIVE I					
Category	ELECTIVE	Year	Ι	Credits	3	Co	urse	P23MTE11D
	COURSE	Semester	Ι			Co	ode	
Instruct	ional Hours	Lecture	Tutorial		Lab Practice			Total

per week	4 1 5
Pre-requisite	Basics of Differentiation and Integration
Objectives of the	To develop the skills of solving algebraic, transcendental,
Course	differential and integral equations numerically and C++ Programme.
Course Outline	<b>UNIT I:</b> Method of False Position - Bisection Method - Iterative
	Method - Newton-Raphson Method - Graeffe Root Squaring
	Method - Programme for Bisection Method.
	Chapter 2: Sections 2.2, 2.3, 2.4, 2.5, 2.8 and 2.11.1
	UNIT II: Gauss Elimination Method – Jordan Method – Jacobi
	Iteration Method - Gauss-Seidel Iterative Method - Eigen Value
	Problem – Programme for Gauss Elimination Method.
	Chapter 3: Sections 3.3, 3.4, 3.7, 3.8, 3.13 and 3.15.1.
	<b>UNIT III:</b> Curve Fitting -Fitting a Straight Line by the Method of
	Group Averages – Least Square Curve Fitting Method – Method of
	Moments – Weighted Least Squares Method – Programme to Fit a
	Straight Line Using Group Average Method.
	Chapter 4: Sections 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6.1
	<b>UNIT IV:</b> Finite Differences $- E$ , $\mu$ and D Operators $-$ Gregory-
	Newton Forward Interpolation Formula - Gregory-Newton
	Backward Interpolation Formula – Gauss Forward Interpolation
	Formula – Gauss Backward Interpolation Formula – Programme for
	Interpolating Using Gregory-Newton Forward Interpolation.
	Chapter 5: Sections 5.1, 5.2, 5.7, 5.8, 5.9, 5.10 and 5.23.1
	<b>UNIT V:</b> Numerical Differentiation – Trapezoidal – Simpson's 1/3
	Rule - Simpson's 3/8 Rule – Romberg Formula – Programme to
	Find Derivative at Initial Point by Newton Forward Formula.
	Chapter 6: Sections 6.1, 6.6, 6.7, 6.8, 6.11 and 6.16.1
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC
internal component	/ others to be solved
only, Not to be included	(To be discussed during the Tutorial hour)
in the External	
Examination question	
paper)	
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill.
Recommended Text	1.Nita H. Shah, Numerical Methods With C++ Programming,
	PHI Learning Private Limited, 2009.

<b>Reference Books</b>	1. C.F.Gerald and P.O.Wheatly; Applied Numerical Analysis,							
	Addison Wesley, Fifth Edition, 1998.							
	2. V. Rajaraman, Computer Oriented Numerical Methods, PHI, 3rd							
	Edition, 2006.							
	3. E.V.Krishnamurthy and S.K. Sen, Computer Based Numerical							
	Algorithms, Alfinated East-west Pless PVt Ltd, 1st Edition, 2009.							
	4. M.K.Jain, S.R.K.Iyengar and R.K.Jain; Numerical Methods for							
	Scientific and Engineering Computation, New Age International							
	Publishers, Fourth Edition, 2013.							
Website and	https://www.codesansar.com/numerical-methods/,							
e-Learning Source	https://www.phindia.com/Books/BookDetail/9788120335967/nume							
	rical-methods-with-cprogramming-shah,							
	https://www.udemy.com/course/learn-numerical-methods-using-c/							

Students will be able to

**CLO 1:** understandthe iterative methods for finding the roots of transcendental and algebraic equations with C++ Programme.

**CLO 2:** solve a system of linear algebraic equations and study Convergence of iterative methods.

**CLO 3:** fit a Curve for given set of data through C++ Programme.

**CLO 4:** approximate the polynomial by interpolation method via C++ Programme.

CLO 5:analyze Numerical Differentiation and Integration using Programming in C++.

		POs						PSOs		
	1	2	3	4	5	6	1	2	3	
CLO1	3	2	3	2	1	2	3	2	2	
CLO2	3	2	3	2	1	2	3	2	2	
CLO3	3	2	3	2	1	2	3	2	2	
CLO4	3	2	3	2	1	2	3	2	2	
CLO5	3	2	3	2	1	2	3	2	2	

# SEMESTER -II -ELECTIVE -III-GROUP B

Title of	the Course	1. LIE GROUPS ANDLIE ALGEBRAS						
Paper	Number	ELECTIV	ELECTIVE III					
Category	ELECTIVE	Year	Ι	Credits	3	Cour	rse	P23MTE22A
	COURSE	Semester	II			Cod	le	
Instructi	ional Hours	Lecture	Lecture Tutorial			tice		Total
per	r week	3		1				4
Pre-requis	site	Basics set theory and Groups						

60

Objectives of the Course	To introduce the concept of Lie Algebras and Lie Groups and to study their properties						
	study then properties						
Course Outline	UNIT I:Lie groups, Subgroups, and cosets, Action of Lie groups on manifolds and representations, Orbits and homogeneous spaces, Left, right, and adjoint action, Classical groups. Chapter 2: 2.1-2.5						
	<b>UNIT II:</b> : Exponential map, The commutator, Adjoint action and						
	Jacobi identity.						
	<b>Chapter</b> 3: 3.1-3.3						
	<b>UNIT III:</b> Subalgebras, ideals, and centre, Lie algebra of vector						
	fields, Stabilizers and the center.						
	Chapter 3: 3.4-3.6						
	UNIT IV: Campbell-Hausdorff formula, Fundamental theorems of						
	Lie theory, Complex and real forms, Example: $so(3, \mathbb{R})$ , $su(2)$ , and						
	$SI(2, \mathbb{C})$						
	UNIT V. Basic definitions Operations on representations						
	Irreducible representations. Intertwining operators and Schur						
	lemma.						
	<b>Chapter</b> 4 : 4.1-4.4						
Extended Professional	Questions related to the above topics, from various competitive						
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC						
internal component	/ others to be solved						
only, Not to be included	(To be discussed during the Tutorial hour)						
in the External							
Examination question							
paper)	Knowledge Duckley Colving Archetical shills D. C. '						
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional						
Decommonded Terra	Competency, Professional Communication and Transferrable Skill.						
kecommended 1 ext	1. 1. Alexander Kirillov J.K. Introduction to Lie Algebras and Lie						
	Groups SUNY AISIONY BROOK, NY 11/94						

Reference Books	1Alexander Kirillov J.R Lie Groups , Lie Algebras, and
	Representations.
	2Alexander Kirillov J.R Introduction to Lie Algebras and representation theory.
	3Alexander Kirillov J.R Introduction to Lie Algebras
Website and	URL:http//www.math.sunysb.edu/"kirillov/liegroup
e-Learning Source	

Students will be able to

CLO 1: understandthe definition of Lie Groups and Lie Algebras.

CLO 2: studied exponential map, The commutator, Adjoint action and Jacobi identity.

**CLO 3:** gained the Subalgebras, ideals, and centre, Lie algebra of vector fields, Stabilizers and the center.

**CLO 4:** Campbell-Hausdorff formula, Fundamental theorems of Lie theory, Complex and real forms, Example:  $so(3, \mathbb{R})$ , su(2), and  $sl(2, \mathbb{C})$ 

**CLO 5:**Operations on representations, Irreducible representations, Intertwining operators and Schur lemma.

			PO	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	1	2	3	2	2
CLO2	3	2	3	2	1	2	3	2	2
CLO3	3	2	3	2	1	2	3	2	2
CLO4	3	2	3	2	1	2	3	2	2
CLO5	3	2	3	2	1	2	3	2	2

#### **SEMESTER -II -ELECTIVE -III-GROUP B**

Title of	the Course	2.MATHEN	IATIO	CAL PROC	GRAMMIN	NG				
Paper	Number	ELECTIVE	III							
Category	ELECTIVE	Year	Ι	Credits	3	Course P23MTE22				
	COURSE	Semester	II			Code	;			
Instructi	ional Hours	Lecture	T	utorial	Lab Prac	ctice	Total			
per	week	3		1			4			
Pre-requis	ite	UG level Op	eration	ns Research						
Objectives	of the	To understan	d the	methods of	optimizatio	on technic	ques, the theory of			
Course		optimization	techn	iques and fa	miliar in so	olving tee	chniques,			
		analysing the	e resu	ilts and pro	pose recor	nmendati	ions to the			
		decision mak	king pr	ocess.						
Course Ou	ıtline	UNIT I:Inte	ger L	inear Prog	ramming					
		Intro	duction	n - Illustrat	tive application	ation inte	eger programming			
		solution al	lgorith	ms, Branc	h and Bo	und Alg	orithm -zero-one			
		implicit enu	merati	on algorith	m- Cutting	plane alg	orithm			
		Chapter 9: 9	9.1, 9.2	2.1, 9.2.3						
		UNIT II: De	etermi	nistic Dyna	amic Prog	ramming				
		Intro	duction	n- Recursiv	ve nature	of con	nputation in DP-			
		Forward and	d Bac	kward re	ecursion-	Selected	DP applications			
		cargo- Load	ing m	nodel W	ork force	size mod	del- Equipment –			
		replacement	model	- Inventory	models					
		Chapter10:1	10.1 to	10.3						
		UNIT III: D	ecisio	n Analysis	and Game	es:				
		Decis	sion er	vironment-	Decision r	naking ı	under certainty			
		(Analytical H	Hierard	hy approac	h). Decisio	n making	g under risk-			
		Expected val	ue cri	terion- Vari	ations of th	e expecte	ed value criterion			
		– Decision u	nder u	ncertainty	Game theor	ry. Optim	nal solution of			
		Two-Perso	n zer	o-Sum gam	es- Solutio	n of mixe	ed strategy games			
		Chapter 14:	14.1 t	o 14.4						
		UNIT IV:Si	mulat	ion Modeli	ng :					
		What is simulation? Monte Carlo Simulation- Types of								
		simulation- Elements of Discrete Event simulation- Generic								
		definition of	even	ts- Samplin	g from pr	obability	distributions.			
		Methods for	gathe	ering statisti	ical observa	ations – S	Sub Interval			
		method- Rep	ublica	n method- l	Regenerate	(Cycle M	/Iethod)-			
		Simulation L	angua	lges						
		Chapter 18:	18.1 t	o 18.7						

	UNIT V: Nonlinear Programming Algorithm
	Unconstrained nonlinear Programming algorithm- Direct
	search method- Gradient method Constrained algorithms:
	Separable programming- Quadratic programming- Geometric
	programming- Stochastic programming- Linear Combination
	Method- SUMT algorithm
	<b>Chapter</b> 21: 21.1, 21.2
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC
internal component	/ others to be solved
only, Not to be included	(To be discussed during the Tutorial hour)
in the External	
Examination question	
paper)	
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill.
<b>Recommended Text</b>	1.Hamdy A.Taha, Operation Research an Introduction, 6 <sup>th</sup> edition,
	University of Arkansas Fayetteville
Reference Books	1.F.S. Hillier and G. J. Liberman Introduction to operation
	Research 4 <sup>th</sup> Edition, McGno Hill Book Compnany, New York,
	1989
	2.B.E.Gillett, Operation Research- A computer oriented
	algorithmic Approach, TMH Edition NewDelhi, 1976
Website and	www.pearsonglobaleditions.com
e-Learning Source	

Students will be able to

CLO 1: Integer Linear Programming

CLO 2: Deterministic dynamic Programming

**CLO 3:** Decision analysis and games

**CLO 4:** Simulation Modeling

CLO 5:Nonlinear Programming algorithm

			P	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	1	2	3	2	2
CLO2	3	2	3	2	1	2	3	2	2
CLO3	3	2	3	2	1	2	3	2	2
CLO4	3	2	3	2	1	2	3	2	2
CLO5	3	2	3	2	1	2	3	2	2

# SEMESTER -II -ELECTIVE -III-GROUP B

Title of	the Course	<b>3. FUZZY SETS AND THEIR APPLICATIONS</b>									
Paper	·Number	ELECTIVE	E III								
Category	ELECTIVE	Year	Ι	Credits	3	Cour	rse	P23MTE22C			
	COURSE	Semester	II			Cod	Code				
Instruct	ional Hours				Lab Prac	ctice	Total				
per	r week	3		1			4				
Pre-requis	ite	UG level se	ts and	functions							
Objectives	of the	To introduce	e the c	concept of t	fuzzy theor	y and s	study	its application			
Course		in real probl	ems. 7	Fo study the	e uncertaint	ty envir	onm	ent through the			
		fuzzy sets th	at inc	orporates.	To underst	and the	fuzz	y relations and			
		fuzzy arithm	etic					-			
Course Ou	ıtline	UNIT-I: F	rom (	Classical Se	ts To Fuzz	v Sets					
		From Class	sical	Sets To Fi	zzv Sets:	A Gra	ind r	paradigm shift.			
		Introduction	- Fuz	zv Sets Ve	erses Crisp	Set	ts :	An Overview -			
		Fuzzy Sets	· Ba	isic types	– Fuzzy	sets ·	Basi	ic Concepts –			
		Characterist	ics an	id Si	onificance	of the	nar	radigm shift _			
		Additional E	Proper	ties of a	ute Pepr	os une	, pui ions	of Euzzy sets			
		First Doom	nogitic	the order = 0	Second	Docon	nnog	ition theorem			
		Third Decom		ion theorem	- Secolia	Decon Decon	into	for furges acto			
		Third Decon	nposit		I- Extensio	on Princ		for fuzzy sets.			
		Chapter 1 S	ection	is 1.3, 1.4, 0	Chapter :2	Section	ns 2.	1 and 2.			
					<u> </u>						
		UNIT-II: Op	peration	ons on Fuzz	zy Sets						
		Operations	on	Fuzzy Se	ets:Types	of ope	erati	ons – Fuzzy			
		complement	s – F	First Chara	cterization	- -	Theo	orem of Fuzzy			
		Complements - Second Characterization Theorem of Fuz									
		Complement	ts -	Fuzzy Inte	ersections:	t-Norm	s-S	Some classes of			
		Fuzzy Inters	section	ns (t–Norm	s) - Fuzzy	Union	s: t-	Conorms -			
		Some classe	es of I	Fuzzy Unio	ons (t– Co	norms)	- C	ombinations of			
		Operations -	- Agg	regation Or	perations.						
		Chapter 3 Se	ection	s 3.1, 3.2, 3	.3, 3.4, 3.5						

	UNIT III. Euggy Arithmotics
	UNIT-III: FUZZY AFILINMEUC: Fuzzy Arithmetic introduction Fuzzy Numbers Membershin
	functions of Euzzy numbers theorem Linguistic variables
	Arithmetic operations on intervals Arithmetic operations on Eugen
	Arunneuc operations on intervals – Arunneuc operations on Fuzzy
	numbers – Lattice of Fuzzy numbers – Fuzzy Equations – Equation
	A + X = B and Equation $A * X = B$ .
	Chapter 4 Sections 4.1, 4.2, 4.3, 4.4
	UNIT-IV: Fuzzy Relations
	Fuzzy Relations introduction Crisp and Fuzzy Relations -
	Projections and Cylindric Extensions – Binary Fuzzy Relations –
	Binary Relations on a Single Set – Fuzzy Equivalence Relations –
	Fuzzy Compatibility Relations –Fuzzy Ordering Relations –
	Fuzzy Morphisms – SUP-i Compositions of Fuzzy Relations –
	INF-omega Compositions of Fuzzy Relations.
	Chapter 5 Sections 5.3, 5.4, 5.5, 5.6, 5.7, 5.8
	UNIT-V: Fuzzy Decision Making and Applications
	Fuzzy Decision Making introduction -General Discussion -
	Individual decision making – Multiperson Making – Multicriteria
	Decision Making – Multistage Decision Making – Fuzzy Ranking
	methods – Fuzzy Linear programming. ltiperson Decision Making-
	Ranking methods – Fuzzy Linear programming
	Applications: Medicine- Economics-Fuzzy systems and Genetic
	applications- Fuzzy Regression- Interpersonal communication-
	Other Applications
	Chapter 15 Sections 15.2,15.3, 15.6, 15.7
	Chapter 17Sections 17.1 to17.7
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC
internal component only,	/ others to be solved
Not to be included in the	(To be discussed during the Tutorial hour)
External Examination	
question paper)	
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill.
Recommended Text	<b>1George J. Klir and Bo Yuan</b> , "Fuzzy sets and Fuzzy Logic Theory and Applications", Prentice Hall of India, (2005).

<b>Reference Books</b>	1.A.K. Bhargava: Fuzzy Set Theory, Fuzzy Logic and their
	Applications, published by S. Chand Pvt limited, 2013
	2.S. Rajasekaran& Y.A. VijiaylakshmiPai, Neural Networks, Fuzzy
	logic and genetic algorithms, Prentice Hall of India
	3. H.J. Zimmermann, "Fuzzy Set Theory and its Applications", Allied Publishers Limited (1991).
	4. M. Ganesh, "Introduction to Fuzzy sets and Fuzzy logic", Prentice Hall of India, New Delhi (2006).
Website and	-http://mathforum.org. http://ocw.mit.edu/ocwweb/Mathematics.
e-Learning Source	http://www.opensource.org, http://www.Fuzzylogic .net

- Students will be able to
- CLO 1: Crisp sets and fuzzy sets
- CLO 2: Operation on Fuzzy sets
- CLO 3: Fuzzy relation
- CLO 4: Decision making in Fuzzy environment

## CLO 5: Applications

			PO	Os				PSOs		
	1	2	3	4	5	6	1	2	3	
CL01	3	2	3	2	1	2	3	2	2	
CLO2	3	2	3	2	1	2	3	2	2	
CLO3	3	2	3	2	1	2	3	2	2	
CLO4	3	2	3	2	1	2	3	2	2	
CLO5	3	2	3	2	1	2	3	2	2	

# SEMESTER -II -ELECTIVE -III-GROUP B

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Title of the Course	4.DISCRETE MATHEMATICS								
Paper Number			C P4	2	C				
Category ELECTIVE	Year	1 11	Credits	3		irse	P23M1E22D		
Instructional Hours	Jacture		utorial	Loh Drog		ue	Tatal		
nor wook		L	1		tice		<u>10tai</u>		
Pro-roquisito	JIG level set	te and	1 functions						
Objectives of the				f anni ana		:	da Lattiana		
Course of the	Declars Ale		$\sigma$	i semi gro	oups, n	nonoi	ds, Lattices,		
Course	Boolean Alg	gebra, G	Jrammer ar	id Languag	es				
Course Outline	UNIT I: Ma	athem	atical Logi	c:					
	Introduction	– Sta	tements An	d Notation	– Cor	nnecti	ves : Negation,		
	Conjunction	– Dis	junction – S	Statement F	Formul	as Ar	nd Truth Tables		
	– Condition	nal Ar	nd Bicondi	tional – V	Vell F	Forme	ed Formulas –		
	Tautotogies	– E	quivalance	of Form	ulas	– D	uality Law –		
	Tautological	Impli	cations – F	ormulas W	ith Dis	stinct	Truth Tables –		
	Funtionally	Comp	lete Sets of	Connectiv	ves – (	Other	Connectives –		
	Normal Far	ns: D	isiunctive N	Normal For	ms –	Coni	unctive Normal		
	Forms –	Princi	oal Disiun	ctive Nor	mal l	Form	s – Principal		
	Conjunctive	Norm	al Forms				s interput		
	Chapter1 ·	Sectio	$n 1 1 t_0 1 3$						
	Chapterr	Sectio	11.110 1.5						
		T	OPT P	6 7					
	UNIT II: Th	e The	ory Of Infe	rence for	The St	tatem	ent Calculus:		
	Validity Usi	ng Tru	th Tables -	- Rules of I	Inferer	nce –	Consistency of		
	Premises Ar	nd Ind	irect Metho	d of Proof	– The	e Prec	licate Calculus:		
	predicates –	The S	tatement Fi	unctions, V	ariable	es An	d Quantifiers –		
	Predicate Fo	rmula	s – Free An	d Bound V	ariable	es - 7	The Universe of		
	Discourse.	Infere	ence Theory	of The F	Predica	ate Ca	alculus : Valid		
	Formulas And equivalences – Some Valid Formulas Over								
	Universes – Special Valid Formulas Involving Quantities – T								
	of Inference For The Predicate Calculus – Formulas Involving N								
	Than One O	uantifi	er				6		
	Chapter1 : S	Sectio	<b>n</b> 1.4 and 1	1.5					

	UNIT III: Lattices:
	Lattices as partially ordered sets and their properties, Lattices as
	algebraic systems, sublattices, Direct products and homomorphisms,
	Some special lattices such as complete, complemented and
	distributive lattices
	Chapter4: Section 4.1, 4.1.3 to 4.1.5
	UNIT IV:Boolean Algebra
	Boolean Algebra as Lattices, Various Boolean identities, The
	switching algebra example, Sub-algebras, direct product and
	homomorphisms, join-irreducible elements, Atoms and minterms,
	Boolean forms and their equivalence. Minterms Boolean forms.
	sum of products canonical forms Minimization of Boolean forms
	Chapter 4: Section 4.2.1 to 4.2.2
	<b>UNIT V: Boolean functions</b> : Boolean forms and Free Boolean
	Algebras, Values of Boolean expressions and Boolean functions.
	Representation and minimization of Boolean functions
	Chapter 4: Section 4.3 and 4.4
Extended Professional	Ouestions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC
internal component	/ others to be solved
only. Not to be included	(To be discussed during the Tutorial hour)
in the External	(10 be discussed during the Tutorial hour)
Examination question	
nonor)	
paper)	Knowledge Drohlem Colving Analytical shility Drofessional
Skins acquired from this	Compatency Professional Communication and Transformula Strill
course	Competency, Professional Communication and Transferrable Skill.
kecommended Text	1.J.P Trumbly and K. Mononar, Discrete Mathematical Structure
	and its application to computer Science, Tata McGraw Hills, New
	Delhi.
keierence Books	I Kenneth H Rosan, Discrete Mathematics and its applications, /
	edition, wCB/McGraw Hill Educations, New York 2008
	2 C.L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill
	Publishing Company Limited
Website and	- <u>http://mathforum.org</u> , <u>http://ocw.mit.edu/ocwweb/Mathematics</u> ,
e-Learning Source	http://www.opensource.org, http://www.discreate .net

Students will be able to

CLO 1: Semigroups and Monoids

CLO 2: Lattices

CLO 3: Grammars and Languages

CLO 4: Boolean Algebra

CLO 5:Boolean functions:

			P	Os			PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	1	2	3	2	2
CLO2	3	2	3	2	1	2	3	2	2
CLO3	3	2	3	2	1	2	3	2	2
CLO4	3	2	3	2	1	2	3	2	2
CLO5	3	2	3	2	1	2	3	2	2

Semester III Elective V to be chosen from Group D

Title of the Course			1.FLUID DYNAMICS						
Paper Number			ELECTIVE V						
Category			Year	II			Course		P23MTE33A
	Elective		Semester	III	Credits	3	Code		
Instructional Hours			Lecture	Tute	orial	Lab Practice Total		al	
per week			2	1				3	
Pre-requisite			UG Level Calculus and Vector Calculus						
<b>Objectives</b> of the			This course aims to discuss kinematics of fluids in motion,						
Course			Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.						
<b>Course Outline</b>			UNIT - I						
			Kinematics of Fluids in motion - Real fluids and Ideal fluids -						
			Velocity of a fluid at a point, Stream lines, path lines, steady and						
			unsteady flows - Velocity potential - The vorticity vector- Local						
			and particle rates of changes - Equations of continuity - Worked						
			examples - Acceleration of a fluid - Conditions at a rigid boundary.						
			Chapter 2: Sections 2.1 to 2.10						
			UNIT - II						
			Pressure at a point in a fluid at rest - Pressure at a point in a moving						
			fluid - Conditions at a boundary of two inviscid immiscible fluids-						
			Euler's equation of motion - Discussion of the case of steady						
			motion under conservative body forces.						
			UNIT - III						
			Some three dimensional flows – Introduction - Sources sinks and						
			doublets - Images in a rigid infinite plane - Axis symmetric flows -						
			Stokes stream function						
			Chapter 4:Sections 4.1, 4.2, 4.3, 4.5						
			UNIT - IV						
			Meaning of two dimensional flow - Use of Cylindrical polar						
			coordinate - The stream function - The complex potential for two						
			dimensional, irrotational incompressible flow - Complex velocity						
			potentials for standard two dimensional flows - Some worked						
			examples - Two dimensional Image systems - The Milne Thompson						
			circle Theorem.						
			Chapter 5: Sections 5.1 to 5.8						
	UNIT - V								
---------------------------	--								
	Stress components in a real fluid - Relations between Cartesian								
	components of stress - Translational motion of fluid elements - The								
	rate of strain quadric and principal stresses - Some further properties								
	of the rate of strain quadric - Stress analysis in fluid motion -								
	Relation between stress and rate of strain - The coefficient of								
	viscosity and Laminar flow - The Navier - Stokes equations of								
	motion of a Viscous fluid.								
	Chapter 8: Sections 8.1 to 8.9								
Extended Professional	Questions related to the above topics, from various competitive								
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC								
internal component	/ others to be solved								
only, Not to be included	(To be discussed during the Tutorial hour)								
in the External									
Examination question									
paper)									
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional								
course	Competency, Professional Communication and Transferrable Skill								
<b>Recommended Text</b>	1.F. Chorlton, Text Book of Fluid Dynamics, CBS Publications,								
	Delhi, 1985								
<b>Reference Books</b>	1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985								
	2. E.Krause, Fluid Mechanics with Problems and Solutions,								
	Springer, 2005								
	3. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids,								
	Taylor and Francis, New York, 2005								
	4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002								
	5. I.Petrila, Basics of Fluid Mechanics and Introduction to								
	Computational Fluid Dynamics, Springer, Berlin, 2004								
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,								
e-Learning Source	http://www.opensource.org								

Students will be able to

CLO 1: Understand the basic properties and principles of viscous and non-viscous fluids
CLO 2: Derive and deduce the consequences of the governing equations of fluids
CLO 3: Solve kinematics problems such as finding particle paths and streamlines
CLO 4: Understand the basic theorems of fluid mechanics and its applications
CLO 5: Derive the boundary layer equations of some basic flows and its solutions

			Р	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	2. PROBAE STATISTIC	BILIT CS	Y THEORY	Y AND MA	THE	EMAT	TCAL
Paper Nur	nber	Elective V						
Category	Elective	Year	Year II Course					
		Semester	III	Credits	3	Cod	le	<b>P23MTE33B</b>
Instruction	nal Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	ıl
per week (	hrs)	2	1		-		3	
Pre-requis	ite	Random var	iables	and statistic	s Knowledg	ge in	UG Le	evel
Objectives	of the	To impart th	e stati	stical conce	pts and resu	lts w	ith rig	orous
Course		Mathematic	al treat	ment.				
		To enable th	e real-	life application	tions of Stat	tistics		
Course Ou	ıtline	UNIT- I: Th	eory o	of Probabili	ity:			
		Theory of	Probab	ility introdu	uction- Axio	omati	c appr	oach to axioms
		of Probabil	ity, C	Conditional	probability	/ _M	lultipli	icative law of
		Probability-	Total	probability	and Baye'	s the	orem	<ul> <li>Independent</li> </ul>
		events. Disc	rete ra	andom varia	able - conti	nuou	s rand	lom variables –
		Properties of	of dist	ribution fu	nction-Func	tion	of rai	ndom variable-
		Two dime	nsion	random	variable	- N	Iargin	al Probability
		Distribution	s –Co	nditional P	robability l	Distri	bution	is- independent
		random vari	ables.					Ĩ
		Chapter 1:	1.4 – 1	.48 and Ch	hapter 2 : 2	.1 – 2	.33	
		UNIT-II: M	oment	Generatin	- g Function	:		
		Mathematica	l Expe	ctations int	roduction- I	Expec	tation	, functions of a
		random va	riable,	properties	s of expe	cted	value	es – Moment
		Generating	Functi	on: Momen	ts -Momen	t Gen	eratin	g Function and
		properties	- Cha	aracteristic	Functions:	Pro	obabili	ity Generating
		Function-	Correla	ation: prop	erties of	corre	lation	coefficient –
		Regression:	prope	erties of re	egression c	o-effi	cient	-Multiple and
		Partial Co	rrelatio	on: relatio	n betweer	n M	ultiple	e and partial
		Correlation	Coeffi	cients			•	×
		Chapter 3:	3.1 – 3	.18, Chapt	er 5, Chapt	ter 6,	Chap	ter 8, Chapter
		9 and Chap	ter 11	•	•	,	•	· •

UINI I - 111;	Distributions:
Introductio	n about Distributions: Geometric Distribution -
Memoryles	s property of geometric distribution -The Normal
Distribution	- Uniform Distribution - Exponential Distribution -
Gamma Di	stributions - Beta Distributions- Sampling distribution -
Chi Square	e, t, F Distribution – Students t Distribution – F-
Distribution	l.
Chapter 15	, Chapter 16, Chapter 17, Chapter 18, Chapter
19,Chapter	20, and Chapter 22
UNIT-IV: E	stimation:
Estimation in	ntroduction- Concepts of Point and Interval Estimator –
Efficiency -	Consistent Estimator – Sufficient Estimator – Properties
of Estimato	r -invariance property of consistent estimator - method
of Maxim	um Likelihood Estimators-Minimum chi square
Estimator	
Chapter 23	
UNIT-V:Cl	assifications and types:
Classificatio	ns: One way and two way classification -ANOVA-
design of E	xperiments: Experimental Units –basic principles in the
design of 1	Experiments- Completely block designs - Completely
Randomize	d Design -Randomized Block design – Latin square
designs- an	alysis of Latin square designs- merits and demerits of
Completely	Randomized Design - merits and demerits of Random
Block desig	n and Latin square design –Factorial Experiments.
Chapter 26	and Chapter 28
Extended Professional Questions	related to the above topics, from various competitive
Component (is a part of examination	ns UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC
internal component / others to b	e solved
only. Not to be included (To be discu	ussed during the Class hour)
in the External	
in the External Examination question	
in the External Examination question paper)	
in the External Examination question paper) Skills acquired from this Knowledge	e, Problem Solving
in the External Examination question paper) Skills acquired from this Knowledge	e, Problem Solving
in the External Examination question paper) Skills acquired from this Knowledge course Recommended Text 1.P.R.Vital	e, Problem Solving , "Mathematical Statistics", Margham publications,
in the External Examination question paper) Skills acquired from this course Recommended Text I.P.R.Vital Edition 201	e, Problem Solving , "Mathematical Statistics", Margham publications, 2.

<b>Reference Books</b>	1. Gupta. S.C. &Kapoor,V.K. (2002). Fundamentals of
	Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi
	2. Mood A. M & Graybill F. A & Boes D. G (1974) : Introduction to
	theory of Statistics, Mcgraw Hill.
	3. Hogg R. V. & Craig A. T. 1988) : Introduction to Mathematical
	Statistics, Mcmillan. BansilalandArora (1989).New Mathematical
	Statistics, SatyaPrakashan, New Delhi.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, http://en.wikipedia.org

Students will be able to

CLO 1 Demonstrate the basic concepts of statistics, probability and random variables

CLO 2: Apply the concepts in finding the moments of the distributions

**CLO 3:** Limit distribution of sample quantiles

CLO 4: Identify the type of the distribution and estimation

CLO 5: Understand the basics of sampling distribution theory

			P	POs							
	1	2	3	4	5	6	1	2	3		
CLO1	3	2	3	2	1	2	3	2	2		
CLO2	3	2	3	2	1	2	3	2	2		
CLO3	3	2	3	2	1	2	3	2	2		
CLO4	3	2	3	2	1	2	3	2	2		
CLO5	3	2	3	2	1	2	3	2	2		

Title of the (	Course	3.MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE								
Paper Numb	ber	ELECTIV	ΕV							
Category H	ELECTIVE	Year	II	Credits	3	Course P23MTE		P23MTE33C		
		Semester	III			Cod	le			
Instructiona	al Hours	Lecture	Tute	orial	Lab Prac	tice	Tota	al		
per week		2	1				3			
Pre-requisit	e	Basic Skill	s in ma	chines.						
Objectives o Course	of the	To get artif	ficial int	elligence w	ith the help	of ma	achine	es.		
	une	AI Founda AI, Golde Structure o Chapter 1 UNIT II: Data - The Volume, V Data Proce Preparation for AI?, Me Chapter 2 UNIT III: Machine I with Mach Order, Cho Tune the Unsupervis Learning. Chapter 3 UNIT IV: Common Framework Classifier, Ensemble I Chapter 3 UNIT V: Deep Lear Learning, Artificial N Networks - Chapter 4	tions, A n Age f AI. e Fuel ariety a ess, Bu n, Ethics ore Data Learning ine Le oose a M Model sed Lea Types c for K-Near Modelli ning - What is Neural I RNN, o	lan Turing of AI, Te for AI, Da and Velocity siness Under s and Gover a Terms and g - Mining I arning?, Th Iodel, Train , Applying rning, Rein of Mach Machine I est Neighbor ng, K-Mean Difference I s Deep Lea Networks, E CNN, GAN	and the Tu echnologica ata Basics, y of Data, I erstanding, mance, Hoy I Concepts. Insights from Machine Machine the Model g Algorithm forcement ine Learn Learning A bur, Linear s Clustering Between D rning, The Back Propages, Deep Learning	Type Datab Datab Data w Mud m Da e Lea l, Eva ms, S Learn ing Algori Regro g.	s of ases a Under ch Da ta, Wirning luate to Superning, Algorithms, ession	Strong AI, Weak of Modern AI, Data, Big Data, and Other Tools, erstanding, Data ta Do You Need hat Can You Do Process - Data the Model, Fine- vised Learning, Semi-supervised thems, General Naïve Bayes , Decision Tree, ng and Machine Deep Learning, Various Neural ications.		

Extended Professional	Questions related to the above topics from various competitive
Component (is a part of	avaminations NET / LICC _ CSIP / CATE / TNPSC / others to be
Component (is a part of	examinations NET / UOC - CSIK / UATE / INFSC / Others to be
internal component	solved
only, Not to be included	(To be discussed during the Tutorial hour)
in the External	
Examination question	
paper)	
Skills acquired from this	Getting knowledge in artificial intelligence using Machines.
course	
<b>Recommended Text</b>	1.Tom Taulli, Artificial Intelligence Basics: A Non-Technical
	Introduction, Apress
Reference Books	<ol> <li>Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education, 2007.</li> <li>Kevin Night, Elaine Rich, and Nair B., Artificial Intelligence, McGraw Hill, 2008.</li> <li>Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997.</li> <li>Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014.</li> </ol>
Website and	http://mathforum.org_http://ocw.mit.edu/ocwweb/Mathematics
e-Learning Source	http://www.opensource.org_http://en.wikipedia.org
c-Learning Source	http://www.opensource.org, http://en.wikipedia.org

Students will be able to

**CLO 1:** Understand the AI Foundations.

CLO 2: Deal with Data.

CLO 3: Work with Data in an AI project.

**CLO 4:** Construct Machine Learning Algorithms.

CLO 5:Understand Deep learning.

			PO	Os			PSOs           2         2           3         3           3         3           3         2           3         2           3         2           3         2           3         2           3         2           3         2           3         2		
	1	2	3	4	5	6	2	2	3
CLO1	3	2	3	2	3	3	3	3	3
CLO2	3	2	3	2	2	3	3	3	2
CLO3	3	2	3	2	2	3	3	2	1
CLO4	2	2	2	2	2	3	3	2	1
CLO5	2	2	2	2	2	3	3	2	1

Title of the Course	4.STOCH	4.STOCHASTIC PROCESSES							
Paper Number	ELECTIV	ΈV							
Cotogory Elective	Year	II	Crodits	3	Cou	rse	P23MTE33D		
Category Elective	Semester	III	Cicuits	5	Cod	le			
Instructional Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	al		
per week	2	1				3			
Pre-requisite	UG level P	robabili	ty Theory a	nd Queuing	g Theo	ory			
Objectives of the	e To introduce a wide variety of stochastic processes and								
Course	application	s.							
Course Outline	UNIT - I								
	Definition	of stoc	hastic proc	cesses – M	larkov	v cha	ins: Definition-		
	order of	a mark	ov chain	– Higher	transi	ition	probabilities –		
	classification	on of sta	ites and cha	ins.					
	Chapter 2	: Section	ns 2.1 - 2.3,	Chapter 3	: Sec	tions	3.1- 3.4		
	UNIT – II								
	Markov P	rocess v	with discre	te state sp	ace:	Poisso	on process and		
	related d	istributi	ons – P	roperties	of	Poisso	on process -		
	Generaliza	tions of	Poisson pr	ocesses – B	irth a	and de	eath processes –		
	Continuous	s time M	Iarkov chai	ns.					
	Chapter 4	:Section	ns 4.1 - 4.5						
	UNIT – II	I							
	Markov p	rocesses	s with con	tinuous sta	ate sj	pace:	Introduction -		
	Brownian	motion -	– Weiner p	rocess and o	differ	ential	equations for it		
	- Kolmogr	ov equat	tions – Firs	t passage ti	me di	stribu	ition for Weiner		
	process – C	Ornstein	– Uhlenbed	ch process.					
	Chapter 5		ns 5.1 - 5.6						
	UNIT – IV								
	Branching	Proces	ses: Introc	luction –	Prope	erties	of generating		
	tunctions of Branching processes – Distribution of the total number								
	ot progeny – Continuous - Time Markov branching process - Age								
	dependent branching process: Bellman-Harris process.								
	Chapter 9	Chapter 9: Sections 9.1, 9.2, 9.4, 9.7							
	$\mathbf{U}\mathbf{N}\mathbf{I}\mathbf{I} = \mathbf{V}$								
	model M/	1100ess	consignt hal	avior of N	шь. С 1/л///1		hal Birth and		
	death prov	$v_{11} - u$		theory ·	1/1V1/1 N/[/N/	/1	Model related		
	distribution			$\frac{1001y}{\sqrt{S/S}}$	IVI/IVI	/1 —	M/M/S/M Non		
	hirth and d	13 — IVI/I 2211 - IVI/I	$v_{I}$ $\infty$ - $v_{I}$ $v_{I}$	$  \mathbf{o}   \mathbf{o} - \mathbf{L} \mathbf{U} \mathbf{S} \mathbf{S}$	syste	лн - IV с IV/	(X)/M/1		
	Chapter 1	van Qu D-Sectio	101 $101$	сээ . Duik ( Л <b>5</b>	lucue	s - w	· / 1 <b>V1/ 1</b>		
	Chapter 10:Sections 10.1 - 10.5								

Extended Professional	Ouestions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC
internal component	/ others to be solved
only, Not to be included	(To be discussed during the Tutorial hour)
in the External	
Examination question	
paper)	
Skills acquired from this	Knowledge, Problem Solving, Analytical ability, Professional
course	Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	J. Medhi, Stochastic Processes, 2nd Edition, New age international
	Private limited, New Delhi, 2006
<b>Reference Books</b>	1. K. Basu, Introduction to Stochastic Process, Narosa Publishing
	House, New Delhi, 2003
	2. Goswami& B. V. Rao, A Course in Applied Stochastic Processes,
	Hindustan Book Agency, New Delhi, 2006
	3. G. Grimmett& D. Stirzaker, Probability and Random Processes,
	3rd Ed., Oxford University Press, New York, 2001
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org

Students will be able to

**CLO 1**: Acquire in-depth knowledge about stationary stochastic processes and Markov chains.

CLO 2: Proficient in Markov Process with discrete state space.

CLO 3: Proficient in Markov processes with continuous state space.

CLO 4: Proficient in Branching processes and age dependent branching process.

CLO 5: Proficient in solving stochastic processes in queuing systems.

			PO	Os				PSOs	
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

# Group E :(PM/AP/IC/ITC)

# 1.MAT LAB

 $2. Mathematical \ documentation \ using \ LATEX \ / \ other \ packages$ 

3. Mathematical Python

4.Mathematical application MOOC course

Title of the Course		1. MATLAB								
Paper Nur	nber	ELECTIV	'E VI							
Category	ELECTIVE	Year	II	Credits	3	Course		P23MTE44A		
	COURCE	Semester	IV			Cod	e			
Instruction	nal Hours	Lecture	Tuto	rial	Lab Practice		Tota	Total		
per week		1	-		3	4				
Pre-requis	ite	Basic Skills in computers								
Objectives of the CourseTo impart the programming concepts of Matlab .Specific ou of learning the learner will be able to use Matlab for inter computations Ableto draw 2D and 3D graphs. Unde richness of Matlab rather than using algebraic Number theory Word for documentationAble to applying programming techn to solve the programs at advanced level.					becific outcome for interactive ohs. Understand ber theory M.S. ning techniques					

Course Outline	UNIT-I:
	Unit -I: MATLAB: Brief Introduction:
	MATLAB: Importing and Visualizing Images- Importing and
	displaying images -Converting between image types -Exporting
	images- Interactive Exploration of Images- Obtaining pixel intensity
	values- Extracting a region of interest- Computing pixel statistics –
	Introduction To MATLAB:Brief Introduction - Installation of
	MATLAB – History - Use of MATLAB - Key features.
	MATLAB Software: Introduction to MATLAB Software -
	MATLAB window - Command window - Workspace - Command
	history - Setting directory - working with the MATLAB user
	interface - Basic commands - Assigning variables - Operations with
	variables
	UNIT-II:
	Data Files and Data Types:
	Data Files and Data Types introduction -Character and string -
	Arrays and vectors - Column vectors - Row vectors.
	Basic Mathematics:
	BODMAS Rules - Arithmetic operations - Operators and special
	characters -Mathematical and logical operators - solving
	arithmetic equations

### UNIT-III:

#### **TOperations on Matrix :**

Operations on Matrix introduction -Creating rows and columns Matrix - Matrix operations - Finding

transpose, determinant and inverse -Solving matrix

Other Operations: Trigonometric functions -Complex numbersfractions -Real numbers- Complex numbers

#### **UNIT-IV:**

#### Image processing:

Image processing with Measuring object sizes-Creating a custom interactive tool- Pre-processing Images

- Adjusting image contrast -Reducing noise in an image -Using sliding neighbourhood operations -Using

block processing operations

#### **UNIT-V:**

#### Symbolic Math:

Symbolic Math in MATLAB: Calculus: Numerical Integration-

Linear Algebra- Roots of Polynomials-

Algebraic equations Differential Equations (1st & 2nd order) -

Transforms (Fourier, Laplace, etc.)-

Ordinary Differential equations -Examples of few ODEs

Extended	Professional	Type their own Mathematical article
Component	(is a part of	
internal con	nponent only,	
Not to be in	cluded in the	
External	Examination	
question pap	er)	

Skills acquired from this	Efficiently writing documents
course	
Recommended Text	
	1. Y. Kirani Singh & B. B. Chaudhuri, "MATLAB
	Programming", Prentice-Hall of India Pvt. Ltd,
	New Delhi, 2008.
<b>Reference Books</b>	12. Desmond. J.Higham&Nicholas J.Hiham, "MATLAB
	Guide", 2 <sup>nd</sup> edition SIAM, 2005.
Website and	https://services.math.duke.edu/computing/tex/online.html,
e-Learning Source	https://www.overleaf.com/learn

## **Course Outcomes:**

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

- CO1: Use MATLAB for interactive computations.
- CO2: Familiar with memory and file management in MATLAB.
- CO3: Generate plots and export this for use in reports and presentations.
- CO4: Cooperating and working with others using subversion
- CO5: Debugging and optimising their programs

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	1	1	1	1	2	3	2	1
CLO2	3	2	1	1	1	2	3	3	2
CLO3	3	2	1	1	1	1	3	2	2
CLO4	3	1	1	1	1	1	3	2	1
CLO5	3	2	1	1	1	2	3	2	2

Title of the	e Course	2.MATHEMATICAL DOCUMENTATION USING LATEX							
Paper Number		ELECTIVE VI							
Category	ELECTIVE	Year	II	Credits	3	Course		P23MTE44B	
	COURCE	Semester	IV			Cod	le		
Instruction	nal Hours	Lecture	Tuto	rial	Lab Pract	tice	Tota	al	
per week		1	-		3		4		
Pre-requis	site	Basic Skill	s in com	puters					
Objectives	s of the Course	To introd	uce stud	ents with a	a software t	hat is	s used	for typesetting	
		especially	in Mat	hematics a	ind develop	o typi	ng sk	till for students	
<u> </u>		with vario	ous docui	nents form	ats of LaTe	X.			
Course Ou	itline	UNIT-I:							
		Typing a	very sho	rt "article'	' – Typing	Math	n- Foi	rmula gallery –	
		Typing equations and aligned formulas- The anatomy of an article –							
		Article templates							
		Chapter 1: 1.1 to 1.6.							
		UNIT-II:							
		Your first article - LATEX error Messages - Logical & Visual							
		design- A brief over view – Using LATEX- What's next?							
		Chapter 1: 1.7 to 1.12.							
		UNIT-III :							
		Typing Text : The Keyboard- Words, sentences & paragraphs-							
		Instructing LATEX – Symbols not on the keyboard – Commenting							
		Out- Changing font characteristics							
		Chapter 2: 2.1 to 2.6.							
		UNIT-IV :							
		Lines, paragraphs and pages, Spaces, Boxes, Foot notes, Splitting							
		up the file							
		Chapter 2: 2.7 and 2.11.							

	UNIT-V:
	Text environments: List environments - Tabbing environment -
	Miscellaneous displayed text environments- Proclamations - Proof
	environment- Some general rules for displayed text environment -
	Tabular environments – Style & Size environments
	Chapter 3: 3.1 to 3.8.
Extended Professional	Type their own Mathematical article
Component (is a part of	
internal component only,	
Not to be included in the	
External Examination	
question paper)	
Skills acquired from this	Efficiently writing documents
course	
Recommended Text	1. George Grazer Math into Latex : An Introduction to Latex and
	AMS Latex ISBN 0-8176-3805-9. © Birkhauser Boston 1996.
<b>Reference Books</b>	1. Leslie Lamport A document preparation system LATEX, Second
	Edition,
	2. S. Swapna Kumar LATEX- A Beginner Guide to Professional
	documentation,
Website and	https://services.math.duke.edu/computing/tex/online.html,
e-Learning Source	https://www.overleaf.com/learn

Students will be able to

CLO 1: know how to create basic types of LaTex documents (article).

CLO 2: typeset latex commands.

CLO 3: create a paragraph, symbols, comments and font style.

CLO 4: change font characteristics.

CT.	n	5.	know	about	various	anvironmente
	U	э.	NIIOW	about	various	environments.

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	1	1	1	1	2	3	2	1
CLO2	3	2	1	1	1	2	3	3	2
CLO3	3	2	1	1	1	1	3	2	2
CLO4	3	1	1	1	1	1	3	2	1
CLO5	3	2	1	1	1	2	3	2	2

Title of the Course		<b>3.MATHEMATICAL PYTHON -I</b>							
Paper Nur	nber	ELECTIV	ΈV	Τ					
Catagory	Flootivo	Year	II	Credits	2	Cou	irse	P23MTE44C	
Category	Liective	Semester	III	Creatis	5	Cod	le		
Instruction	nal Hours	Lecture	ſ	<b>Futorial</b>	Lab Prac	actice To		al	
per week		3	1	1 4			4		
Pre-requis	Basic com	puter	r skill						
Objectives	s of the	Problem so	olvin	g and program	ming capal	oility			
Course									
Course Ou	ıtline	UNIT – I							
		Features of Python - Chronology and Uses - Installation of Anaconda - Basic Data Types Revisited – Strings - Lists and Tuples - Conditional Statements: if, ifelse, and ifelifelse constructs - ifelifelse Ladder - Logical Operators - The Ternary Operator - get Construct – Examples Chapter 1: 1.2, 1.4, 1.5 Chapter 2: 2.2 to 2.4 Chapter 3: 3.2 to 3.7							

	UNIT – II
	Looping: While - Patterns -Nesting and Applications of Loops in Lists – Functions: Features of a Function - Basic Terminology - Definition and Invocation - Types of Function - Implementing Search – Scope - Recursion Chapter 4: 4.2 to 4.4 Chapter 5: 5.2 to 5.8 UNIT – III
	Iterations, Generators, and Comprehensions: Power of "For" - Iterators - Defining an Iterable Object - Generators – Comprehensions - File Handling: Introduction - File Handling Mechanism - Open Function and File Access Modes - Python Functions for File Handling - Command Line Arguments - Implementation and Illustrations <b>Chapter 6: 6.2 to 6.6. Chapter 7: 7.1 to 7.6</b>
	UNIT – IV
	Strings: Introduction - Use of "For" and "While" - String Operators - Functions for String Handling - Introduction to Object Oriented Paradigm: Introduction - Creating New Types - Attributes and Functions - Elements of Object-Oriented Programming
	Chapter 8: 8.1 to 8.4 Chapter 9: 9.1 to 9.4
	UNIT – V Classes and Objects: Introduction to Classes - Defining a Class - Creating an Object - Scope of Data Members - Nesting - Constructor - Constructor Overloading – Destructors – Inheritance: Introduction to Inheritance and Composition - Importance and Types – Methods - Search in Inheritance Tree - Class Interface and Abstract Classes Chapter 10: 10.1 to 10.8 Chapter 11: 11.1 to 11.5
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / TNPSC / others to be solved
internal component	(To be discussed during the Tutorial hour)
only, Not to be included	
in the External	
Examination question	
paper)	
Skills acquired from this	Knowledge, Professional Competency, Professional
course	Communication and Transferrable Skill
Recommended Text	H.Bhasin: Python Basics, Mercury Learning and Information Dulles, Virginia Boston, Massachusetts New Delhi

<b>Reference Books</b>	1. Beginning-Python, Second Edition by Magnus Lie Hetland
	2. The Complete Reference Python by Martin C. Brown
	3. Head First Python by Patrick Barry
	4. Learning Python, O'Reilly by Mark Lutz
	5. Python in a Nutshell, O'Reilly by Alex Martelli
Website and	https://nptel.ac.in/courses/106/106/106106212/
e-Learning Source	https://programming-steps.blogspot.com/2013/10/raptor-flowchart
	https://wiki.python.org/moin/BeginnersGuide/Download
	https://www.edx.org/learn/python

Students will be able to

- CLO 1: Appreciate the importance and features of Python
- CLO 2: Define and classify functions
- CLO 3: Understand the use and application of iterators
- CLO 4: Understand how to create a class in Python
- CLO 5: Differentiate between inheritance and composition

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

#### **<u>NME-</u>**Skill Enhancement Courses

Skill Enhancement Courses are chosen so as to keep in pace with the latest developments in the academic / industrial front and provides flexibility of choice by the stakeholders / institutions.

Group F :Skill Enhancement Courses) SEC:

- Computational Mathematics using SageMath
- Office Automation and ICT Tools
- Numerical analysis using Python
- Differential equations using Python
- Industrial Mathematics /Statistics using latest programming packages
- Research Tools and Techniques

#### **Skill Enhancement Courses (SEC)**

#### Group F

Title of the	e Course	1.COMPU	1.COMPUTATIONAL MATHEMATICS USING SageMath								
Paper Nur	nber	SEC III	SEC III								
Category	SEC	Year	II		Credits	2	Course		P23MTS411		
		Semester	IV				Cod	e			
Instructional Hours		Lecture	e Tuto		orial	Lab Prac	tice	Total			
per week		2		-		2		4			
Pre-requis	site	Basic Con	npute	r Skil	l						
Objectives	s of the	Problem s	Problem solving and Programming capability								
Course											

Course Outline	<b>UNIT-I :</b> Sage as a Calculator:Elementary functions and Usual Constants-Online help and Automatic Completion-Python variables-Symbolic variables – First Graphics <b>Chapter 1: 1.2.2 to 1.2.6</b>						
	UNIT-II :						
	Expressions and Simplifications:Symbolic Expressions-Transforming Expressions-Usual Mathematical Expressions-Assumptions-Some Pitfalls –Explicit Solving-Equations with no explicit solution						
	Chapter 2: 2.1.1 to 2.1.5 and 2.2.1 to 2.2.2						
	UNIT-III :						
	Analysis-Sums-Limits-Sequences- Power Series Expansions-Series- Derivatives-Partial Derivatives-Integrals						
	Chapter 2: 2.3.1 to 2.3.8						
	UNIT-IV :						
	Basic Linear Algebra-Solving Linear Systems-Vector Computations-Matrix Computations-Reduction of a Square Matrix						
	Chapter 2: 2.4.1 to 2.4.4						
	UNIT-V:						
	Graphics- Graphical Representation of a Function-Parametric Curve- Curve in Polar Coordinates-Curve defined by an Implicit equations- Data Plot-Displaying solutions of Differential Equations-3D curves						
	Chapter 4: 4.1.1 to 4.1.1.6 and 4.2						
Extended professional Component (is a part ofinternal component only, Not to be	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)						
included in the External Examination question paper)							
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional						
this course	Competency, Professional Communication and Transferrable Skill						
Recommended Text	with Sage Math						

Reference Books	1.Gregory V. Bard ; Sage for Undergraduates(online version)
	2. Craig Finch; Sage Biginner's Guide; PACKT Publishing(Open
	Source )
Website and	1.https://onlinecourses.nptel.ac.in/noc21_ma29/preview
e-Learning Source	2.https://mosullivan.sdsu.edu/Teaching/sdsu-sage-
	tutorial/sageprog.html

Students will be able to

**CLO1:** Deal with Symbolic Variables

CLO2: Describe the symbolic expressions and some Pitfalls

**CLO3**: Demonstrates the analysis concepts

CLO4: Solve the simultaneous equations

**CLO5:** Displaying the solutions of Differential Equations

			P	PSOs					
	PO1	PO2	PO3	PO4	PO5	PO6	PS01	PS02	PSO3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the Course	2.OFFICE	2.OFFICE AUTOMATION AND ICT TOOLS											
Paper Number	SEC III												
Catagomy SEC	Year	II	Credits	2	Cou	rse	P23MTS412						
Calegory SEC	Semester	IV			Cod	e							
Instructional Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	al						
per week	2	2				4							
Pre-requisite	Basics of	Compute	er										
Objectives of the	Enable the	e studen	ts to study	MS Office	and e	enrich	the knowledge						
Course	in Informa	tion Cor	nmunicatio	n Technolog	gy (IC	CT)							
Course Outline	UNIT – I												
	Classificat	ion of C	omputers -	Basic Com	puter	Organ	nisation - Types						
	of Computer Software - Evolution of Internet - Basic Internet												
	Terminologies - Getting Connected to Internet Applications -												
	Application	n Softwa	are Package	s - Introduc	tion t	o Offi	ice Packages						
	Chapter 2	:1.7, 1.8	, 2.3, 2.9 to	2.11, 3.5, 3	3.6 in	Text	book 1.						
	UNIT – II												
	MS Word	: Under	standing Y	our Forma	tting	Optio	ons - Changing						
	Paragraph	Formatt	ing - Using	g Bullets, N	Jumbe	ering,	and Multilevel						
	Lists - Pri	inting V	Vord Docu	ments – J	Using	Tabl	es to Organize						
	Informatio	n - Addi	ing and Org	anizing Fig	gures a	and G	raphics - Using						
	Headers a	ind Foo	ters - Ad	ding Lines	, Bo	rders,	Shading, and						
	Backgroun	ds - Kee	ping Long	Documents	Unde	er Coi	ntrol - Tools for						
	Academic	and Pr	ofessional	Documents	s - C	Creatin	ng and Editing						
	Letters - C	Creating	Envelopes	and Label	s - U	Jsing	Mail Merge to						
	Personalize	e Letters	and Envelo	opes		U	C						
	Chapter 1	3, 15, 16	5, 17 in Tex	t book 2.									
	UNIT – II	I											
	MS Excel	Worki	ng with W	orksheets a	nd W	/orkbo	ooks - Finding,						
	Replacing,	and Tr	ansforming	Data - Ci	ustom	izing	the Worksheet						
	Window -	Window - Printing Worksheets - Entering Data in an Excel											
	Worksheet	Worksheet - Changing Formatting for a Cell or Range - Designing											
	and Forma	tting a	Worksheet	for Maxim	um R	eadab	oility - Entering						
	and Editing	g Formu	las - Findin	g the Right	Funct	tion	.,						
	Chapter:	18. 19. 2	0 in Text b	ook 2.									
	UNIT – IV	 7	0.000	•									
	MS Excel	(Contin	ued): Defin	ing a Rang	e as a	a Tabl	e - Sorting and						
	Filtering D	Filtering Data in a Table - Importing and Exporting Data - Building											
	an Excel C	an Excel Chart - Labeling a Chart's Elements - Customizing Axes											
	Customizi	ng a Cha	rt's Annear	ance		Cust							
	Chanter /	21 22 in	Text hool	· 2									
	Chapter	-1, 11	I TCAL DUOK	<i>4</i> .		hapter: 21, 22 in Text book 2.							

	UNIT – V							
	MS PowerPoint: Creating a Presentation - Editing the Presentation							
	Outline - Changing a Slide Layout - Editing Slides - Viewing a							
	Presentation - Managing Slide Shows - Organizing Formats with							
	Master Slides - Applying and Modifying Themes - Using							
	Transitions to Control Pacing - Animating Text and Objects on a							
	Slide - Adding Music, Sounds and Video to Your Presentation -							
	Planning Your Presentation - Running a Slideshow - Creating							
	Presentations for the Web							
	Chapter: 23 to 26 in Text book 2.							
Extended Professional	Online Presentation and attending online interview using ICT tools.							
Component								
Skills acquired from this	Knowledge, Professional Communication and Transferrable Skill							
course								
<b>Recommended Text</b>	1. E Balagurusamy, Fundamentals of Computing and Programming,							
	Second Edition, Tata McGraw Hill Education Private Limited,							
	New Delhi							
	2. Ed Bott, Woody Leonhard, Using Microsoft Office 2007, Pearson							
	Education, 2007							
<b>Reference Books</b>	1. CloriaMadumere, $3 - IN - 1$ Microsoft Word, Powerpoint and							
	Excel 2010, First Edition 2016, Create space Independent							
	Publishing Platform Education Pvt. Ltd.							
	2. Ron Mansfield, Working in Microsoft Office, Tata McGraw Hill							
Website and	https://nptel.ac.in/courses/							
e-Learning Source	https://www.coursera.org/							

Students will be able to

CLO 1:Perform basic editing functions, formatting text, copy and moving objects and text.

CLO 2: Learn the formatting skills on paragraphs, tables, lists, and pages.

CLO 3: Handle data in Excel spreadsheet.

**CLO 4**: Understand the need and use of using Excel templates.

**CLO 5**: Learn to modify presentation themes, formatting techniques and presentation styles.

			PSOs						
	1	1 2 3 4 5 6							3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1

CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1

Title of the	e Course	3.NUMERICAL ANALYSIS USING PYTHON									
Paper Nur	nber	SEC III									
Category	SEC	Year	II	Credits	2	Cou	rse	P23MTS413			
		Semester	IV			Cod	e				
Instruction	nal Hours	Lecture	Tuto	orial	Lab Pract	tice	Total				
per week		2			2		4				
Pre-requis	ite	UG level Mathematics									
Objectives	of the	To introduce the concepts and to develop working knowledge on									
Course		the numer	the numerical methods for Mathematical concepts such as								
		differentiation, integration etc. to solve these problems using									
		Python pro	grammi	ng language	e.						
Course Ou	ıtline	UNIT-I:									
		Mathematic	cal Mo	odeling and	d Applicat	ions,	App	olied Scientific			
		Computing	, Pytho	n Programr	ning, Back	groun	d,Seri	ies Expansions,			
		Floating-Po	oint Nu	mbers, Pyt	hon Numbe	er Re	prese	ntation, Errors,			
		Floating-Po	oint A	Arithmetic.	Numerica	ul C	Calculu	us-Introduction,			
		Numerical	Differ	entiation,	Numerical	Inte	gratic	on, Composite			
		Formulas,	Practica	al Numeric	al Integrati	on, P	ython	Functions for			
		Numerical	Calculu	S							
		Chapter 1,	2 and 3	3							

	UNIT-II :
	Linear Equations-Introduction, Gauss Elimination, LU Factorization
	and Applications, Iterative Methods, Linear Least Squares
	Approximation, Eigenvalues, Python's Linear Algebra Functions
	Chapter 4
	UNIT-III :
	Iterative Solution of Nonlinear Equations-Introduction, The
	Bisection Method, Fixed Point Iteration, Newton's Method, , The
	Secant Method,, Newton's Method in Higher Dimensions, Python
	Functions for Equation Solving
	Chapter 5
	UNIT-IV :
	Interpolation-Introduction, Lagrange Interpolation, Difference
	Representations. Splines, Python Interpolation Functions
	Chapter 6
	UNIT-V:
	Differential Equations-Introduction and Euler's Method, Runge-
	Kutta Methods, Multistep Methods, Systems of Differential
	Equations, Boundary Value Problems: Shooting Methods,
	Conclusions and Connections: Differential Equations. Python
	Functions for Ordinary Differential Equations
	Chapter 7
Extended Professional	Creating python functions for numerical methods and comparing
Component (is a part of	with the Python libraries
internal component	(To be discussed during the Tutorial hour)
only. Not to be included	
in the External	
Examination question	
naper)	
Skills acquired from this	Ability to create and write solver for numerical solutions of
course	mathematical problems
Recommended Text	1 P.R. Turner, T. Arildsen, K. Kayanagh, Applied Scientific
Recommended Text	Computing With Python Springer International Publishing AG
	part of Springer Nature 2018
Reference Rooks	1   M STEWART Python for Scientists Cambridge University
NCICI CHUU DUUKS	Press 2014
	2. C. Hill, Learning Scientific Programming with Python, Second
	Edition, Cambridge University Press, 2020
Website and	https://www.w3schools.com/python/python_math.asp
e-Learning Source	
0	

Students will be able to

CLO 1: Learn foundations of Python and numerical calculus of Python.

**CLO 2:** Learn the linear equations and study the different elimination and iterative methods and write the Python programs to solve this linear equations

**CLO 3:** Obtain the solutions of nonlinear equation using different iterative methods and write the Python programs to solve this nonlinear equations.

**CLO 4:** Define Interpolation. Methods for calculating the interpolation and write the Python programs to find the interpolation

**CLO 5:**Learn different numerical methods to solve ODE and systems of ODE and write the Python programs to solve ODE.

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	3	2	2
CLO2	3	2	3	2	3	3	3	2	2
CLO3	3	2	3	2	3	3	3	2	2
CLO4	3	2	3	2	3	3	3	2	2
CLO5	3	3	3	2	3	3	3	2	2

Title of the	e Course	4.DIFFERENTIAL EQUATIONS USING PYTHON											
Paper Nur	nber	SEC III		<b>`</b>									
Category	SEC	Year	II	Credits	2	Cou	irse	P23MTS414					
		Semester	IV			Cod	Code						
Instruction	nal Hours	Lecture	Tuto	Tutorial Lab Practic		tice	ice Total						
per week		2			2		4						
Pre-requis	site	UG level I	UG level Differential equations										
Objectives	s of the	To introdu	ce Pyth	on program	ming langu	lage a	nd so	lve the ordinary					
Course		and partial	differer	tial equation	ons.								
Course Ou	ıtline	UNIT-I:	U <b>NIT-I :</b>										
		A short Python tutorial, Typing Python, Objects and identifier											
		Numbers, Namespaces and modules, Container objects, Python if											
		statements, Loop constructs, Functions, Introduction to Python											
		classes, Th	classes, The structure of Python, Prime numbers: a worked example										
		Chapter 3	Chapter 3										
		UNIT-II:	UNIT-II :										
		One-dimen	sional a	rrays,Two-	dimensiona	l arra	ys,Hig	gher-					
		dimensiona	al arrays	, Domestic	input and o	utput	, Fore	ign input and					
		output, Mis	scellane	ous ufuncs,	Polynomia	ls, Lii	near a	lgebra, More					
		numpy and	beyond	l,Scipy,Scik	tits								
		Chapter 4											
		UNIT-III :	T										
		wo-dimens	ional gr	aphics-Intro	oduction, G	etting	starte	d: simple					
		figures, Ca	rtesian j	plots, Polar	plots, Error	bars,	Text	and					
		annotations	s, Displa	aying mathe	ematical for	mulae	e, Con	tour plots,					
		Compound	figures	, Animatior	ns, Mandelb	rot se	ets: a v	vorked					
		example.Tl	nree-din	nensional g	raphicsIntro	oducti	on, Vi	sualization					
		software, A	three-o	limensional	curve, A si	imple	surfac	ce, A					
		parametrica	ally defi	ned surface	e, Three-din	nensio	onal vi	sualization of a					
		Julia set.											
		Chapter 5	and 6										
		UNIT-IV :											
		Ordinary d	ifferenti	al equation	s, Initial val	lue pr	oblem	is, Basic					
		concepts, T	he odei	nt function,	Two-point	boun	dary v	alue problems,					
		Delay diffe	rential of	equations									
		Chapter 7											

	UNIT-V
	:Partial differential equations: a pseudospectral approach, Initial-
	boundary value problems, Method of lines, Spatial derivatives via
	finite differencing, Spatial derivatives by spectral techniques for
	periodic problems, The IVP for spatially periodic problems,
	Spectral techniques for non-periodic problems, An introduction to
	f2py, A real-life f2py example
	Chapter 8
Extended Professional	Creating python functions to solve differential equations and
Component (is a part of	comparing with the Python libraries
internal component	(To be discussed during the Tutorial hour)
only, Not to be included	
in the External	
Examination question	
paper)	
Skills acquired from this	Ability to create and write solver for numerical solutions of
course	mathematical problems.
<b>Recommended Text</b>	J. M. STEWART, Python for Scientists, Cambridge University
	Press, 2014
<b>Reference Books</b>	1. P.R. Turner, T. Arildsen, K. Kavanagh, Applied Scientific
	Computing With Python, Springer International Publishing
	AG, part of Springer Nature, 2018
	2. C.Hill, Learning Scientific Programming with Python,
	Second Edition, Cambridge University Press, 2020
Website and	https://www.w3schools.com/python/python_math.asp
e-Learning Source	

Students will be able to

CLO 1: Learn the basics of Python and write simple Python programs.

**CLO 2:** Learn to create the single and multi-dimensional arrays, to use the linear algebra functions available in Python and packages numpy, scipy and scikits

**CLO 3:** Create various types of two and three dimensional graphs using Python programs.

CLO 4: Solve the ODE, IVP, BVP and delay differential equation using Python programs

CLO 5:Solve the PDE using different methods and write the program for solving PDE.

			P	Os		PSOs			
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	1	2	2
CLO2	3	2	3	2	3	3	1	3	2
CLO3	3	2	3	2	3	3	2	2	2
CLO4	3	2	3	2	3	3	2	3	2
CLO5	3	3	3	2	3	3	2	2	2

Title of the	e Course	5.INDUSTRIAL STATISTICS WITH MINITAB												
Paper Nur	nber	SEC III												
Category	SEC	Year	Π		Credits	2	Cou	rse	P23MTS415					
		Semester	IV				Cod	le						
Instruction	nal	Lecture		Tuto	orial	Lab Prac	tice	Tota	al					
Hours		2				2		4						
per week														
Pre-requis	ite	Statistical Methods												
Objectives	of the	To execute statistical methods via minitab to analyze industrial												
Course		problems.												
Course Ou	ıtline	UNIT I												
		Worksheets	s and	d Pro	jects, Data	o Operatio	ns, H	listogr	rams, Dotplots,					
		Boxplots, I	Bar D	Diagra	ms, Pie Ch	arts, Upda	ting C	Graphs	Automatically.					
		Chapters:	1 & 2	1										
		UNIT II	UNIT II											
		Pareto Cha	Pareto Charts and Cause-Effect Diagrams, Stratification, Identifying											
		Points on	Points on a Graph, Scatterplots with Panels and Marginal Graphs,											
		Creating an	n Arra	y of S	Scatterplots									
		Chapters3	& 4											
		UNIT III												
		Random 1	Numł	pers a	and Numb	ers Follov	ving	a Pat	tern, Sampling					
		Random D	ata fr	om a	Column, R	andom Nu	mber	Gener	ation, Example:					
		Solving a P	roble	em Us	ing Randon	n Numbers	•							
		Chapter 5												
		UNIT IV												
		File 'CHL	ORI	NE', (	Graph of I	ndividual	Obser	vation	is, Customizing					
		the Graph,	Grap	ohs of	Moving R	langes, Fil	e 'Mo	DTOR	S', Plotting the					
		Proportion	of De	efectiv	ve Units, Fi	le 'CATHE	ETER	', File	'FABRIC'.					
		Chapters1	8 & 2	20										
		UNIT V												
		Matrix Des	ign (	Creatio	on and Data	a Collectio	n, Ar	nalysis	s of the Results,					
		Contour Pl	ots a	nd Re	esponse Su	rface Plots	s, Noi	nparan	netric Analysis,					
		Identificati	on of	the B	est Model f	or the Data	ı.							
		Chapters2	8 & 2	29										

Extended	Questions related to the above topics, from various competitive						
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /						
Component (is a part	others to be solved						
of internal	(To be discussed during the Tutorial hour)						
component only,							
Not to be included in							
the External							
Examination							
question paper)							
Skills acquired from	Statistical methods for industrial problems along with Minitab						
this course	software, Analysis of Industrial Problems using Minitab software						
Recommended	1.Pere Grima Cintas, Lluıs Marco Almagro, Xavier Tort-						
Text	MartorellLlabres, Industrial Statistics with Minitab, Wiley, 2012.						
<b>Reference Books</b>	1. ShelemyahZacks, Ron S Kennet, Modern Industrial Statistics:						
	With Applications in R, MINITAB and JMP, Wiley, 2021.						
	2. Avner Friedman, Walter Littman, Industrial Mathemetics: A						
	Course in Solving Real-World Problems, SIAM, 1994.						
	3. Douglas C. Montgomery, Scott M. Kowakski, Minitab Manual						
	Design and Analysis of Experiments, Wiley, 2012.						
Website and	https://en.wikipedia.org/wiki/Minitab						
e-Learning Source	What is MiniTab? Data Analysis Tool   Simplilearn						

Students will be able to

**CLO 1:** Understand the basics of Minitab software.

CLO 2: Use Tools and Techniques to analyze Industrial Problems.

CLO 3: Get better views of Problems.

**CLO 4:** Produce Visual Solutions.

CLO 5: Make use of Minitab to arrive better Decisions.

			P	PSOs					
	1	2	3	4	5	6	2	2	3
CLO1	3	3	3	2	3	3	3	3	3
CLO2	3	2	2	2	2	3	3	3	2
CLO3	3	2	2	2	2	3	3	2	2
CLO4	2	2	2	2	2	3	3	2	2
CLO5	2	2	2	2	2	3	3	2	2

# **OTHER DEPARTMENTS( NOT FOR MATHEMATICS STUDENT)- SEC I**

# SEMESTER -II / III -NMEI/NME II -SEC I / SEC II

# **GROUP-**C

TITLE OF THE	1.MATHE	I.MATHEMATICS FOR LIFE SCIENCES-									
COURSE											
Paper Number	NME I/N	ME II -	SEC I/SEC	II	1		<b></b>				
Category	Year	I/II	Credits	2	Course P23MT		P23MTN101				
	Semester	II/III			Cod	Code					
Instructional Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	al				
per week	2/3	1				3/4					
Pre-requisite	+2 level M	Iathema	tics								
Objectives of the	To introdu	ice the	basic math	ematical co	oncep	ts suc	ch as sequence,				
Course	vectors, ma	vectors, matrices used in Life sciences and give some applications									
	in life scier	nce.									
Course Outline UNITI :											
Sequences and Discrete Difference Equations, Sequences, Lim											
a Sequence, Discrete Difference Equations, Geometric											
Arithmetic Sequences, Linear Difference Equation with Consta											
	Coefficients, Introduction to Pharmacokinetics										
	Chapter 5										
	UNIT II :										
	Vectors and Matrices, Vector Structure: Order Matrices Vector										
	Algebra, D	Algebra, Dynamics: Vectors Changing over Time									
	Chapter 6										
	UNIT III :										
	Matrix Alg	ebra, M	atrix Arithn	netic, Appli	catior	ıs					
	Chapter 7										
	UNIT IV	:									
	Long-Term	n Dynan	nics or Equi	librium, No	otion c	of an E	Equilibrium,				
	Eigenvecto	rs, Stab	ility								
	Chapter 8										
	UNIT V:										
	Leslie Matrix Models and Eigenvalues, Leslie Matrix Models,										
	Long-Term Growth Rate (Eigenvalues), Long-Term Population										
	Structure (	Corresp	onding Eige	nvectors)							
	Chapter 9										

Extended Professional	Questions related to the above topics, from various competitive						
Component (is a part of	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC						
internal component	/ others to be solved and the						
only, Not to be included	(To be discussed during the Tutorial hour)						
in the External							
Examination question							
paper)							
Skills acquired from this	Ability to model and solve the discrete biological models.						
course							
Recommended Text	1.E.N. Bodine, S. Lenhart, and L. J. Gross, Mathematics for the Life						
	Sciences, Princeton University Press, 2014.						
<b>Reference Books</b>	1. L. J. S. Allen, An Introduction to Mathematical Biology,						
	Pearson, 2006						
	2. J.D. Murray, Mathematical Biology - I. An Introduction,						
	Springer-Verlag, 2002.						
Website and	https://www.classcentral.com/course/swayam-biostatistics-and-						
e-Learning Source	mathematical-biology-13925						

Students will be able to

**CLO 1:** Define sequence, difference equations, limit of sequence and study the difference equations.

**CLO 2:** Define the vectors and matrix, find the order of matrix and study the dynamics of vectors

CLO 3: Define arithmetic on matrices and applications of matrices.

CLO 4: Define Eigen values and eigen vectors and study the equilibrium and stability.

**CLO 5:** Develop Leslie matrix models and long term population structure of the corresponding models.

			P	Os			PSOs			
	1	2	3	4	5	6	1	2	3	
CLO1	3	2	3	2	3	3	2	2	2	
CLO2	3	2	3	2	3	3	2	3	3	
CLO3	3	2	3	2	3	3	2	2	3	
CLO4	3	2	3	2	3	3	2	3	3	
CLO5	3	3	3	2	3	3	2	2	3	

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# SEMESTER -II/SEMESTER III -NMEI/NME II-SEC I/SEC II

# **GROUP-**C

Title of the	e Course	2.MATHEMATICS FOR SOCIAL SCIENCES									
Paper Nur	nber	NMEI/NM	IE II-SI	EC I/SEC I	I	_					
Category	SEC	Year	I/II	Credits	2	Cou	irse	P23MTN302			
		Semester	II/III			Cod	le				
Instruction	nal Hours	Lecture	Tuto	orial	Lab Prace	tice	Tota	al			
per week		2/3	1				3/4				
Pre-requis	ite	+2 level M	+2 level Mathematics								
Objectives	of the	To introduce the mathematical concepts linear algebra calculus									
Course		using socia	l scienc	es.							
Course Ou	ıtline	UNIT-I:									
		Linear Alg	gebra, V	Vectors and	d Matrices	, Ope	eration	ns on Vectors,			
		Matrices-D	etermin	ants, Rank	of a Matrix						
		Chapter 1	:1.1 to 1	.5							
		UNIT-II:									
	Statistical Applications of Linear Algebra, Linear Applications,										
		Linear Algebraic Systems, Applications to Networks, Some									
		Complements on Square Matrices									
		Chapter 1:1.6 to 1.10									
		UNIT-III :	:								
		Differentia	l Calcul	us, What's	a Function,	Loca	l Beha	Sehavior and			
		Global Behavior, What's a Function of a Vector									
		Chapter 2									
		UNIT-IV :	:								
		Integral Calculus, Integrals and Areas, Fundamental Theorem of									
		Integral Calculus, Antiderivative Calculus, An Immediate									
		Application: Mean and Expected Values, Frequency/Probability									
		Density Fu	nctions:	Some Case	es, People S	urviv	al				
		Chapter 3									
		UNIT-V:									
		Dynamic Systems-Introduction, Local Information: The Motion									
		Law, Extracting Info from a Motion Law, Classic Approach,									
		Numerical Approach, Qualitative Approach, A Newcomer: The									
		Phase Diag	gram, So	me Politica	lly Relevan	it App	olicatio	ons			
		Chapter 4									

Extended Professional	Questions related to the above topics, from various competitive						
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC						
internal component	/ others to be solved						
only, Not to be included	(To be discussed during the Tutorial hour)						
in the External							
Examination question							
paper)							
Skills acquired from this	Ability to create and analyse the mathematical models arise in social						
course	science.						
Recommended Text	1.L. Peccati, M. D'Amico, M. Cigola, Maths for Social Sciences,						
	Springer, 2018.						
<b>Reference Books</b>	1. S. Tan, Mathematics For Management, Life And Social						
	Sciences, Brooks/Cole, 1996						
	2. H. Anton, B. Kolman, Mathematics with Applications for						
	the Management, Life, and Social Sciences, 2nd edition,						
	Academic Press, 2014.						
Website and	https://www.classcentral.com/course/swayam-biostatistics-and-						
e-Learning Source	mathematical-biology-13925						

Students will be able to

**CLO 1:** Define vectors and matrices and operations on vectors and matrices and calculate the rank and determinants.

**CLO 2:** Solve the system of linear equations and apply the matrix theory to networks and other fields

**CLO 3:** Define the derivative of the functions and able to analyze the local and global behaviour of the continuous functions.

**CLO 4:** Define integration and able to calculate the area of the continuous curve and able to calculate the expected values of continuous random variables.

**CLO 5:**Able to study the dynamical behaviour of the social science problems.

			PO	PSOs					
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3
CLO3	3	2	3	2	3	3	2	2	3
------	---	---	---	---	---	---	---	---	---
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

## SEMESTER -II/SEMESTER III -NMEI/NMEII-SEC I/SEC II

## **GROUP-**C

Title of the	e Course	3.STATISTICS FOR LIFE AND SOCIAL SCIENCES									
Paper Nur	nber	NME I/NN	AE II-S	EC I/SEC	II						
Category	SEC	Year	I/II	Credits	2	Cou	rse	P23MTN3			
		Semester	II/III			Code					
Instruction	nal Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	tal			
per week		2/3	1				3/4				
Pre-requis	ite	+2 level M	athemat	ics							
Objectives	of the	To enhances basic skills in the areas of data collection. To acquaint									
Course		the student with the average calculation in various situation. To									
		study about deviation of data from the central values. To know the									
		testing tools and methods .									
Course Ou	ıtline	UNITI :									
		Primary	and Sec	condary da	ta: Collecti	on of	Data	–Primary data-			
		Secondary	data-ch	noice of m	nethods-Dire	ect p	ersona	al Observation-			
		Indirect of	oral Int	erview-Info	ormation T	Throug	gh A	gencies-Mailed			
		questionna	ire Sche	edules send	d through	Enun	ierato	rs, Sources of			
		secondary	data- D	ata precau	tions in the	e in t	he use	e of secondary			
		data- Sample questionnaire									
		Chapter 4									
		_									

#### UNIT II:

**Central Tendency and Dispersion:** Measure of Central Tendency-Meaning- Definition – Arithmetic Mean - Median- Definition Mode - Definition -Geometric mean- Definition- Harmonic mean – Definition- Individual data- Discrete series and continuous series – Problem in all the three types.

**Dispersion**: Measure of dispersion- range- Quartail deviation- Mean Deviation Standard deviation - Individual data- Discrete series and continuous series – Problem in all the three types., Computation of Quartiles, Decides, Percentiles, Etc. Significance of Measuring Variation,Range, The Interquartile Range or the Quartile Deviation, Merits and Limitations, The Standard Deviation

#### **Chapter 9 and Chapter 10**

#### UNIT III:

**Correlation and Regression:** Correlation and Regression introduction -Types of correlation graphical representation of Correlation - Karl Pearson's coefficient of correlation – Rank correlation- Coefficient of rank correlation.

Regression: Significance of regression-difference between correlation and regression-RegressionLines - Regression equations **Chapter 12 and Chapter 13** 

#### **UNIT IV :**

**Theoretical distributions:** Theoretical distributions introduction -Binomial distribution – properties of binomial distribution- simple problems in binomial distribution - Poisson distribution- simple problems in Poisson distribution -Normal distributions – properties of Normal distributions - practical problems in Normal distributions.

Chapter 19

	UNIT V:							
	Sampling Theory and Testing of Significance:							
	Sampling Theory and Testing of Significance introduction - Estimation-Hypothesis-Test of significance- Small sample test - Student 't' test –Large sample test for significance of average- Student F-test- Chi –Square test for Goodness of fit-Simple practical problems using - Chi –Square test Chapter 20							
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)							
Skills acquired from this	Ability to collect and analyse the data using the statistical methods.							
course								
Recommended Text	1.R.S.N. Pillai and V.Bagavathi,, "Statistics", Sultan Chand, New Delhi, 2008							
Reference Books	<b>1.</b> .S. P. Gupta, Statistical Methods, Forty Sixth Revised Edition, Sultan Chand & Sons, New Delhi, 2021							
	<ul> <li>2.S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statisitics", Sultan Chand and Sons, New Delhi -2, 2011</li> <li>3.Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta</li> <li>4.G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.</li> </ul>							
Website and	https://alison.com/course/the-fundamentals-of-							
e-Learning Source	statistics?utm_source=google&utm_medium=cpc&utm_campaign= PPC_Tier-4_First-Click_CoursesBroad_&utm_adgroup=Course- 2075_The-Fundamentals-of- Statistics&gclid=CjwKCAjw6liiBhAOEiwALNqncf9ojFl3Uc738RVoW 7KdG4FiGqFXcEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_B wE							

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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CLO 1: Collect the data, frame the questions and to find the sample size for their study.

**CLO 2:** Classify the samples and to calculate the mean, median, mode, standard deviation for discrete as well as continuous data.

**CLO 3:** Define the probability and random variables, some special probability distributions and do the hypothesis testing of their samples .

**CLO 4:**.Define Chi-square test, Yates corrections, when to use and not to use the Chi-square test.

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3
CLO3	3	2	3	2	3	3	2	2	3
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

CLO 5:Do the F-test and for the samples.

## SEMESTER -II/SEMESTER III -NMEI/NME II-SEC I/SEC II

# **GROUP-**C

Title of the	e Course	4.GAME THEORY AND STRATEGY									
Paper Nur	nber	NME I/NI	MEII-S	EC I/SECI	Ι						
Category	SEC	Year	I/II	Credits	2	Cou	rse	P23MTN4			
		Semester	II/III			Cod	e				
Instruction	nal Hours	Lecture	Tuto	orial	Lab Pract	tice	Tota	al			
per week		2/3	1	1 3/4							
Pre-requis	site	+2 level Ma	athemat	ics							
Objectives	of the	To enhance	es basic	skills in the	areas of re	esourc	e utili	ization, game			
Course		theory and	replace	ment strateg	gies						
Course Ou	tling	LINITT .									
Course Or	ume	Linger Pr	aromn	ning proble	m•						
			Jgi allin	nng proor							
		Introducti	ons- Li	near Progra	mming: Ma	athem	atical	formulation of			
		linear prog	grammin	ng problem	1- Basic S	olutic	on - 1	Solving Linear			
		Programmi	ng pro	blem using	Graphical	solut	10n- l	Unbounded and			
		Infeasible s	olution	in graphica	l methods						
		Chapter 3	Objective 2								
		UNIT II:									
		Transportation Problem:									
		Transportat	ion Pro	hlem introd	luction- M	athem	natical	formulation of			
		the problem Finding Initial Basic Ecosible Solution using North									
		West Corn	er Rub	e - Row	minima n	netho	ds- C	olumn minima			
		method - N	latrix M	linima Metl	nod - Vogel	's Ai	nproxi	imation Method			
		– Optimum	solutio	n – MODI	method	5 1 ]	prom				
		Chanter 10									
		•••• <b>P</b> •••									
		UNITIII :									
		Assignment	t Proble	em:							
		Assignment	Proble	m: Introdu	iction – D	efinit	ion o	f Assignment			
		Problem -Mathematical formulation of Assignment Problem -									
		Assignment Algorithm – Problem solving using Assignment									
		Algorithm- Application of Assignment Problem: Minimization case									
		routing problem									
		Chapter 11									

	UNITIV :
	Game Theory : Two person Zero Sum Game –Maximin-Minimax
	principles- Game without saddle point –Mixed integers –Graphic
	Solution of 2 x n and mx2 Games –Dominance properties
	Chapter 17
	UNITV:
	Replacement Problem:
	Replacement Problem: Introduction about Replace problem –
	Definition Replace problem -and System Reliability – Replacement
	of Equipment that Deteriorates Gradually- Exercise Problems -
	Replacement of Equipment the Fails Suddenly-problems in
	replacement of Equipment the Fails Suddenly
	Chapter 18
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC
internal component	/ others to be solved
only, Not to be included	(To be discussed during the Tutorial hour)
in the External	
Examination question	
paper)	
Skills acquired from this	Ability to collect and analyse the data using the statistical methods.
course	
Recommended Text	1. Kanti Swarup, P.K. Gupta, Man Mohan, "Operations
	Research", Sultan Chand & Sons, Educational Publishers, New
	Delhi 2013

<b>Reference Books</b>	1.Panneerselvam.R, "Operations Research", 2nd Edition, PHI									
	Learning Private Limited, Delhi, 2015									
	2 Prom Kumor Cunto Fr. Hiro D.S. "Operations									
	2 .Frem Kumar Gupta.Er, Hira.D.S. Operations									
	Research", 7 <sup>th</sup> Edition, S. Chand& Company Pvt. Ltd. 2014									
	3. Hiller.F.S&Lieberman.J "Introduction to Operation Research									
	",7 <sup>th</sup> Edition, Tata– MCGraw Hill									
	Publishing Company, NewDelhi, 2001.									
	4G. Srinivasan, "Operations Research principles and									
	applications", Second Edition, PHI Learning Private									
	Limited, New Delhi-110001, 2012.									
	5. Taha H.A., "Operations ResearchAn introduction" Prennce Hall									
	of India Private Ltd 1 <sup>st</sup> Edition New									
	Delhi (2008).									
Website and	https://alison.com/course/the-fundamentals-of-									
e-Learning Source	statistics?utm_source=google&utm_medium=cpc&utm_campaign=									
0	PPC_Tier-4_First-Click_CoursesBroad_&utm_adgroup=Course-									
	2075_The-Fundamentals-of-									
	Statistics&gclid=CjwKCAjw6liiBhAOEiwALNqncf9ojFl3Uc738RVoW									
	7KdG4FiGqFXcEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_B wE									

**Course Learning Outcome (for Mapping with POs and PSOs)** 

Students will be able to

**CLO 1:** Understand the application of OR and frame a LP Problem with solution – graphic and through solver add in excel.

CLO 2: Analyze and interpret results of transportation and problem using appropriate

**CLO 3:** Analyze and interpret results method Solutions of assignment and problem using appropriate method.

CLO 4:.Define Game theory and finding solution in different strategy

CLO 5: Find the replacement period of equipment that fails suddenly/gradually.

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3

CLO3	3	2	3	2	3	3	2	2	3
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

## SEMESTER -II/SEMESTER III -NME I/NME II-SEC I/SEC II

# **GROUP-**C

Title of the	e Course	5. HISTOR	Y	OF M	<b>IATHEM</b> A	ATICS					
Paper Nur	nber	NME- I/NN	<b>IE</b>	II -SI	EC I/SEC I	Ι					
Category	SEC	Year	I/	ΊΙ	Credits	2	Cou	rse	P23MTN5		
		Semester	II	/III			Cod	e			
Instruction	nal Hours	Lecture	Tutorial		rial	Lab Pract	ice	Tota	al		
per week		2/3		1				3/4			
Pre-requis	site	+2 level Ma	the	ematic	2S						
Objectives	of the	To impart sl	kill	s in n	umerical ar	nd quantitati	ve teo	chniqu	ues.		
Course		Able to critically evaluate various real life situations by resorting to									
		Analysis of law issues and fasters. Able to demonstrate and									
		Analysis of key issues and factors. Able to demonstrate various									
		principles involved in solving mathematical problems and									
		thereby reducing the time taken for performing job functions									
Course Ou	ıtline	UNITI :									
		Numbers – H	ICI	F - L	CM – Squa	re Roots &	Cube	Root	s- Problems on		
		numbers.									
		Chapters 1,	2 ,	5,7							
		UNIT II:									
		Decimal Frac	ctic	ons , S	Simplification	on, Time &	Dista	nce.			
		Chapter 3,4,	,17								
		UNITIII:									
		Surds and Ir	ndie	ces –	Percentage	e – Profit a	nd L	oss- S	Simple Interest.		
		Chapters 9,	10,	,11, 2	1						

	UNITIV :
	Ratio and Proportion – Partnership – Allegation or Mixture-
	Probability.
	Chapters 12, 13, 20, 31
	UNITV:
	Average – Problems on Age-Calender.
	Chapters 6,8,27
Extended Professional	Questions related to the above topics, from various competitive
Component (is a part of	examinations UPSC / / TNPSC / others to be solved
internal component	(To be discussed during the Tutorial hour)
only, Not to be	
included in the External	
Examination question	
paper)	
Skills acquired from	Ability to solve problems using the mathematical l methods.
this course	
<b>Recommended Text</b>	1. <u>Text Book:</u>
	Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive
	Examinations", S.Chand & Company Ltd., Ram Nagar, New Delhi -
	2007
	2007.
	•
Website and	Link: https://books.shunyafoundation.com/book-quantitative-aptitude-
e-Learning Source	by-r-s-aggarwal-published-by-s-chand-english/dp/ODTRGH2E

## **Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Collect the data, frame the questions and to find the sample size for their study.

**CLO 2:** Classify the samples and to calculate the mean, median, mode, standard deviation for discrete as well as continuous data.

**CLO 3:** Define the probability and random variables, some special probability distributions and do the hypothesis testing of their samples .

**CLO 4:**.Define Chi-square test, Yates corrections, when to use and not to use the Chi-square test.

			PSOs						
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	2	3	3	2	2	2
CLO2	3	2	3	2	3	3	2	3	3
CLO3	3	2	3	2	3	3	2	2	3
CLO4	3	2	3	2	3	3	2	3	3
CLO5	3	3	3	2	3	3	2	2	3

**CLO 5:**Do the F-test for the samples.