# M.Sc., MATHEMATICS

# SYLLABUS 2023-2024 ONWARDS



# PERIYAR UNIVERSITY PERIYAR PALKALAI NAGAR SALEM – 636011

# NEW INITIATIVE IN MODERNISING POST GRADUATE PROGRAMME IN MATHEMATICS

## CONTENTS

- 1. Introduction
- 2. Learning and Teaching Activities
- 3. Assessment Activities
- 4. Teaching methodologies
- 5. Faculty Course File
- 6. Template for PG Programme in Mathematics
- 7. Template for Semester
- 8. Instructions for Course Transaction
- 9. Testing Pattern
- 10. Different Types of Courses
- 11. Elective Courses (ED from other Department Experts)
- 12. Skill Development Courses
- 13. Institution-Industry-Interaction
- 14. Syllabus

#### **INTRODUCTION**

# M.Sc. Mathematics : Programme Outcome, Programme Specific Outcome and Course Outcome

Mathematics is the study of quantity, structure, space and change, focusing on problem solving, with wider scope of application in science, engineering, technology, social sciences etc. The key core areas of study in Mathematics include Algebra, Analysis (Real & Complex), Differential Equations, Geometry, and Mechanics. The Master Degree M.Sc. Mathematics is awarded to the students on the basis of knowledge, understanding, skills, attitudes, values and academic achievements expected to be acquired by learners at the end of the Programme. Learning outcomes of Mathematics are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for gaining knowledge of Mathematics.

Master degree in Mathematics is the culmination of in-depth knowledge of algebra, Real analysis, geometry, differential equations and several other branches of Mathematics. This also leads to study of related areas like Computer science, Financial Mathematics, Mathematical Statistics and many more. Thus, this programme helps learners in building a solid foundation for higher studies in Mathematics. The skills and knowledge gained have intrinsic aesthetics leading to proficiency in analytical reasoning. This can be utilised in Mathematical modelling and solving real life problems.

Students completing this programme will be able to present Mathematics clearly and precisely, make abstract ideas precise by formulating them in the language of Mathematics, describe Mathematical ideas from multiple perspectives and explain fundamental concepts of Mathematics to non-Mathematicians.

Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

4

Programme	M.Sc., MATHEMATICS
Programme Code	
Duration	PG - 2 years
Programme	PO1: Problem Solving Skill
Outcomes (Pos)	Apply knowledge of Management theories and Human Resource
	practices to solve business problems through research in Global
	context.
	PO2: Decision Making Skill
	Foster analytical and critical thinking abilities for data-based decision-making.
	PO3: Ethical Value
	Ability to incorporate quality, ethical and legal value-based
	perspectives to all organizational activities.
	PO4: Communication Skill
	Ability to develop communication, managerial and interpersonal skills.
	PO5: Individual and Team Leadership Skill
	Capability to lead themselves and the team to achieve organizational
	goals.
	PO6: Employability Skill
	skills in the competitive environment.
	I I I I I I I I I I I I I I I I I I I
	PO7: Entrepreneurial Skill
	Equip with skills and competencies to become an entrepreneur.
	PO8: Contribution to Society
	Succeed in career endeavours and contribute significantly to society.
	PO 9 Multicultural competence
	Possess knowledge of the values and beliefs of multiple cultures and
	a global perspective.
	PO 10: Moral and ethical awareness/reasoning
	Ability to embrace moral/ethical values in conducting one's life.
Programme	PSO1 – Placement
Specific Outcomes	To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of
	reference to decisions and actions.

PSO 2 - Entrepreneur
To create effective entrepreneurs by enhancing their critical thinking,
problem solving, decision making and leadership skill that will
facilitate startups and high potential organizations.
PSO3 – Research and Development
Design and implement HR systems and practices grounded in
research that comply with employment laws, leading the organization
towards growth and development.
PSO4 – Contribution to Business World
To produce employable, ethical and innovative professionals to
sustain in the dynamic business world.
PSO 5 – Contribution to the Society
To contribute to the development of the society by collaborating with
stakeholders for mutual benefit.

Semester-I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester-IV	Credit	Hours
1.1. Core-I	5	7	2.1. Core- IV	5	6	3.1. Core- VII	5	6	4.1. Core-XI	5	6
1.2 Core- II	5	7	2.2 Core- V	5	6	3.2 Core- VIII	5	6	4.2 Core-XII	5	6
1.3 Core – III	4	6	2.3 Core – VI	4	6	3.3 Core – IX	5	6	4.3 Project with viva voce	7	10
1.4 Discipline Centric Elective –I	3	5	2.4 Discipline Centric Elective – III	3	4	3.4 Core – X (Industry Module) Machine Learning	4	6	4.4Elective - VI (Industry / Entrepreneur ship) 20% Theory 80% Practical	3	4
1.5 Generic Elective- II:	3	5	2.5 Generic Elective - IV:	3	4	3.5 Discipline Centric Elective - V	3	3	4.5 Skill Enhancement course / Professional Competency Skill	2	4
			2.6 NME I	2	3	3.6 NME II	2	3	4.6 Extension Activity	1	
			2.7 Human Rights	2	1	3.7 Internship/ Industrial Activity	2	-			
	20	30		24	30		26	30		23	30
				r	Total Cr	edit Points -93					

### **CREDIT DISTRIBUTION FOR PG PROGRAMME**

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	20	20	22	20	82
Part B					
(i) Discipline – Centric / Generic		2	2		4
Skill					
(ii) Soft Skill				2	
(iii) Summer Internship /		2	2		6
Industrial Training					
Part C				1	1
Total	20	24	26	23	93

#### COMPONENT WISE CREDIT DISTRIBUTION

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

#### **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				PSO	Os			
	1	2	3	4	5	6	 1	2	
CLO1									
CLO2									
CLO3									
CLO4									
CLO5									

#### LEARNING AND TEACHING ACTIVITIES

#### 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

- 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 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%

#### **Assessment Details:**

### CREDIT DISTRIBUTION FOR PG PROGRAMME IN MATHEMATICS M.Sc Mathematics First Year Semester-I

	Courses	Credit	Hours per
			Week(L/T/P)
Part A	Core Courses3 (CC1, CC2, CC3)	14	20
	Elective Courses 2(Generic / Discipline Specific) EC1, EC2	6	10
		20	30

#### Semester-II

	Courses	Credit	Hours per
			Week(L/T/P)
Part A	Core Courses3 (CC4, CC5, CC6)	14	18
	Elective Course 2 (Generic / Discipline Specific) EC3, EC4	6	9
Part B	NME-I & Human Rights	4	3
		24	30

#### Second Year Semester-III

	Courses	Credit	Hours per
			Week(L/T/P)
Part A	Core Courses3 (CC7, CC8, CC9)	15	18
	Elective Course 3 (Generic / Discipline Specific) EC5	3	3
	Machine Learning (Industry Module) (CC10)	4	6
Part B	NME-II	2	3
	Internship	2	
		26	30

#### Semester-IV

Part	Courses	Credit	Hours per
			Week(L/T/P)
Part A	Core Courses3 (CC11, CC12)	10	12
	Elective Course 1 (Generic / Discipline Specific) EC6	3	4
	Project with Viva voce (CC13)	7	10
Part B	Skill Enhancement Course	2	4
Part C	Extension Activity (Can be carried out from Sem II to Sem IV)	1	
		23	30

# CREDIT DISTRIBUTION FOR PG PROGRAMME IN MATHEMATICS

# **M.SC MATHEMATICS**

0			ILS	Universi	ity Examinat	tion	
N'S	Subject Code	Subject Title	Hou	Internal (25%)	External (75%)	Total	Credits
		SEMESTE	R I				
1	23PMACO1	Algebraic Structure	7	25	75	100	5
2	23PMACO2	Real Analysis – I	7	25	75	100	5
3	23PMACO3	Ordinary Differential Equation	6	25	75	100	4
4	ELECTIVE –I	From Group 'A'	5	25	75	100	3
5	ELECTIVE –II	From Group 'B'	5	25	75	100	3
		SEMESTER	RII				
6	23PMACO4	Advanced Algebra	6	25	75	100	5
7	23PMACO5	Real Analysis – II	6	25	75	100	5
8	23PMACO6	Partial Differential Equation	6	25	75	100	4
9	ELECTIVE –III	From Group 'C'	4	25	75	100	3
10	ELECTIVE –IV	From Group 'D'	4	25	75	100	3
11	23PMAHR01	Human Rights	1	25	75	100	2
12	NME-I		3	25	75	100	2
		SEMESTER	L III				
13	23PMACO7	Complex Analysis	6	25	75	100	5
14	23PMACO8	Probability Theory	6	25	75	100	5
15	23PMACO9	Topology	6	25	75	100	5
16	23PMAC10	Machine Learning(Industry Module)	6	25	75	100	4
17	ELECTIVE -V	From Group 'E'	3	25	75	100	3
18	23PMAI01	Internship	-	-	-	-	2
19	NME-II		3	25	75	100	2

SEMESTER IV									
20	23PMACO11	Functional Analysis	6	25	75	100	5		
21	23PMACO12	6	25	75	100	5			
22	ELECTIVE VI	From Group 'F'	4	25	75	100	3		
23	23PMAPR01	10	25	75	100	7			
24	SEC	4	25	75	100	2			
25		Extension Activity	-				1		
		TOTAL	120			2300	93		

#### **ELECTIVE COURSES**

Courses are grouped (Group A to Group F) so as to include topics from Pure Mathematics(PM), Applied Mathematics(AM), Industrial Components(IC) and IT Oriented(ITC) courses for flexibility of choice by the stakeholders / institutions.

#### Semester I : Elective I and Elective II

Elective I to be chosen from Group A and Elective II to be chosen from Group B

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

1	1. Number Theory and Cryptography	-23PMAE11					
4	2. Graph Theory and Applications	-23PMAE12					
	3. Formal Languages and Automata Theory	-23PMAE13					
4	4. Programming in C++ and Numerical Methods	-23PMAE14					
Group	Group B:(PM/AP/IC/ITC)						
1.	Lie Groups and Lie Algebras	-23PMAE15					
2.	Mathematical Programming	-23PMAE16					
3.	Fuzzy Sets and Their Applications	-23PMAE17					
_							

**4.** Discrete Mathematics-23PMAE18

#### Elective III to be chosen from Group C and Elective IV to be chosen from Group D

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

1.	Algebraic Topology	-23PMAE21
2.	Mathematical Statistics	-23PMAE22
3.	Statistical Data Analysis using R Programming	-23PMAE23
4.	Tensor Analysis and Relativity	-23PMAE24
Group	D:(PM/AP/IC/ITC)	
1.	Wavelets	-23PMAE25
2.	Modelling and Simulation with Excel	-23PMAE26
3.	Machine Learning and Artificial Intelligence	-23PMAE27
4.	Neural Networks	-23PMAE28
Semes	ter III : Elective V	
Electiv	$\mathbf{ve} \mathbf{V}$ to be chosen from Group E.	
Group	E: (PM/AP/IC/ITC)	
1.	Algebraic Number Theory	-23PMAE31
2.	Fluid Dynamics	-23PMAE32
3.	Stochastic Processes	-23PMAE33
4.	Mathematical Python	-23PMAE34

#### **Semester IV : Elective VI**

**Elective VI** to be chosen from Group F.

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

1.	Algebraic Geometry	-23PMAE41
2.	Financial Mathematics	-23PMAE42
3.	Resource Management Techniques	-23PMAE43
4.	Mathematical Python	-23PMAE44

#### 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 G (Skill Enhancement Courses) SEC:

1.Computational Mathematics using SageMath	-23PMASEC01
2. Mathematical documentation using LATEX / other packages	-23PMASEC02
<b>3.</b> Office Automation and ICT Tools	-23PMASEC03
4. Numerical analysis using SCILAB	-23PMASEC04
5. Differential equations using SCILAB	-23PMASEC05
6. Industrial Mathematics /Statistics using latest programming packages	-23PMASEC06
7. Research Tools and Techniques	-23PMASEC07

# EXTRA DISCIPLINARY COURSES FOR OTHER DEPARTMENTS (NOT FOR MATHEMATICS STUDENTS)

Students from other Departments may also choose any one of the following as Extra Disciplinary Course.

- ED-I: Mathematics for Life Sciences
- ED-II: Mathematics for Social Sciences
- ED-III: Statistics for Life and Social Sciences
- ED-IV: Game Theory and Strategy
- ED-V: History of Mathematics

Courses	Lecture Tutorial		Lab Practice	Total
	hrs	hrs		hrs
Core	75	15		90
Electives	75	15		90
ED	75	15		90
Lab Practice Courses	45	15	30	90
Project	20		70	90

#### **Instructions for Course Transaction**

#### 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.

# WRITTEN EXAMINATION : THEORY PAPER (BLOOM'S TAXONOMY BASED) QUESTION PAPER MODEL

Intended Learning Skills	Maximum 75 Marks Passing Minimum: 50% Duration : Three Hours
	Part –A (10x 2 = 20 Marks) Answer ALL questions Each Question carries 2mark
Memory Recall / Example/ Counter Example / Knowledge about the Concepts/ Understanding	Two questions from each UNIT

	Question 1 to Question 10 Part – B (5 x 5 = 25 Marks)
	Answer ALL questions Each questions 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)
	Answer any THREE questions
	Each question 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

For instance,

[CO1 : K2] Question xxxx [CO3 : K1] Question xxx

#### **MINIMUM MARKS FOR PASSING:**

#### a). Theory Papers:

The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks in the Theory Exam conducted by the University. The Continuous Internal Assessment (CIA) Mark 25 is distributed to four components viz., Tests, Assignment, Seminar and Attendance as 10, 05, 05 and 05 marks, respectively.

#### b). Practical paper:

A minimum of 50 marks out of 100 marks in the University examination and the record notebook taken together is necessary for a pass. There is no passing minimum for the record notebook. However submission of record notebook is a must.

#### c). Project Work/Dissertation and Viva-Voce:

A candidate should secure 50% of the marks for pass. The candidate should attend viva-voce examination to secure a pass in that paper.

Candidate who does not obtain the required minimum marks for a pass in a Paper / Practical/ Project/Dissertation shall be declared Re-Appear (RA) and he / she has to appear and pass the same at a subsequent appearance.

#### CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class. All other successful candidate shall be declared to have passed in the Second Class. Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in the First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance. Candidates who pass all the examinations prescribed for the additional the first instance and within a period of two academic years from the year of admission to the course only are eligible for University Ranking.

#### MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME:

The maximum duration for completion of the PG Programme shall not exceed Four Years from the year of admission.

#### TRANSITORYPROVISION:

Candidates who were admitted to the PG course of study before 2023-2024 shall be permitted to appear for the examinations under those regulations for a period of three years, that is, up to end inclusive of the examination of April / May 2024. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

#### **DIFFERENT TYPES OF COURSES**

#### (i) Core Courses ( Illustrative )

- 1. Algebra
- 2. Real Analysis
- 3. Ordinary Differential Equations
- 4. Partial Differential Equations
- 5. Topology
- 6. Complex Analysis
- 7. Mechanics
- 8. Functional Analysis
- 9. Differential Geometry

#### (ii) Elective Courses (ED within the Department Experts) (Illustrative)

- 1. Discrete Mathematics
- 2. Number Theory and Cryptography
- 3. Formal Languages and Automata Theory
- 4. Programming in C++ and Numerical Methods
- 5. Fuzzy Sets and Their Applications
- 6. Mathematical Programming
- 7. Algebraic Number Theory
- 8. Java Programming
- 9. Analytical Number Theory
- 10. Tensor Analysis and Relativity
- 11. Stochastic Processes
- 12. Algebraic Geometry
- 13. Fluid Dynamics
- 14. Financial Mathematics
- 15. Wavelets
- 16. Mathematical Statistics

#### (iii)Elective Courses (ED from other Department Experts)

#### (iv) Skill Development Courses

#### (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 FOR DIFFERENT COURSES OF M.Sc MATHEMATICS

Title of the Course	ALGEBRA	ALGEBRAIC STRUCTURES							
Paper Number	CORE I	CORE I							
Category Core	Year	Ι	Credits	5	Cou	rse			
	Semester	Ι			Cod	e	23PMAC01		
Instructional Hours	Lecture	Tuto	rial	Lab Prac	tice	Tota	l		
per week	6	1				7			
Pre-requisite	UG level M	lodern	Algebra						
Objectives of t	he To introduc	the c	oncepts and	to develop	o worl	king k	nowledge on class		
Course	equation, s	solvabi	lity of g	roups, fin	ite a	beliar	n groups, linear		
	transformati	ons, re	al quadratic	forms					
Course Outline	UNIT-I:Co	ounting	g Principle -	· Class equ	ation	for fin	ite groups and its		
	applications	- Sylo	w's theorem	ns (For theo	rem 2	.12.1,	First proof only).		
	Chapter 2:	Section	ns 2.11 and	l 2.12 (Omi	it Len	nma 2	.12.5)		
	UNIT-II : S	olvabl	e groups - I	Direct produ	ucts - ]	Finite	abelian groups-		
	Modules								
	Chapter 5 :	Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem							
	5.7.1)								
	Chapter 2:	Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)							
	Chapter 4:	Chapter 4: Section 4.5							
	UNIT-III :	UNIT-III : Linear Transformations: Canonical forms – Triangular							
	form - Nilpo	form - Nilpotent transformations.							
	Chapter 6:	Chapter 6: Sections 6.4, 6.5							
	UNIT-IV:	<b>UNIT-IV</b> : Jordan form - rational canonical form.							
	Chapter 6 :	Chapter 6 : Sections 6.6 and 6.7							
	UNIT-V: T	UNIT-V: Trace and transpose - Hermitian, unitary, normal							
	transformati	transformations, real quadratic form.							
	Chapter 6 :	Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)							
Extended Profession	nal Questions 1	related	to the ab	ove topics	s, fro	m va	rious competitive		
Component (is a part	of examination	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /							
internal compone	ent others to be	others to be solved							
only, Not to be includ	ed (To be discu	(To be discussed during the Tutorial hour)							
in the Extern	nal								
Examination questi	on								
paper)									
Skills acquired from the	nis Knowledge	, Prol	blem Solv	ving, Anal	lytical	abil	ity, Professional		
course	Competency	, Profe	essional Con	nmunicatio	on and	Trans	sferrable Skill		
Recommended Text	I.N. Herster	in. <i>Top</i>	pics in Alge	<i>bra</i> (II Edi	ition)	Wiley	Eastern Limited,		
	New Dell	New Delhi, 1975.							

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

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

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 and to verify whether the transformation in Hermitian, unitary and normal

				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	
		Semester	Ι				Cod	le	23PMAC02
Instruction	nal	Lecture		Tute	orial	Lab Pra	ctice	Tota	al
Hours		6		1				7	
per week									
Pre-requis	ite	UG level 1	eal a	nalysi	is concepts				
Objectives	of the	To work comfortably with functions of bounded variation, Rier							ation, Riemann-
Course		Stieltjes Integration, convergence of infinite series, infinite produc							infinite product
		and uniform convergence and its interplay between various lir							various limiting
		operations.							
Course Ou	ıtline	UNIT-I :	Fu	nctior	ns of bo	ounded v	ariati	on -	Introduction -
		Properties	of m	onoto	nic function	ns - Funct	ions o	f bou	nded variation -
		Total varia	tion	- Ade	ditive prope	erty of tota	l varia	ation -	- Total variation
		on [a, x]	as a	ı func	ction of x	- Functio	ons of	bo	unded variation
		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 Abel's test - Rearrangement of series - Riemann's theorem							
		on conditionally convergent series.							
		Chapter 8	Sect	tions	8.8, 8.15, 8	.17, 8.18			
		UNIT-II:	The	Riem	ann - Stiel	tjes Integi	<b>ral -</b> Ir	ntrodu	ction - Notation
		- The defin	ition	of th	e Riemann	- Stieltjes	integr	al - L	inear 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 theorems.							
		Chapter - 7 : Sections 7.1 to 7.14							
		UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded							
		variation-Sufficient conditions for the existence of Riemann-Stieltjes							
		integrals-Necessary conditions for the existence of RS integrals- Mean							
value theorems -integrals as a function of the interval -					erval – Second				
	fundamental theorem of integral calculus-Change of variable -Seco					variable -Second			
	Mean Value Theorem for Riemann integral- Riemann-Sti						iemann-Stieltjes		
		integrals d	lepen	ding	on a parai	neter- Dif	fferent	iation	under integral
		sign-Lebes	gue o	criteri	aon for exis	stence of R	liemar	n inte	egrals. Chapter -
		7: 7.15 to 7.26							

	<b>UNIT-IV : Infinite Series and infinite Products</b> - Double sequences
	- Double series - Rearrangement theorem for double series - A
	sufficient condition for equality of iterated series - Multiplication of
	series – Cesaro summability - 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 - Stielties 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, 9.11, 9.13
Extended	Ouestions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /
Component (is a	others to be solved
part of internal	(To be discussed during the Tutorial hour)
component only.	(10 00 allocation a anning the Fatorial Hour)
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-
Tovt	Wesley Publishing Company Inc. New York 1974
Reference Books	1 Bartle R G Real Analysis John Wiley and Sons Inc. 1976
Reference Books	2 Rudin W Principles of Mathematical Analysis 3 <sup>rd</sup> Edition
	2. Rudin, W. Trinciples of Mainematical Analysis, 5 Edition. McGraw Hill Company, New York, 1976
	3 Malik S C and Savita Arora Mathematical Analysis Wiley
	Fastern Limited New Delhi 1001
	A Sanjay Arora and Bansi Lal Introduction to Real Analysis Satva
	4. Sanjay Alora and Dansi Lai, <i>Introduction to Keut Analysis</i> , Satya
	5 Gelhaum B.R. and I. Olmsted Counter Framples in Analysis
	Holden day San Francisco 1964
	6 A I Gunta and NR Gunta Principles of Real Analysis Decrean
	Education (Indian print) 2003
Website and	http://mathforum.org_http://ocw.mit.adu/ocw.wah/Mathamatics
	http://mannorum.org, http://ocw.nnt.edu/ocwweb/Mathematics,
e-Learning Source	<u>http://www.opensource.org</u> , <u>www.matnpages.com</u>

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

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.

			Р		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	ORDINARY DIFFERENTIAL EQUATIONS										
Paper Nur	nber	CORE III										
Category	Core	Year	Ι		Credits	4	Cou	irse				
		Semester	r I				Cod	le	23PMAC03			
Instruction	nal	Lecture		Tuto	orial	Lab Prac	tice	Tota	al			
Hours		5		1				6				
per week												
Pre-requis	site	UG level	Calcu	lus ar	nd Different	ial Equatio	ons					
Objectives	s of the	To devel	op s	trong	backgrou	nd on fin	ding	solu	tions to linear			
Course		differential	l equa	ations	with const	ant and var	riable	coeff	ficients and also			
		with sing	ular j	points	s, to study	existence	e and	l unio	queness of the			
		solutions o	of first	t orde	r differenti	al equation	S					
Course Ou	ıtline	UNIT-I:	L <mark>ine</mark> a	ır equ	ations witl	n constant	coeff	icient	S			
		Second or	der h	omog	geneous equ	uations-Init	ial va	alue p	problems-Linear			
		dependenc	e ar	nd in	ndependenc	e-Wronskia	an a	nd a	a formula for			
		Wronskian	-Non	-hom	ogeneous e	quation of o	order	two.				
		Chapter 2	: Sec	tions	1 to 6							
		<b>UNIT-II : Linear equations with constant coefficients</b>										
		Homogene	ous a	nd no	on-homoger	eous equat	ion of	f orde	r n –Initial			
		value prob	lems-	Anni	ihilator met	hod to solv	e non	-hom	ogeneous			
		equation-	Algeł	bra of	constant co	efficient of	perato	ors.				
		Chapter 2	: Sec	ctions	7 to 12.							
		UNIT-III	: Lin	ear e	quation wi	th variable	coef	ficien	ts			
		Initial val	lue p	oroble	ems -Exist	ence and	unic	juenes	ss theorems –			
		Solutions	to so	lve a	non-homo	geneous e	quatio	on –	Wronskian and			
		linear depe	enden	ce – r	eduction of	the order of	of a h	omog	eneous equation			
		– homoge	neous	s equ	ation with	analytic of	coeffi	cients	s-The Legendre			
		equation.		1		2			C			
		Chapter	: 3 Se	ection	ns 1 to 8 ( C	mit sectio	on 9)					
		UNIT-IV	:Line	ar eq	uation wit	h regular s	ingul	lar po	oints			
		Euler equa	tion -	- Seco	ond order ed	juations wi	th reg	gular s	singular points –			
		Exceptiona	al case	es – E	Bessel Func	tion.	-		• •			
		Chapter 4	4 : S	ectio	ns 1 to 4 an	d 6 to 8 (0	Omit	sectio	ons 5 and 9)			
		UNIT-V	: Exi	istenc	e and uni	queness of	f solu	utions	to first order			
		equations:	Equ	ation	with varia	able separa	ated	– Ex	act equation –			
		method of	suce	cessiv	e approxin	nations –	the L	ipsch	itz condition –			
		convergen	ce of	f the	successive	approxim	nation	s and	d the existence			
		theorem.				-						
		Chapter 5	: Sec	ctions	1 to 6 ( O	mit Section	ns 7 t	o 9)				

Extended	Questions related to the above topics, from various competitive						
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /						
Component (is a	others to be solved						
part 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 (3 <sup>rd</sup>						
Text	Printing) Prentice-Hall of India Ltd., New Delhi, 1987.						
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, <i>Elementary</i>						
	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						

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

Students will be able to

CLO1: Establish the qualitative behavior of solutions of systems of differential equations .

**CLO2:** Recognize the physical phenomena modeled by differential equations and dynamical systems.

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

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

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

			Р	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	ADVANC	ADVANCED ALGEBRA									
Paper Number	CORE IV				-						
Category Core	Year	Ι		Credits	5	Cou	irse				
	Semester	II				Cod	le	23PMAC04			
Instructional	Lecture		Tuto	orial	Lab Pra	actice	Tota	al			
Hours	5		1				6				
per week											
Pre-requisite	Algebraic	Algebraic Structures									
Objectives of the	To study	field e	extens	sion, roots	of polyno	omials,	Galoi	is Theory, finite			
Course	fields, div	vision	ring	gs, solvab	ility by	radica	ils ai	nd to develop			
	computatio	onal sk	cill in	abstract al	gebra.						
Course Outline	<b>Durse Outline</b> UNIT-I :Extension fields – Transcendence of e.										
	Chapter 5	: Sect	ion 5	.1 and 5.2							
	UNIT-II :	Root	ts or ]	Polynomial	s More	about r	oots				
Chapter 5: Sections 5.3 and 5.5											
	UNIT-III	: Elem	nents	of Galois t	heory.						
	Chapter 5	: Sect	tion	5.6							
	<b>UNIT-IV</b> : Finite fields - Wedderburn's theorem on finite divis										
	rings.										
	Chapter 7	: Sect	ions	7.1 and 7	<b>'.2 (Theo</b>	rem 7.2	2.1 on	ly)			
	UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral										
	Quaternior	ns and	the F	Four - Squa	re theorem	n.					
	Chapter :	5: Sec	ction	5.7 (omit	Lemma	a 5.7.1	, Len	nma 5.7.2 and			
	Theorem	5.7.1)									
	Chapter 7	: Sect	tions	7.3 and 7.	.4						
Extended	Questions	relate	ed to	the abov	e topics,	from	vario	ous competitive			
Professional	examinatio	ons UF	PSC /	TRB / NE	T / UGC	– CSI	R / G.	ATE / TNPSC /			
Component (is a	others to b	e solve	ed								
part of internal	(To be disc	cussed	l duri	ng the Tuto	rial hour)	)					
component only,											
Not to be included											
in the External											
Examination											
question paper)											
Skills acquired from	Knowledg	Knowledge, Problem Solving, Analytical ability, Professional									
this course	Competen	Competency, Professional Communication and Transferrable Skill									
Recommended	I.N. Hers	tein. 7	Topic	s in Algebi	a (II Edi	tion) V	Vilev	EasternLimited.			
Text	New De	elhi, 19	975.	0.2	、 <i>·</i>	, .	5	· · · · · · · · · · · · · · · · · · ·			

<b>Reference Books</b>	1. M.Artin, Algebra, Prentice 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									
	ngs, Narosa Publishing House, New Delhi, 1999									
	4. D.S.Malik, J.N. Mordeson and M.K.Sen, <i>Fundamental of Abstract</i>									
	Algebra, McGraw Hill (International Edition), New York. 1997.									
	5. N.Jacobson, <i>Basic Algebra</i> , 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									

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

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.

			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			
		Semester	II				Cod	le	23PMAC05		
Instruction	nal	Lecture		Tute	orial	Lab Prac	tice	Tota	al		
Hours		5		1				6			
per week											
Pre-requis	ite	Elements of	f Rea	al Ana	alysis						
Objectives	of the	To introdu	ice n	neasu	re on the r	eal line, L	ebesg	ue m	easurability and		
Course		integrabilit	y, I	Fourie	er Series	and Integ	grals,	in-d	epth study in		
		multivaria	ole ca	lculu	s.						
Course Ou	ıtline	UNIT-I :	Meas	ure o	on the Rea	l line - L	ebesg	gue O	uter Measure -		
		Measurable	e set	s - R	Regularity -	Measurat	ole Fu	inctio	ns - Borel and		
		Lebesgue N	Meas	urabil	ity						
		Chapter -	2 See	c 2.1 t	to 2.5 (de B	arra)					
		UNIT-II:	Inte	gratic	on of Funct	tions of a 1	Real	varial	ble - Integration		
		of Non- n	egati	ve fu	nctions - T	The Genera	al Inte	egral	- Riemann and		
		Lebesgue I	ntegi	als							
		Chapter -	3 See	c 3.1,3	3.2 and 3.4	(de Barra	)				
		UNIT-III	: Fo	urier	Series and	l Fourier	Integ	grals	- Introduction -		
		Orthogona	l syst	em o	f functions	- The theo	rem o	n bes	t approximation		
		- The Four	ier so	eries o	of a functio	n relative t	to an	orthor	normal system -		
		Properties	of Fo	ourier	Coefficien	ts - The R	iesz-F	Fischer	r Thorem - The		
		convergence	ce an	d repi	resentation	problems i	n for	trigon	ometric series -		
		The Riema	ann -	- Leb	esgue Lem	ma - The	Dir	ichlet	Integrals - An		
		integral re	pres	entatio	on for the	partial s	sums	of F	ourier series -		
		Riemann's	loc	calizat	tion theor	em - S	uffici	ent	conditions for		
		convergence	ce d	of a	Fourier	series at	a	partic	cular point –		
		Cesarosum	mabi	ility	of Fourier	series-	Conse	equen	ces of Fejes's		
		theorem - 7	The V	Veiers	strass appro	ximation th	neorer	n			
		Chapter 1	1 : S	ection	ns 11.1 to 1	1.15 (Apos	stol)				
		UNIT-IV	: Mu	ltivar	riable Diffe	rential Ca	lculu	s - Int	roduction - The		
		Directional	der	ivativ	e - Directio	onal deriva	ative a	and c	ontinuity - The		
		total deriv	ative	- Th	e total deri	vative exp	oresse	d in t	terms of partial		
		derivatives	- Th	e mat	rix of linea	function -	The.	Jacobi	ian matrix - The		
		chain rule	- Ma	trix fo	orm of chain	n rule - Th	e mea	n - va	lue theorem for		
		differential	ole f	unctio	ons - A suff	ficient con	dition	for d	ifferentiability -		
		A sufficient condition for equality of mixed partial derivative $a = \frac{1}{2}$									
		Taylor's theorem for functions of K to K									
		Chapter 12 : Section 12.1 to 12.14 (Apostol)									
		UNIT-V :	Imp	licit H	unctions a	nd Extren	num I	robl	ems : Functions		
		With non-z	ero J	acobi	an determin	iants – The	e inve	rse tu	nction theorem-		
		The Implic	cit tu	inctio	n theorem-	Extrema o	real	valu	ea functions of		
		severable v	variat	bles-E	xtremum pi	oblems wi	th side	e cono	litions.		
		Chapter 1	3 : S	ection	ns 13.1 to 1.	3.7 (Apost	ol)				

Extended	Questions related to the above topics, from various competitive						
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /						
Component (is a	others to be solved						
part 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, <i>Measure Theory and Integration</i> , 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. <i>The Lebesgue Integral</i> , Cambridge University Press,						
	1951.						
	2. Munroe, M.E. <i>Measure and Integration</i> . Addison-Wesley,						
	Mass.1971.						
	3. Roydon,H.L. <i>Real Analysis</i> , Macmillan Pub. Company, New York,						
	4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill						
	Company, New York, 1979.						
	5. Malik, S.C. and Savita Afora. <i>Mathematical Analysis</i> , Wiley						
	Eastern Limited. New Delhi, 1991.						
	6. Sanjay Afora and Bansi Lal, <i>Introduction to Real Analysis</i> , Satya						
<b></b>	Prakashan, New Delhi, 1991						
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,						
e-Learning Source	http://www.opensource.org						

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

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.

			Р	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	PARTIAL DIFFERENTIAL EQUATIONS									
Paper Nur	nber	CORE VI				-					
Category	Core	Year	Ι		Credits	4	Cou	rse			
		Semester	Π				Cod	e	23PMAC06		
Instruction	nal	Lecture		Tute	orial	Lab Prac	tice	Tota	al		
Hours		5		1				6			
per week											
Pre-requis	site	UG level j	partia	l diffe	erential equ	ations					
Objectives	of the	To classify	y the	secon	d order par	tial differen	ntial e	quatic	ons and to study		
Course		Cauchy pr	obler	n, me	thod of sep	paration of	varia	bles,	boundary value		
		problems.									
Course Ou	ıtline	UNIT-I :N	<b>Iath</b>	emati	cal Models	s and Clas	sifica	tion o	of second order		
		equation :	Clas	sical	equations-V	ibrating st	ring –	Vibra	ating membrane		
		– waves	in e	lastic	medium	- Conduct	tion of	of hea	at in solids –		
		Gravitation	nal po	otentia	al – Second	d order equ	ation	s in tv	wo independent		
		variables -	- can	onical	l forms – e	quations w	vith co	onstan	nt coefficients -		
		general sol	ution	1							
		Chapter 2	: See	ctions	2.1 to 2.6						
		Chapter 3	: Se	ctions	3.1 to 3.4	(Omit 3.5)					
		UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-									
		Kowalews	ky t	heore	m – Hom	ogeneous	wave	equa	ation – Initial		
		Boundary	value	e prot	olem- Non-	homogeneo	ous b	ounda	ry conditions –		
		Finite strir	ng w	ith fiy	ked ends -	Non-home	ogene	ous w	vave equation –		
		Riemann 1	nethe	od –	Goursat pr	roblem – s	pheri	cal wa	ave equation –		
		cylindrical	wav	e equa	ation.						
		Chapter 4	: See	ctions	4.1 to 4.11						
		UNIT-III	:Me	ethod	of separ	ation of	varia	bles:	Separation of		
		variable-	Vibra	ting s	string prob	lem – Exi	stence	e and	uniqueness of		
		solution of	f vib	rating	string pro	oblem - H	eat co	onduct	tion problem –		
		Existence	and 1	unique	eness of so	lution of h	neat c	onduc	tion problem –		
		Laplace an	d bea	am eq	uations						
		Chapter 6	: See	ctions	6.1 to 6.6	(Omit sect	$\frac{1}{2}$	7)			
		UNIT-IV	: Bo	ounda	ry Value I	Problems :	Bou	ndary	value problems		
		– Maxımu	m ar	nd mi	nimum pri	1000000000000000000000000000000000000	Uniqu	eness	and continuity		
		theorem –	Dır	1chlet	Problem	tor a circl	e, a	circi	ular annulus, a		
		rectangle -	- Diri	ichlet	problem in	volving Po	isson	equat	ion – Neumann		
		problem for a circle and a rectangle.									
		Chapter 8	: Se	ctions	8.1 to 8.9						
		UNIT-V:	Gree	en's F	unction:	I ne Delta f	unctio	on – G	streen's function		
		– Method o	of Gr	een s	runction –	Dirichlet P	roblei	n for $1$	the Laplace and		
		Helmholtz operators – Method of images and eigen functions –									
		Higher din		onal p	roblem - N	eumann Pr	oblen	1.			
		Chapter 1	<b>U</b> : S	ection	n 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	others to be solved						
part 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	TynMyint-U and Lokenath Debnath, Partial Differential Equations						
Text	for Scientists and Engineers (Third Edition), North Hollan, New						
	York, 1987.						
Reference Books	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, <i>Introduction to Partial Differential Equations</i>						
	and Boundary Value Problems, McGraw Hill, New York, 1968.						
	4. M.D.Raisinghania, Advanced Differential Equations, S.Chand &						
	Company Ltd., New Delhi, 2001.						
	5. S, Sankar Rao, <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						

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

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	COMPLE	COMPLEX ANALYSIS									
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Paper Nur	nber	CORE VI	I									
Category	Core	Year	II		Credits	5	Cou	rse				
		Semester	III				Cod	e	23PMAC07			
Instruction	nal	Lecture		Tute	orial	Lab Prac	tice	Tota	al			
Hours		5		1				6				
per week												
Pre-requis	site	UG level	Comp	plex A	nalysis							
Objectives	of the	To Study	Cau	ıchy	integral fo	ormula, loc	cal pr	opert	ies of analytic			
Course		functions,	functions, general form of Cauchy's theorem and evaluation o									
		definite int	lefinite integral and harmonic functions									
Course Ou	ıtline	UNIT-I : C	auch	y's In	tegral Form	ula: The In	dex of	a poi	nt with respect to			
		a closed cur	rve –	The In	tegral formu	ıla – Higher	deriva	atives.	. Local Properties			
		of analytica	1 Fund	ctions:								
		Removable	e Sing	gulari	ties-Taylors	s's Theorer	n – Z	eros a	and poles – The			
		local Mapp	oing -	- The	Maximum	Principle.						
		Chapter 4	: See	ction	2 : 2.1 to 2.	3						
		Chapter 4	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- Sir	nple	Conti	nuity - Ho	omology -	The	Gene	ral statement of			
		Cauchy's	Theorem	rem -	Proof of	Cauchy's	theor	em -	Locally exact			
		differential	ls- M	Iultipl	y connecte	d regions	- Res	sidue	theorem - The			
		argument p	orinci	ple.								
		Chapter 4	: Sec	ction 4	4:4.1 to 4	.7						
		Chapter 4	: See	ction	5: 5.1 and	5.2						
		UNIT-III	:Ev	aluat	ion of D	efinite Ir	ntegra	als a	and Harmonic			
		Functions	Eval	luation	n of definit	e integrals	- De	finiti	on of Harmonic			
		function a	ind t	oasic	properties	- Mean	value	prop	verty - Poisson			
		formula.										
		Chapter 4 : Section 5 : 5.3										
		Chapter 4	: See	ctions	6:6.1 to 6	5.3						
		UNIT-IV	:Har	monio	e Functions	s and Powe	er Ser	ies E	xpansions:			
		Schwarz tl	neore	m - 7	The reflection	on principl	e - W	/eiers	trass theorem –			
		Taylor's S	eries	– Lau	rent series .							
		Chapter 4 : Sections 6.4 and 6.5										
		Chapter 5 : Sections 1.1 to 1.3										
		UNIT-V: Partial Fractions and Entire Functions: Partial fraction							Partial fractions			
		- Infinite p	rodu	cts – (	Canonical p	oroducts – 0	Gamn	na Fu	nction- Jensen's			
		formula – I	Hada	mard'	s Theorem							
		Chapter 5	: Sec	ctions	2.1 to 2.4							
		Chapter 5	: Sec	ctions	3.1 and 3.2	2						

Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /
Component (is a	others to be solved
part of internal	(To be discussed during the Tutorial hour)
component only,	(10 be discussed during the Tutorial hour)
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	Lars V. Ahlfors, <i>Complex Analysis</i> , (3 <sup>rd</sup> edition) McGraw Hill Co.,
Text	New York, 1979
<b>Reference Books</b>	1. H.A. Presfly, <i>Introduction to complex Analysis</i> , 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, <i>Analytic function Thorey</i> (2 vols.), Gonm& Co, 1959.
	4. M.Heins, <i>Complex function Theory</i> , 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 jensen'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		

Paper Number	PROBABILITY THEORY								
· · · · · · · · · · · · · · · ·	CORE VI	II							
Category Core	Year	Π		Credits	5	Cou	rse		
	Semester	III				Cod	e	23PMAC08	
Instructional	Lecture	•	Tute	orial	Lab Prac	tice	Tota	al	
Hours	5		1				6		
per week									
Pre-requisite	UG level a	algeb	ra and	l calculus					
Objectives of the	To introdu	To introduce axiomatic approach to probability theory, to study some							
Course	statistical	cha	racteri	istics, disc	crete and	con	tinuoi	us distribution	
	functions a	and t	heir p	roperties, c	haracterist	ic fun	ction	and basic limit	
	theorems of	of pro	babili	ty.					
Course Outline	UNIT-I: - Probability Variables Distributio variables - Chapter 1 Chapter 1 Chapter 2 UNIT-II: The Cheby Moments types. Chapter 3 UNIT-III: functions - characteris - Determin - Charact Probability Chapter 4 UNIT-IV Binomial - - Uniform (continuou Chapter 5 UNIT-V: of large nu - Levy-Cr Chebyshev Theorem - Inequality Chapter 6	Ranc ility - Di - Di - Fund : Sec : Sec Para /shev of ra : Sec Para /shev of ra : Sec Cha - Cha tic fund i Sec : Sec	lom F axior Bayes stribu Con ctions tions tions tions amete Inequ ndom ctions aracter inction c fun erating ctions ne Pr ya – F norm stribut ction s t The Chintc unov T Colmor	<b>Events and</b> ns – Constitution Function ditional D of random <b>1.1 to 1.7</b> <b>2.1 to 2.9</b> <b>rs of the D</b> nality – Abstitution <b>f</b> vectors – <b>3.1 to 3.8</b> <b>eristic function</b> of the sum distribution <b>f</b> and <b></b>	Random Maintenne Regression istribution variables. istribution variables. istribution variables. istribution variables. istribution solute mon Regression ctions : Pons and mon n of the ind unction by nultidiment listribution etric – Poist n – Beta (Omit Sector ochastic con borel-Can ng Law of La Borel-Can ng Law of La	Varia form endent t Dis - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	bles: nulae c ever tributi independent pectat – Ord the fi ties o s – se lent ra charac l rand discre discre distribution for the fi content of the fill the	Random events – conditional nts – Random ion – Marginal endent random ion-Moments – ier parameters – irst and second of characteristic emi0invariants – andom variables teristic function dom vectors – int , two point , te) distributions / and Laplace – Bernaulli law pution functions orem – Poisson, ers – Lindberg a - Kolmogorov ers. nd 6.12. (Omit	

Extended	Questions related to the above topics, from various competitive
Professional	examinations UPSC / TRB / NET / UGC - CSIR / GATE / TNPSC /
Component (is a	others to be solved
part 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	M. Fisz, Probability Theory and Mathematical Statistics, John Wiley
Text	and Sons, New York, 1963.
Reference Books	1. R.B. Ash, Real Analysis and Probability, Academic Press, New
	York, 1972
	2. K.L.Chung, A course in Probability, Academic Press, New York,
	1974.
	4. R.Durrett, <i>Probability</i> : <i>Theory and Examples</i> , (2 <sup>nd</sup> Edition)
	Duxbury Press, New York, 1996.
	5. V.K.RohatgiAn Introduction to Probability Theory and
	Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd
	Print).
	6. S.I.Resnick, A Probability Path, Birhauser, Berlin, 1999.
	7. B.R.Bhat , Modern Probability Theory (3rd Edition), New Age
	International (P)Ltd, New Delhi, 1999
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, http://www.probability.net

Students will be able to

**CLO1:** To define Random Events, Random Variables, to describe Probability, to apply Bayes, to define Distribution Function, to find Joint Distribution function, to find Marginal Distribution and Conditional Distribution function, to solve functions on random variables.

**CLO2:** To define Expectation, Moments and Chebyshev Inequality, to solve Regression of the first and second types.

**CLO3:** To define Characteristic functions, to define distribution function, to find probability generating functions, to solve problems applying characteristic functions

**CLO4:** To define One point, two-point, Binomial distributions, to solve problems of Hypergeometric and Poisson distributions, to define Uniform, normal, gamma, Beta distributions, to solve problems on Cauchy and Laplace distributions

**CLO5:** To discuss Stochastic convergence, Bernaulli law of large numbers, to elaborate Convergence of sequence of distribution functions, to prove Levy-Cramer Theorems and de Moivre-Laplace Theorems, to explain Poisson, Chebyshev, Khintchine Weak law of large numbers, to explain and solve problems on Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

		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 Nur	nber	CORE IX									
Category	Core	Year	II		Credits	5	Cou	rse			
		Semester	III				Cod	e	23PMAC09		
Instruction	nal	Lecture		Tute	orial	Lab Prac	tice	Tota	al		
Hours		5		1				6			
per week											
Pre-requis	ite	Real Anal	ysis								
Objectives	of the	To study	topo	logica	al spaces, c	continuous	funct	tions,	connectedness,		
Course		compactne	ompactness, countability and separation axioms.								
Course Ou	ıtline	UNIT-I :	<b>JNIT-I : Topological spaces :</b> Topological spaces – Basis for a								
		topology -	- The	orde	r topology	– The pro	duct t	opolo	gy on $X \times Y$ –		
		The subspa	ace to	polog	y - Closed	sets and lin	mit po	oints.			
		Chapter 2	: Sec	ctions	12 to 17						
		UNIT-II :	Cont	inuot	is function	s: Continu	ous fu	nctio	ns – the product		
		topology -	The	metri	c 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	: Sec	ctions	26 to 29.						
		UNIT-V:	Coun	tabilit	y and Separ	ration Axio	om: Tł	ne Co	untability		
		Axioms – '	The s	epara	tion Axiom	s – Norma	l space	es – T	The		
		Urysohn L	emma	a – Tł	ne Urysohni	metrizatior	n Theo	orem –	- The Tietz		
		extension t	heore	em.							
		Chapter 4	: Sec	ctions	30 to 35.						
Extended		Questions	relat	ed to	the abov	e topics,	from	vario	ous competitive		
Professiona	al	examinatio	ons U	PSC /	TRB / NE	T / UGC -	- CSII	R / G.	ATE / TNPSC /		
Componen	t (is a	others to b	e solv	/ed							
part of	internal	(To be disc	cussed	d duri	ng the Tuto	rial hour)					
component	only,										
Not to be	included										
in the	External										
Examinatio	on										
question pa	iper)										
Skills acqu	ired from	Knowledg	ge, F	Proble	m Solving	g, Analyt	ical	ability	y, Professional		
this course		Competence	cy, Pr	ofess	ional Comn	nunication	and T	ransfe	errable Skill		
Recommen	nded	James R.	Munł	kres,	Topology (	2 <sup>nd</sup> Edition	n) Pea	arson	Education Pve.		
Text		Ltd., De	lhi-2	002 (*	Third Indiar	n Reprint)					

<b>Reference Books</b>	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
	3. J.L. Kelly, <i>General Topology</i> , Van Nostrand, Reinhold Co., New York
	<ol> <li>L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.</li> </ol>
	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

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

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	1	2	3	3	3	3	2	1	

Title of the	e Course	MACHINE LEARNING [Advancements in industry 4.0]										
Paper Nur	nber	CORE X										
Category	Core	Year	II		Credits	4	Cou	rse				
		Semester	III				Cod	le	<b>23PMAC10</b>			
Instruction	nal	Lecture		Tuto	orial	Lab Pra	ctice	Tota	al			
Hours		5		1				6				
per week												
Pre-requis	ite	Basic Know	wledg	ge con	nputer scier	nce						
Objectives	of the											
Course												
Course Ou	ıtline	UNIT-I: N	UNIT-I : MACHINE LEARNING									
		Machine 2	Machine Learning : Introduction -Definition –Types of Mach									
		Learning	-Su	pervis	sed, Unsi	upervised	,Rein	forcei	ment Learning-			
		Algorithms	s for	Mac	hine Learn	ing – pro	blems	solv	ed by Machine			
		Learning –	Too	ls for	Machine Le	earning – A	Applic	ations	5			
		UNIT-II :	ROB	ΟΤΙΟ	C PROCES	S AUTO	MATI	ON(F	RPA)			
		Robotic P	roces	ss Au	tomation(F	<b>RPA</b> ):Intro	oductio	on to	RPA –Need for			
		automation	pro	gramr	ning constr	ucts in R	PA- R	obots	and Softbots –			
		RPA architecture and process methodologies Industries best suited										
		for RPA.			- F		5					
		UNIT-III ·CLOUD										
		Cloud Computing : Need-Definition –Types of Cloud -Types of										
		services –S	laas		• 11000 200		- JP CS	01 0	iouu ijpos oi			
		UNIT-IV :		BER								
		<b>Cyber Security:</b> Cyber Crime and Information security – Classification of										
		cyber Crime	e Typ	bes.								
		UNIT-V: Y	IT-V: VIRTUAL									
		Virtual Re	ality	lity: Definition- Types of Head Mounted Displays-Tools								
		for Reality	v		5	1			1 2			
Extended		Questions	relat	ted to	the abov	e topics,	from	vario	ous competitive			
Professiona	al	examinatio	ns U	PSC /	/ TRB / NE	T / UGC	– CSI	R / G.	ATE / TNPSC /			
Component	t (is a	others to be	e solv	ved								
part of	internal	(To be disc	usse	d duri	ng the Tuto	rial hour)						
component	only,											
Not to be	included											
in the	External											
Examinatio	on											
question pa	iper)											
Skills acqu	ired from	Knowledg	e, I	Proble	m Solving	g, Analy	tical	ability	y, Professional			
this course		Competence	ey, Pi	ofess	ional Comn	nunication	and T	ransfe	errable Skill			
Recommen	nded	Higher Edu	icatio	on for	industry 4.	0 and Trar	nsform	ation	to Education5.0			
Text		by P. Ka	aliraj	and T	.Devi							
Reference	Books											
Website an	nd	http://math	<u>for</u> ur	<u>n.org</u> .	, <u>http://</u> ocw.	. <u>mit.ed</u> u/o	<u>cww</u> et	o/ <u>M</u> atl	hematics,			
e-Learning	g Source	http://www	.ope	nsour	ce.org , http	://en.wiki	pedia.	org				

Title of the	e Course	Functiona	Functional Analysis									
Paper Nur	nber	CORE XI										
Category	Core	Year	Π		Credits	5	Cou	rse				
		Semester	IV				Cod	e	23PMAC11			
Instruction	nal Hours	Lecture		Tuto	orial	Lab Prace	tice	Tota	ıl			
per week		5		1				6				
Pre-requis	ite	Elements of	f Rea	al Ana	lysis			•				
Objectives	of the	To provide	e stu	dents	with a stro	ong founda	tion i	n fun	ctional analysis,			
Course		focusing o	n spa	aces, o	operators an	nd fundame	ental	theore	ms. To develop			
		student's s	tudent's skills and confidence in mathematical analysis and proof									
		techniques	echniques.									
Course Ou	ıtline	UNIT-I :	JNIT-I :Banach Spaces: The definition and some examples –									
		Continuous	s line	ar trar	nsformation	s – The Hal	hn-Ba	nach t	theorem – The			
		natural im	beddi	ing of	N in $N^{**}$ -	The open	mapp	oing th	neorem – The			
		conjugate of an Operator.										
		Chapter 9	Chapter 9:Sections 46-51									
		UNIT-II :	Hilbe	rt Spa	ces: The de	finition and	l som	e simp	ole properties-			
		Orthogona	l cor	nplem	ents-Ortho	normal s	ets-T	he co	njugate space			
		$H^*$ -The ad	ljoint	t of a	an operator	-self-adjoin	nt op	erator	s-Normal and			
		unitary ope	erator	s – Pr	ojections.							
		Chapter10	:Sec	tions5	52-59							
		UNIT-III	: ]	Finite-	Dimension	al Spectra	l Th	neory:	Matrices –			
		Determinat	nts ar	nd the	spectrum of	f an operato	or –Th	e spec	ctral theorem.			
		Chapter 1	1:Sec	ctions	60-62							
		UNIT-IV :	Gen	eral P	reliminaries	s on Banach	n Alge	bras:	The definition			
		and some	exam	ples -	- Regular a	ind singula	r elen	nents	<ul> <li>Topological</li> </ul>			
		divisors of	zero	– The	spectrum -	- The formu	la for	the sp	pectral radius-			
		The radical	and	semi-	simplicity.							
		Chapter 1	2:Sec	ctions	64-69							
		UNIT-V:	The	Struc	ture of Co	ommutative	Ban	ach A	Algebras: The			
		Gelfand m	appir	ng – A	Application	of the form	nula <mark>r</mark>	(x) =	$\ x^n\ ^{1/n}$			
		Involutions	s in B	anach	algebras-T	he Gelfand	-Neur	nark tl	heorem.			
		Chapter 1	3:Sec	ctions	70-73							
Extended		Questions	relat	ted to	the abov	ve topics,	from	vario	ous competitive			
Professiona	al	examinatio	ns U	PSC /	TRB / NE	ET / UGC -	- CSI	R / G	ATE / TNPSC /			
Componen	t (is a part	others to be	e solv	ved								
of	internal	(To be disc	ussed	d durii	ng the Tutor	rial hour)						
to be inclu	ded in the											
External	ueu ili ule											
Examinatio	on											
question pa	iper)											

Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional									
this course	Competency, Professional Communication and Transferrable Skill									
Recommended	F.Simmons, Introduction to Topology and Modern Analysis,									
Text	AcGraw Hill Education (India)Private Limited, New Delhi, 1963.									
Reference Books	<ol> <li>W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.</li> <li>B.V. Limaye, Functional Analysis, New Age International,1996.</li> <li>C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987.</li> <li>E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley &amp; Sons, New York, 1978.</li> <li>M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.</li> </ol>									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org, http://en.wikiepedia.org									

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	DIFFERE	ENTI	AL G	EOMETR	Y				
Paper Nur	nber	CORE XI	[							
Category	Core	Year	II		Credits	5	Cou	rse		
		Semester	IV				Cod	e	23PMAC12	
Instruction	nal Hours	Lecture		Tuto	orial	Lab Prace	Practice Total			
per week		5		1				6		
Pre-requis	ite	Linear Alg	gebra	conce	epts and Cal	culus				
Objectives	of the	This cours	se int	troduc	es space cu	rves and th	neir in	trinsi	c properties of a	
Course		surface and	d geo	odesic	s. Further	the non-int	rinsic	prop	erties of surface	
		and the dif	feren	tial ge	ometry of s	urfaces are	explo	red		
Course Ou	ıtline	UNIT-I:	Spa	ce cu	rves: Defin	ition of a s	space	curve	e – Arc length –	
		tangent –	norm	nal ar	nd binorma	l – curvat	ure a	nd to	orsion – contact	
		between cu	irves	and s	surfaces- ta	ngent surfa	ce- ir	nvolut	es and evolutes-	
		Intrinsic ec	uatio	ons – l	Fundamenta	l Existence	Theo	orem f	for space curves-	
		Helies.								
		Chapter I	: Sec	ctions	1 to 9.					
		UNIT-II:	Intri	nsic p	properties of	of a surfac	e: De	finitio	on of a surface –	
		curves on	a su	ırface	- Surface	of revolut	ion –	Heli	coids - Metric-	
		Direction of	coeff	icients	– families	of curves-	Ison	netric	correspondence-	
		Intrinsic pr	opert	ties.						
		Chapter I	[: See	ctions	1 to 9.					
		UNIT-III: Geodesics: Geodesics – Canonical geodesic equations –								
		Normal property of geodesics- Existence Theorems – Geodesic parallels								
		- Geodesia	s cu	rvatur	e- Gauss- E	Sonnet The	orem	– Gau	ussian curvature-	
		surface of o	const	ant cu	rvature.					
		Chapter II: Sections 10 to 18.								
		<b>UNIT-IV :</b> Non Intrinsic properties of a surface:								
		The second fundamental form- Principle curvature – Lines of curvature								
		- Develop	able	- Dev	velopable a	ssociated w	vith s	pace	curves and with	
		curves on surface - Minimal surfaces – Ruled surfaces.								
		Chapter III: Sections 1 to 8.								
		UNIT-V :Differential Geometry of Surfaces :								
		Compact	surfa	ces v	whose poin	ts are um	blics-	Hill	pert's lemma –	
		Compact s	urfac	ce of	constant cu	rvature – (	Comp	lete s	urface and their	
		characteriz	ation	– Hil	bert's Theor	rem – Conji	ugate	points	s on geodesics.	
		Chapter I	V : S	Section	ns 1 to 8 (O	mit 9 to 15	5).			
Extended		Questions	relat	ted to	the abov	ve topics,	from	vario	ous competitive	
Professiona	al	examinatio	ns U	PSC /	TRB / NE	ET / UGC -	- CSI	R / G	ATE / TNPSC /	
Componen	t (is a part	rt others to be solved								
of	internal	(To be disc	usse	d durii	ng the Tutor	rial hour)				
component	only, Not									
to be inclu	ded in the									
External										
Examinatio	on									
question pa	iper)									

Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional									
this course	Competency, Professional Communication and Transferrable Skill									
Recommended	T.J.Willmore, An Introduction to Differential Geometry, Oxford									
Text	University Press,(17 <sup>th</sup> Impression) New Delhi 2002. (Indian Print)									
RefereEce Books	1. Struik, D.T. Lectures on Classical Differential Geometry, Addison –									
	Wesley, Mass. 1950.									
	2. Kobayashi. S. and Nomizu. K. Foundations of Differential									
	Geometry, Inter science Publishers, 1963.									
	3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate									
	Texts in Mathematics, Springer-Verlag 1978.									
	4. J.A. Thorpe <i>Elementary topics in Differential Geometry</i> , 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									

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

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

Title of the	e Course	PROJECT WITH VIVA VOCE							
Paper Number         CORE IVX									
Category	Core	Year	II		Credits	7	Cou	rse	23PMAPR01
		Semester	IV				Cod	e	
Instructional		Lecture		Tutorial		Lab Practice		Total	
Hours		10						10	
per week									
Pre-requis	ite	UG Level	Math	nemat	ics				

### **ELECTIVE COURSES**

Courses are grouped (Group A to Group F) so as to include topics from Pure Mathematics(PM), Applied Mathematics(AM), Industrial Components(IC) and IT Oriented(ITC) courses for flexibility of choice by the stakeholders / institutions.

Semester I : Elective I and Elective II

Elective I to be chosen from Group A and Elective II to be chosen from Group B

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

Title of the	Course	NUMBER TH	EOR	YAND CR	<b>YPTOGR</b> A	<b>APH</b> Y	ζ		
Paper Num	ber	ELECTIVE							
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE11	
		Semester	T	-		Cod	e		
		Beinester					T		
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ice	Total		
per week		4	4 1 5						
Pre-requisi	te	UG level Numbe	r Theo	ory			1		
<b>Objectives</b> <b>Course</b>	of the	<ul> <li>To understand fundamental number-theoretic algorithms such as the Euclidean algorithm, the Chinese Remainder algorithm, binary powering, and algorithms for integer arithmetic.</li> <li>To understand fundamental algorithms for symmetric key and publickey cryptography.</li> <li>To understand the number-theoretic foundations of modern cryptography and the principles behind their security.</li> <li>To implement and analyze cryptographic and number-theoretic algorithms.</li> </ul>							
		Elementary Nun divisibility and factoring. Chapter 1 UNITII : Introduction to C Enciphering matri Chapter 3 UNITIII : Finite Fields, Qua UNITIV: Public Key Crypt Chapter 4 UNITV:	nber ' Euclio Classic ices D adratic ograph	Theory: Tin dean algorit al Crypto sy ES Residues an	ne Estimate thm – Con ystems – So d Reciprocit	es foi gruend me sin y (Cha	r doin ces – mple o	ng arithmetic – Application to crypto systems –	
		Primality, Factori (Chapter 5, sectio	ng, Ell ns 1,2	liptic curves ,3 &5 (omit	and Elliptic section 4), C	curve hapter	crypto 6, sec	o systems ctions 1& 2 only)	

Extended Professional Component	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	Knowledge, Problem Solving, Analytical ability, Professional Competency,
this course	Professional Communication and Transferrable Skill
<b>Recommended Text</b>	1. Neal Koblitz, A Course in Number Theory and Cryptography,
	Springer-Verlag, New York, 1987
Reference Books	1. I.Niven and H.S.Zuckermann, An Introduction to Theory of Numbers
	(Edn. 3), Wiley Eastern Ltd., New Delhi, 1976
	2. David M.Burton, Elementary Number Theory, Brown Publishers,
	Iowa,1989
	3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number
	Theory, Springer Verlag, 1972
	4. N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.
Website and	1. https://nptel.ac.in/courses/111101137
a Laaming Sauras	2. https://archive.nptel.ac.in/courses/106/103/106103015/
e-Learning Source	3. https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Students will be able to

CLO 1: Illustrate the implications of properties of divisibility and primes

CLO 2: Distinguish the DES and the AES.

CLO 3: Understanding the Law of Quadratic Reciprocity & Quadratic Residues.

**CLO 4:** Define the fundamentals of cryptography, such as encryption, Authentication and digital signature.

CLO 5:Explain how elliptic curves are used in certain Crypto-graphic algorithms.

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

Title of the	Course	GRAPH THE	ORY	AND APPI	ICATION	S					
Paper Num	ıber	ELECTIVE		•				-			
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE12			
		Semester	Ι	-		Cod	e				
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ice	Tota	ıl			
per week		4	1				5				
Pre-requisi	te	UG level Graph	UG level Graph Theory								
Course Out	tline	UNIT I Basi	c Re	sults: Intr	oduction-Ba	asic	Conc	epts-Subgraphs-			
		Degrees of Vert	ices -	- Paths and	Connected	ness -	- Auto	omorphism of a			
		Simple Graph.	(Cha	pter 1: Se	ctions 1.1	- 1.6	5). D	irected Graphs:			
		Introduction-Ba	sic Co	oncepts-Tou	rnaments.						
		(Chapter 2 : Sections 2.1 - 2.3).									
		UNIT II Connectivity and Trees: Connectivity: Introduction-Vertex									
		cut and Edge	Cut-C	Connectivity	and Edge	Con	nectiv	vity.(Chapter 3:			
		Sections 3.1- 3.	3). Tr	ees: Introdu	ction-Defin	ition,	Char	acterization and			
		Simple Properties-Centers and Centroids- Cutting the Number of									
		Spanning Trees-	Spanning Trees-Cayley's Formula. (Chapter 4: Sections 4.1- 4.5).								
		UNIT III Indep	bende	nt Sets, Ma	tchings and	Cyc]	les: Ir	ndependent Sets			
		and Matchings	: Int	roduction-V	ertex-Indep	ender	nt Se	ets and Vertex			
		Coverings-Edge	-Inde	pendent set	s-Matching	s and	Facto	ors-Matchings in			
		Bipartite Graphs. (Chapter 5: Sections 5.1- 5.5) . Cycles: Introduction-									
		Eulerian Graphs	Hami	iltonian Gra	phs. (Chapt	er 6:	Sectio	ons 6.1- 6.3).			
		UNIT IV Grap Graphs-Edge co Chromatic Poly 7.2.3 only) ,7.6,	<b>h Col</b> loring nomia 7.8, a	orings: Intr gs of Graphs als.(Chapter and 7.9).	oduction-V s-Kirkman's 7: Sections	ertex s Scho 7.1 ,	colori oolgir 7.2 ,7	ngs-Critical l- Problem- .3 (7.2.1 &			
		UNIT V Planar	ity: Ir	troduction-	Planar and	Non	plana	r Graphs –Euler			
		Formula and its	s Con	sequences	K and K ,3	3 are	Nonp	olanar Graphs –			
		Dual of a Plane Graph- The Four-Color Theorem 5 3 and the Heawoo									
		Five- Color Theorem-Hamiltonian Plane Graphs-Tait									
		Coloring.(Chapt	ter 8:	Sections 8.1	l - 8.6 ,8.8 a	and 8.	9).				
Extended Component	Professional	Questions related UPSC / TRB / NE	to the ET / U	e above topic GC – CSIR /	s, from vario GATE / TN	ous co PSC /	mpetit others	tive examinations s to be solved			
		(To be discussed	during	the Tutorial	hour)						

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						
Recommended Text	1. R.Balakrishnan and K.Ranganathan, Text Book of Graph Theory,						
	(2nd Edition), Springer, New York, 2012.						
<b>Reference Books</b>	1. J.A.Bondy and U.S.R. Murty, Graph Theory with Applications,						
	North Holland, New York, 1982.						
	2. Narasing Deo, Graph Theory with Application to Engineering and						
	Computer Science, Prentice Hall of India, New Delhi. 2003.						
	3. F. Harary, Graph Theory, Addison - Wesely Pub. Co. The Mass.						
	1969.						
	4. L. R Foulds, Graph Theory Application, Narosa Publ. House,						
	Chennai, 1933.						
Wahada and	144 m. //m. ath farmer and 144 m. //a and m. it a day/a annual ////ath and it a						
website and	<u>nttp://matnforum.org</u> , <u>nttp://ocw.mit.edu/ocwweb/Mathematics</u> ,						
e-Learning Source	http://www.opensource.org, www.mathpages.com						

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

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

Title of the	Course	FORMAL LA	NGU	AGES AN	DAUTOM	ATA '	THE	ORY		
Paper Num	ıber	ELECTIVE								
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE13		
		Semester	Ι			Cod	e			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tota	l		
per week		4	1				5			
	1		-			11.00				
Objectives	of the	• To teac	h the	student to	o identify (	differ	ent fo	ormal language		
Course			ind th	eir relations	snips theoretical	four	ndatio	n for designing		
		compile	rs	student the	liteoretical	IOUI	luatio	li ioi designing		
		To teach	the s	tudent to us	e the ability	y of a	pplyir	ng logical skills.		
		• Teach t	he stu	ident to pro	ve or dispr	ove t	heore	ms in automata		
		theory u	sing i	ts propertie	s					
		• To teach	the s	tudent the t	echniques f	or inf	ormat	ion processing.		
		• Understand the theory behind engineering applications.								
Course Out	tline	UNIT I Fundamentals: Strings, Alphabet, Language, Operations,								
		Finite state machine, definitions, finite automaton model, acceptance of								
		strings, and languages, FA, transition diagrams and Language								
		recognizers.								
		Finite Automata: Deterministic finite automaton, Non deterministic finite								
		automaton and NFA with $\varepsilon$ transitions - Significance, acceptance of								
		languages. Conversions and Equivalence : Equivalence between NFA with								
		and without $\varepsilon$ transitions, NFA to DFA conversion, minimization of FSM,								
		equivalence betw	een tv	wo FSMs, F	inite Autom	ata w	ith ou	tput- Moore and		
		Melay machines.								
		UNIT II Regu	lar 1	Languages	Regular	sets,	regul	ar expressions,		
		identity rules,	Conv	version fin	ite Automa	ata f	or a	given regular		
		expressions, Conversion of Finite Automata to Regular expressions.								
		Pumping lemma of regular sets, closure properties of regular sets								
		(proofs not requ	ired).							
			,							

	UNIT III Grammar Formalism: Regular grammars-right linear and
	left linear grammars, equivalence between regular linear grammar and
	FA, inter conversion, Context free grammar, derivation trees, sentential
	forms. Right most and leftmost derivation of strings.
	Context Free Grammars: Ambiguity in context free grammars.
	Minimisation of Context Free Grammars. Chomsky normal form,
	Greibach normal form, Pumping Lemma for Context Free Languages.
	Enumeration of properties of CFL (proofs omitted).
	<b>UNIT IV Push Down Automata:</b> Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA. LINEAR BOUNDED AUTOMATA(LBA):LBA,context sensitive grammars ,CS languages
	on TM. Commetable for efforts are serviced a service of the servic
	of IM, Computable functions, recursively enumerable languages.
	(presets not required)
	(proors not required).
	Computability Theory: Chomsky hierarchy of languages, linear
	bounded automata and context sensitive language, LR(0) grammar,
	decidability of, problems, Universal Turing Machine, undecidability of
	posts. Correspondence problem, Turing reducibility, Definition of P
	and NP problems, NP complete and NP hard problems.
Extended Professional Component	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 course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. "Introduction to Automata Theory Languages and Computation".
	Hopcroft H.E. and Ullman J. D. Pearson Education.
	<ol> <li>2. Introduction to Theory of Computation - Sipser 2nd edition</li> </ol>
	<ul><li>2. Introduction to Theory of Computation - Sipser 2nd edition</li><li>Thomson</li></ul>

Reference Books	<ol> <li>Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.</li> <li>Introduction to languages and the Theory of Computation ,John C</li> </ol>
	Martin, TMH
	3. "Elements of Theory of Computation", Lewis H.P. & Papadimition
	C.H. Pearson /PHI.
	4. Theory of Computer Science and Automata languages and
	computation -Mishra and Chandrashekaran, 2nd edition, PHI.
	5. Theory of Computation, By K.V.N. Sunitha and N.Kalyani
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

Student will have the ability to

- Apply knowledge in designing or enhancing compilers.
- Design grammars and automata (recognizers) for different language classes.
- Apply knowledge in developing tools for language processing or text processing.

Title of the	Course	PROGRAMMING IN C++ AND NUMERICAL ANALYSIS							
Paper Num	lber	ELECTIVE							
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE14	
		Semester	Ι	-		Cod	e		
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	al	
per week		4	1 5						
Objectives Course	of the	This courses introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.							
Course Out	tline	UNIT-I Princip	oles o	f OOP-Tok	ens-Expres	sions	, Co	ntrol Structures-	
		Functions-Class	es and	d Objects-co	onstructors	and d	estru	ctors.	
		Chapter 1 to 6							
		UNIT-II Opera	tor O	verloading	and type C	onver	rsion	s - Inheritance -	
		Pointers, Virtua	l Fun	ctions and l	Polymorphi	sm-M	lanag	ging Console I/O	
		Operations-Wor	king v	with Files .					
		Chapter 7 to 11							
		UNIT-III Finite Digit Arithmetic and Errors Floating point							
		arithmetic - Propagated Error - Generated Error - Error in Evaluation							
		of a function f(	x)	Non-linear	Equations:	Bised	ction	method- Secant	
		Method - Regula Falsi Method - Newton's method - Muller's method -							
		Fixed Point met	hod -	Chapters 1,	2 : Only 2.1	to 2.	.6		
		<b>UNIT-IV</b> System of Linear Equations Gauss- Elimination Method -							
		UNIT-IV System of Linear Equations Gauss- Elimination Method Crout's method - Inverse of a matrix - Condition numbers and errors Jacobi's method - Gauss-Seidel Method - Relaxation method Numerical Differentiation and Integration: Numerical Differentiation Numerical Integration - Newton-Cotes Formulas - Gaussia Quadrature - Double Integral Chapter 3 and 5 : 5.1 to 5.5 and 5. (omit 5.6)							
		Differential Ec	uatio <sup>*</sup>	ns:Single	• Step meth	od-Ri	inge	-Kutta Method-	
		Multi-step methods Chapter 6: 6.1 to 6.4 (omit 6.5)							
			ous e	napter of of	1 to on (on		)		
Extended Component	Professional	Questions related to the above topics, from various competities examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC others to be solved						ous competitive GATE / TNPSC /	
		(To be discussed	l durii	ng the Tutor	rial hour)				
Skills acq this course	uired from	Knowledge, Pro Professional Com	blem S munic	Solving, Ana cation and Tr	alytical abilit ansferrable S	ty, Pro Skill	ofessi	onal Competency,	

Recommended Text	1. E. Balagurusamy, Object Oriented Programming with C++, Tata
	McGraw Hill, New Delhi, 1999.
	2. Devi Prasad, An Introduction to Numerical Analysis (3rd edn)
	Narosa Publishing House, New Delhi, 2006.
Reference Books	1. D. Ravichandran, Programming with C++, Tata McGraw Hill, New Delhi, 1996
	<ol> <li>Conte and de Boor, Numerical Analysis, McGraw Hill, New York,</li> <li>1990</li> </ol>
	3. John H.Mathews, Numerical Methods for Mathematics, Science and
	Engineering (2nd Edn.), Prentice Hall, New Delhi, 2000
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Title of the	Course	LIE GROUPS	and I	JE ALGE	BRAS						
Paper Num	ıber	ELECTIVE									
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE15			
		Semester	Ι	-		Code					
Instruction	al Hours	Lecture	Tuto	rial	Lab Pract	ice	Tota	1			
per week		4	1 5								
Pre-requisi	te	UG level linear a	lgebra	and matrix	groups.						
Objectives Course	of the	<ol> <li>In physics, Lie groups appear as symmetry groups of physics, and their Lie algebras (tangent vectors near the id may be thought of as infinitesimal symmetry motions.</li> <li>Lie algebras and their representations are used extensively in physics.</li> </ol>									
Course Out	tline	<b>UNITI:</b> Matrix Li	e Gro	ups							
		Chapter 1									
		UNITII: The Mat	rix Ex	ponential							
		Chapter 2									
		UNITIII:Lie Alg	ebras								
		Chapter 3									
		UNITIV:Basic Representation Theory									
		Chapter 4									
		UNITV:Semisimple Lie Algebras									
		Chapter 7									
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved									
		(To be discussed during the Tutorial hour)									
Skills acq this course	uired from	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill									
Recommen	ded Text	1. Brain Hall, Lie Groups, Lie Algebras and Representations: An									
		Elementary Introduction (Second Edition), Springer, USA, 2015.									
Reference I	Books	I. V. S. Var Sringer 1	adaraj 984.	an, Lie grouj	ps, Lie alget	oras an	d their	representations,			
		2. Brian Hal	ll, Lie	groups, Lie a	algebras and	l repres	sentati	ons, Springer			
		3. Barry Sin	non, R	epresentatio	ns of finite a	and con	mpact	groups, AMS			
		1996. 4 AWKn	ann F	Representatio	n theory of	semisr	ninle I	ie groups An			
		overview	based	on example	s, Princeton	univer	sity pr	ress 2002.			
		5. S. Kumar	esan S	S, A course in	n differentia	l geom	netry an	nd Lie groups,			
		Texts and New Dell	i Kead hi, 200	1ngs 1n Math )2.	ematics, 22.	Hindu	istan E	SOOK Agency,			

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

Website and	1.	https://archive.nptel.ac.in/courses/111/108/111108134/
e-Learning Source	2.	https://www.digimat.in/nptel/courses/video/111108134/L42.html

Students will be able to

**CLO 1:** demonstrate systematic understanding of key aspects of Matrix Lie Groups and Lie Lie groups

**CLO 2:** Determine the exponential of a matrix.

CLO 3:Differentiate Lie groups and Lie Algebras

**CLO 4:** Find the representation of  $s_1(2; C)$ .

**CLO 5:**Explain reductive Lie algebra

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

Title of the	Course	MATHEMATICAL PROGRAMMING								
Paper Num	ıber	ELECTIVE								
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE16		
		Semester	Ι			Cod	e			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	al		
per week		4	1				5			
Objectives	of the	I his course introduces advanced topics in Linear and non-linear								
Course		Programming								
Course Out	tline	UNIT-I INTE	GER	LINEAR I	PROGRAM	IMI	NG:	Types of Integer		
		Linear Program	ming	Problems -	Concept of	Cutti	ing P	lane - Gomory's		
		All Integer Cutt	ing P	Plane Metho	od - Gomor	y's n	nixed	Integer Cutting		
		Plane method	- Bra	unch and H	Bound Met	hod.	- Z	ero-One Integer		
		Programming.	Dynaı	nic Progra	mming: Cł	naract	erist	ics of Dynamic		
		Programming H	Proble	em - Deve	eloping Op	timal	De	cision Policy -		
		Dynamic Progra	mmir	ng Under Ce	ertainty - DI	P app	roacł	n to solve LPP.		
		Chapter-7: 7.1 -	7.7 C	hapter-20: 2	20.1 - 20.5					
		UNIT-II C	LASS	SICAL	OPTIMIZ	ATIO	DN	<b>METHODS:</b>		
		Unconstrained C	Optim	ization - Co	nstrained M	Iulti-	varia	ble Optimization		
		with Equality C	Constr	aints - Cor	strained M	ulti-v	varial	ole Optimization		
		with inequality	Co	onstraints 1	Non-linear	Prog	gram	ming Methods:		
		Examples of NI	_PP -	General N	LPP - Grap	hical	solu	tion - Quadratic		
		Programming - Wolfe's modified Simplex Methods - Beale's Method								
		Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4								
		UNIT-III THEORY OF SIMPLEX METHOD: Canonical and Standard								
		torm of LP - Slack and Surplus Variables - Reduction of any Feasible								
		solution to a Basic Feasible solution - Alternative Optimal solution -								
		resolutions - Dege	onerac	v and its resc	olution	ome	comp	incations and then		
		Chapter-25: 25.1	- 25 4	25 6-25 9	Jution.					
		UNIT-IV REVISED SIMPLEX METHOD: Standard forms for								
		Revised simplex Method - Computational procedure for Standard form								
		Kevised simplex Method and Povised simpley Method								
		Rounded Var	iables	IP pr	oblem: T	he 'he	simi	nlex algorithm		
		Chapter-26: 26 1	1 - 26	A Chapter-	38.281.28	2	Shinj	siex argorithin		
		UNIT-V DADA	$\frac{1-20}{MFT}$	PIC I INF	<b>A P PROC</b>	.2 DAN	или	NC · Variation in		
		the coefficients	ci	Variations	in the Riv	aht h	and	side bi Goal		
		Programming: I		ance betwee	n I P and (	GP ai	oprog	side, or . Ooar		
		Goal Program	ning	- Goal F	Programmin	σΝ	Iodel	formulation -		
		Graphical Solution Method of Goal Programming - Modified Simpley								
		method of Goal Programming								
		Chapter-29: 29.1 - 29.3								
Extended	Professional	Questions related	to the	above topic	s, from vario	ous co	mpet	itive examinations		
Component		UPSC / TNPSC / others to be solved								
1		(To be discussed	during	the Tutorial	hour)					
Skills acq	uired from	Knowledge, Prol	olem S	Solving, Ana	lytical abilit	y, Pro	ofessi	onal Competency,		
this course		Professional Com	munic	ation and Tr	ansferrable S	kill				

<b>Recommended Text</b>	1.J.K.Sharma, Operations Research, Theory and Applications, Third
	Edition (2007) Macmillan India Ltd.
Reference Books	1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice -
	Hall of India Private Limited, New Delhi, 1997.
	2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7th
	Edition) TataMcGraw Hill ompany, New Delhi, 2001.
	3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization
	(2nd Edition) Prentice Hall Pvt Ltd., New York, 1979
	4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern
	Ltd. New Delhi. 1990
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Title of the	Course	FUZZY	Y SE'	TS AND 1	<b>FHEIR A</b>	PPL	ICA	TIONS	
Paper Num	ber	ELECTIVE							
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE17	
		Semester	Ι	-		Cod	e		
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ice	Tot	tal	
per week		4 1 5							
Objectives	of the	This course intro	oduce	s advanced	topics in Li	near	and r	non-linear	
Course		Programming							
Course Out	tline	Unit I Fuzzy s	sets:	Fuzzy sets	– Basic t	ypes	- E	Basic concepts -	
		Characteristics	– Sig	gnificance	of the par	adign	n sh	ift – Additional	
		properties of $\alpha$	- Cut	s (Chapter	1: Sections	1.3 t	o 1.5	5 and Chapter 2:	
		Sections 2.1)							
		Unit II Fuzzy S	Sets V	ersus CRI	SP Sets: Re	eprese	entati	on of Fuzzy sets	
		- Extension prir	nciple	of Fuzzy se	ets – Operat	tion o	n Fu	zzy Sets – Types	
		of Operation – H	Fuzzy	complemen	nts. (Chapte	r 2: S	ectio	ons 2.2 to 2.3 and	
		Chapter 3: Secti	ons 3	.1 to 3.2)					
		Unit III Opera	ations	on Fuzzy	Sets: Fuz	zy in	terse	ction – t-norms,	
		Fuzzy unions –	t cond	orms – Com	binations o	f ope	ratio	ns – Aggregation	
		operations. (Cha	npter 3	3: Sections 3	3.3 to 3.6)				
		Unit IV Fuzzy	Arit	hmetic:Fuz	zy number	s – L	ingu	iistic variables –	
		Arithmetic ope	ration	on interv	vals – La	ttice	of	Fuzzy numbers.	
		(Chapter 4: Sect	ions 4	4.1 to 4.4)					
		Unit V Const	ructin	ng Fuzzy	Sets: Meth	nods	of c	construction: An	
		overview – Dir	ect n	nethods wit	th one exp	ert –	Dire	ect method with	
		multiple expert	s – i	ndirect me	thod with	multi	ple	experts and one	
		expert –	(	Construction	n froi	n	sa	imple data.	
		(Chapter 10: See	ctions	10.1 to 10.	7)				
Extended	Professional	Ouestions related	to the	above topic	s, from vario	ous co	mpet	itive examinations	
Component		UPSC / TNPSC /	others	s to be solved	1		F		
		(To be discussed	during	the Tutorial	hour)				
Skills acq this course	uired from	Knowledge, Pro Professional Com	blem S munic	Solving, Ana cation and Tr	alytical abilitansferrable S	ty, Pro Skill	ofessi	onal Competency,	
Recommen	ded Text	1. G.J. Klir, and	d Bo	Yuan, Fuzz	y Sets and	fuzz	y Lo	ogic: Theory and	
		Applications, Pr	entice	e Hall of Inc	lia Ltd., Ne	w De	lhi, 2	2005.	

<b>Reference Books</b>	1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied							
	Publishers, Chennai, 1996.							
	2. A.Kaufman, Introduction to the Theory of Fuzzy Subsets, Academic							
	Press, New York, 1975.							
	3. V.Novak, Fuzzy Sets and Their Applications, Adam Hilger, Bristol,							
	1969.							
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,							
e-Learning Source	http://www.opensource.org, www.mathpages.com							

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

Title of the	Course	DISCRETE MATHEMATICS							
Paper Num	ıber	ELECTIVE							
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE18	
		Semester	Ι			Cod	e		
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	tal	
per week		4	1				5		
Objectives	of the						•		
Course									
Course Out	tline	UNIT I The Foundations: Logic and Proofs : Propositional -							
		Applications of	Propo	sitional -Pi	opositional	Equi	vale	nces - Predicates	
		and Quantifiers	. (Ch	apter 1: S	ections 1.1	- 1.	3).	Algorithms: The	
		Growth of Funct	tions.	(Chapter 3	: Section 3.	2).			
		UNIT II Count	ing: 7	The Basics of	of Counting	- The	Pige	eonhole Principle	
		-Permutations a	and (	Combinatio	ns - Gener	ralize	d P	ermutations and	
		Combinations	- Ge	enerating	Permutation	ns ai	nd	Combinations .	
		(Chapter 5: Sect	ions 5	5.1- 5.3, 5.5	and 5.6).				
		UNIT III A	Advan	ced Cour	ting Tech	niqu	es:	Applications of	
		Recurrence Re	elatior	ıs - Solv	ring Linea	r R	ecuri	rence Relations	
		Generating Functions . (Chapter 6: Sections 6.1, 6.2 and 6.4).							
		UNIT IV BO	NIT IV Boolean Algebra: Boolean Functions- Representing						
		Boolean Function	ons - ]	Logic Gates	s - Minimiz	ation	of C	Circuits. (Chapter	
		10: Sections 10.	1 -10.	4).					
		UNIT V Modeling Computation: Finite-State machines with Output-							
		Finite-State mad	chines	with No C	Output-Turin	ng Ma	achir	nes. (Chapter 12:	
		Sections 12.2, 12	2.3 an	d 12.5).					
Extended	Professional	Questions related	to the	above topic	s, from vario	ous co	mpet	itive examinations	
Component		UPSC / TNPSC /	others	to be solved	l				
~		(To be discussed	during	the Tutorial	hour)	_		. ~	
Skills acq	uired from	Knowledge, Prol	blem S	Solving, Ana	lytical abilit	y, Pro	ofessi	onal Competency,	
unis course									
Recommen	ded Text	1. Kenneth H.Rosen, Discrete Mathematics and it's Applications,7th							
		Edition, WCB /	McGı	aw Hill Ed	ucation ,Ne	w Yoi	rk,20	008.	

<b>Reference Books</b>	1. J.P. Trembley and R.Manohar, Discrete Mathematical Structures									
	applications to Computer Science, Tata McGraw Hills, New Delhi.									
	2. T.Veerarajan,Discrete Mathematics with Graph Theory and									
	Combinatorics, Tata McGraw Hills Publishing Company Limited ,7th									
	Reprint,2008.									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org, www.mathpages.com									

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

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

### Semester II : Elective III and Elective IV

Elective III to be chosen from Group C and Elective IV to be chosen from Group D

Title of the	Course	ALGEBRAIC TOPOLOGY								
Paper Num	lber	ELECTIVE								
Category	Elective	Year	Ι	Credits	3	Course Code		23PMAE21		
		Semester	Π							
							r			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	tal		
per week		3	1				4			
Objectives	of the	To introduce the	ideas	s of algebra	ic topology	to oth	her b	ranches of		
Course		Mathematics								
Course Out	tline	UNIT I CALCU	LUS I	N THE PLA	ANE: PATH		EGR	ALS		
		Angles and De	forma	tions - Dif	fferential fo	rms	and	path Integrals -		
		Independence of	Path	- Criterion f	for exactness	s. Ang	gles a	and Deformations:		
		Angle functions a	nd W	inding numb	ers - Repara	metriz	zing a	and Deforming the		
		Paths. Winding N	Numbe	ers. Definitio	on - Homoto	opy ai	nd Re	eparametrization -		
		Varying the Point	- Deg	rees and Loc	cal Degrees.					
		Chapter 1 : (a) to (c); Chapter 2: only (a) and (b) Chapter 3 : (a) to (d)								
		UNIT II COHOMOLOGY AND HOMOLOGY								
		De Rham Cohomology and the Jordan Curve Theorem. Definition of the De								
		Rham Graphs - The Coboundary map - the Jordon Curve Theorem -								
		Applications and	l Var	iations. Ho	mology: Ch	nains,	Cyc	les, and HOU -		
		Boundaries, H1U , and Winding Numbers - Chains on Grids - Maps and								
		Homology - The First Homology Group for General Spaces. Chapter 5: (a) to								
		(d) Chapter 6: (a) to (e)								
		UNIT III HOLE	ES AN	D INTEGR	ALS					
		Multiply connected regions - Integrations over continuous Paths and Chains - Periods of Integrals - Complex Integration Mayer-Victoris: The Boundary map - Mayer-Victoris for Homology - Variations and applications - Mayer- Victoris for Cohomology								
		Chapter 9: (a) to (	u) Ch	apter 10: (a)	ιο ( <b>a</b> )					

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

	UNIT IV COVERING SPACES AND FUNDAMENTAL GROUPS
	Covering Spaces: Definition - Lifting paths and Homotopies - G-coverings -
	Covering Transformations. The Fundamental Groups: Definitions and Basic
	Properties - Homotopy - Fundamental Group and Homology. Fundamental
	Groups and Covering Spaces: Fundamental Group and Coverings -
	Automorphisms of Coverings - The Universal Covering - Coverings and
	Subgroups of the Fundamental Group Chapter 11 : (a) to (d) Chapter 12 : (a)
	to (c) Chapter 13: (a) to (d)
	UNIT V THE VAN KAMPEN THEOREM G-Coverings from the
	Universal Covering - Patching Coverings together - The Van Kampen
	Theorem Cohomology: Patching Coverings and Cech cohomology - Cech
	Cohomology and Homology - De Rham Cohomology and Homology - Proof
	of Mayer -Victoris for De Rham Cohomology. Chapter 14 : (a) to (d) ;
	Chapter 15: (a) to (d)
Extended Professional	Questions related to the above topics, from various competitive examinations
Component	UPSC / TNPSC / others to be solved
~ ~ ~ ~	(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1.William Fulton, Algebraic Topology - A First Course, Springer-Verlag, New
	York, 1995
<b>Reference Books</b>	1. M.K.Agoston, Algebraic topology- A First Course, Marcel Dekker, 1962
	2. Satya Deo, Algebraic Topology, Hindustan Book Agency, New Delhi,
	2003.
	3. M.Greenberg and Harper, Algebraic Topology-A First course,
	Benjamin/Cummings, 1981.
	4. C.F. Maunder, Algebraic topology, Van Nastrand, New York, 1970 5. J.R.
	Mukres, Topology, Prentica Hall of India, New Delhi, 2002 (3rd Indian Print)
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Title of the	Course	MATHEMATICAL STATISTICS								
Paper Num	ıber	ELECTIVE								
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE22		
		Semester	Π			Cod	e			
Instruction	al Hours	Lecture	ecture Tutorial Lab Pra		Lab Practi	ce	Tot	al		
per week		3	3 1 4							
Objectives	of the	UG level Mathematical Statistics								
Course	.1.									
Course Out	tline	Unit I Probabi	lity a	nd Randor	n Variable	s: Pro	obabi	lity – Axioms –		
		Combinatorics,	Prob	ability on	finite samp	ple s	paces	s – Conditional		
		probability and	Baye	's theorem	- Independ	ence	of ev	vents – Random		
		variables – Prob	abilit	y distributio	on of a rando	om va	riabl	le – Discrete and		
		continuous rand	dom	variables	- Function	of	a ra	andom variable.		
		(Chapter 1: Sect	ions 1	.3 to 1.6 an	d Chapter 2	: Sec	tions	2.2 to 2.5)		
		Unit II Mom	ents	and Gene	erating Fu	nctio	ns:	Moments of a		
		distribution fur	nction	– Gener	rating func	tions	_	Some moment		
		inequalities. (Chapter 3: Sections 3.2 to 3.4)								
		Unit III Multiple Random Variables: Multiple random variables –								
		Independent random variables – Functions of several random variables.								
		(Chapter 4: Sect	er 4: Sections 4.2 to 4.4)							
		Unit IV Mul	ltiple	Random	Variables	5 (C	ontd	.): Covariance,		
		Correlation and moments - Conditional expectation - Some discrete								
		distributions – Some continuous distributions. (Chapter 4: Sections 4.5								
		and 4.6 and Chapter 5: Sections 5.2 to 5.3)								
		Unit V Limit 7	Theor	ems: Mode	s of conver	gence	- W	eak law of large		
		numbers – Stro	ong la	w of large	numbers	– Ce	ntral	limit theorems.		
		(Chapter 6: Sections 6.2 to 6.4 and 6.6)								
Extended	Professional	Questions relate	ed to	the abov	e topics, f	rom	vario	ous competitive		
Component		examinations UPSC / TNPSC / others to be solved								
01.11	. 1 . 6	(To be discussed	1 duri	ng the Tuto	rial hour)		<u> </u>	1.0		
Skills acq this course	uired from	Knowledge, Prol Professional Com	olem S munic	solving, Ana ation and Tr	ansferrable S	y, Pro Skill	otessi	onal Competency,		
Recommen	ded Text	1. V.K. Rohatg	i and	A. K. MI	D Ehsanes	Saleh	An	introduction to		
		probability and	Statis	tics, John V	Viley Pvt, S	ingap	ore, 2	2001.		

<b>Reference Books</b>	1. G.G. Roussas, A First Course in Mathematical Statistics, Addition
	Wesley Publ. Co. Mass, 1973.
	2. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley,
	New York, 1963.
	3. E.J. Dudewisg and S.N. Mishra, Modern Mathematical Statistics,
	John Wiley, New York, 1988.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Title of the	Course	STATISTICAL DATA ANALYSIS USING R- PROGRAMMING								
Paper Num	lber	ELECTIVE								
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE23		
		Semester	Π			Cod	e			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	al		
per week		3	1		4					
Pre-requisi	te	Basic knowledge	in Coı	nputer and S	tatistics					
Objectives	of the									
Course										
Course Out	tline	UNIT I Introdu	ction	to R progra	mming: Wi	nat is l	<b>R</b> ? - 1	Installing R and R		
		Studio – R Studio	Over	view - Work	ing in the Co	onsole	- Ari	ithmetic Operators		
		– Logical Operati	ons -	Using Funct	tions - Gettin	ng He	lp in	R and Quitting R		
		Studio- Installing	and I	oading pack	ages. Data s	tructu	res, v	variables, and data		
		types in R: Crea	ting '	variables -	Numeric, Cl	naracto	er an	id Logical Data -		
		Vectors - Data F	rames	- Factors -	Sorting Nur	neric,	Chai	racter, and Factor		
		UNIT II Data Vi	isualiz	s. vation using	R: Scatter I	Plots -	Box	Plots - Scatter		
		Plots and Box- ar	nd-Wh	isker Plots 1	Fogether -Cu	istomi	ze pl	ot axes, labels,		
		add legends, and a	add co	lours.						
		UNIT III Descri	iptive	statistics in	<b>R:</b> Measu	res of	cent	tral tendency -		
		Measures of vari	ability	- Skewnes	s and kurtos	sis - S	Sumn	nary functions,		
		describe functions	s, and	descriptive s	tatistics by g	roup.				
		UNIT IV Testing	g of H	ypothesis us	ing R: T-tes	t, Pair	ed Te	est, correlation,		
		Chi Square test, A	nalys	is of Varianc	e and Correl	ation				
		UNIT V Predictive Analytics: linear Regression model, Non-Linear								
		Least Square, multiple regression analysis, Logistic Regression, Panel								
		Regression Analy	sis, A	RCH Model,	GARCH me	odels,	VIF	model.		
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved								
		(To be discussed of	during	the Tutorial	hour)					
Recommen	ded Text	1. Crawley, M. J.	(2006	), "Statistics	- An introdu	ction	using	, R", John Wiley,		
		London 32.								
		2. Purohit, S.G.; C	Gore, S	S.D. and Des	hmukh, S.R.	(2015	5), "S	tatistics using R",		
		second edition. Na	$\frac{1}{2011}$	Publishing H	ouse, New L	Delhi.	Non N	Jour Vouls		
		3. Shahababa B. (2011), "Biostatistics with R", Springer, New York.								
		R". Cambridge U	nivers	ity Press Ne	w Delhi		ar pr	ogramming with		
Website an	d	1. https://cran.r-pi	oject.	org/doc/cont	rib/Owen-Tł	neRGu	iide.r	odf		
e-Learning	Source	2. https://sphweb.	bumc.	bu.edu/otlt/N	/IPH-Module	es/BS/	'R/R-	Manual/R-		
		Manual2.html								
		3. https://smac-gro	oup.gi	thub.io/ds/						
		4. https://www.ge	eksfor	geeks.org/pr	edictive-ana	<u>lysis-i</u>	<u>n-r</u>			

	Pos						PSOs				
	1	2	3	4	5	6	1	2	3		
CLO1	3	3	3	3	3	3	3	3	3		
CLO2	3	2	2	1	2	2	3	2	3		
CLO3	3	3	3	2	3	3	3	3	3		
CLO4	3	1	3	3	3	3	3	2	3		
CLO5	3	2	3	3	3	3	3	3	3		
Title of the	Course	TENSOR A	TENSOR ANALYSIS AND RELATIVITY THEORY								
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Paper Num	lber	ELECTIVE									
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE24			
		Semester	II			Cod	e				
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tota	ıl			
per week		3	1				4				
Objectives	of the	The course aims	to int	to introduce vector algebra and vector calculus and							
Course		special relativity	and r	elativistic k	tinematics,	dynai	mics a	and accelerated			
		systems.									
Course Out	tline	Unit I TENSO	OK A	LGEBRA	Systems	of	Diffe	rent orders -			
		Summation Con	nventi	on - Kron	ecker Sym	bols	- Tra	insformation of			
		coordinates in S	n - Ir	variants - (	Covariant a	nd C	ontrav	ariant vectors -			
		Tensors of Seco	nd Or	der - Mixeo	l Tensors - 2	Zero	Tenso	or - Tensor Field			
		- Algebra of Te	nsors	- Equality	of Tensors	- Sy	mmet	ric and Skew –			
		symmetric tens	ors -	Outer m	ultiplication	n, Co	ontract	tion and Inner			
		Multiplication -	Quoti	ent Law of	Tensors - R	ecipr	ocal T	Tensor of Tensor			
		- Relative Tensor - Cross Product of Vectors.									
		Chapter I : I.1 - I.3, I.7 and I.8 and Chapter II : II.1 - II.19									
		Unit II TEN	NSOR CALCULUS Riemannian Space - Christoffel								
		Symbols and their properties									
		Chapter III: III.1	and	III.2							
		Unit III TENS	OR C	CALCULUS	S (CONTD	) Cov	varian	t Differentiation			
		of Tensors - H	Riema	nn - Chris	stoffel Cur	vatur	e Ter	nsor - Intrinsic			
		Differentiation.									
		Chapter III: III.3	3 - III.	5							
		Unit IV SPI	ECIA	L THEO	RY OF	REL	ATIV	<b>ITY</b> Galilean			
		Transformation	- Ma	axwell's ec	uations -	The	ether	Theory - The			
		Principle of Rela	ativity	<i>.</i>							
		Relativistic Kir	nemati	ics : Lorent	tz Transform	matio	n equ	ations - Events			
		and simultaneit	ty -	Example -	Einstein	Train	ı - T	ime dilation -			
		Longitudinal Contraction - Invariant Interval - Proper time and Proper									
		distance - World	l line	- Example	- twin parac	dox -	additi	on of velocities			
		- Relativistic Do	ppler	effect. Cha	pter 7 : Sect	tions	7.1 ar	nd 7.2			

	Unit V RELATIVISTIC DYNAMICS Momentum - Energy -										
	Momentum - energy four vector - Force - Conservation of Energy -										
	Mass and energy - Example - inelastic collision - Principle of										
	equivalence - Lagrangian and Hamiltonian formulations. Accelerated										
	Systems : Rocket with constant acceleration - example - Rocket with										
	constant thrust .										
	Chapter 7 : Sections 7.3 and 7.4										
Extended Professional	Questions related to the above topics, from various competitive										
Component	examinations UPSC / TNPSC / others to be solved										
	(To be discussed during the Tutorial hour)										
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill										
Recommended Text	1.U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus,										
	Narosa Publishing House, New Delhi, 2004.										
	2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New										
	Delhi, 1985.										
Reference Books	1. J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949.										
	2. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge										
	University Press, 1930.										
	3. P.G.Bergman, An Introduction to Theory of Relativity, New York,										
	1942										
	4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus,										
	Cambridge, 1938.										
Website and	http://mathforum.org_http://ocw.mit.edu/ocw.web/Mathematics										
e-Learning Source	http://www.opensource.org_www.mathpages.com										
c-nearming source	http://www.opensource.org, www.inauipages.com										

Course Learning Outcome (for Mapping with POs and PSOs)

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

Title of the Course			WAV	/ELETS								
Paper Number	ELECTIVE											
Category Elective	Year	Ι	Credits	3	Cou	rse	23PMAE25					
	Semester	Π			Cod	e						
Instructional Hours	Lecture	Tuto	rial	Lab Practi	ce	Tot	al					
per week	3	1				4						
Pre-requisite	Basic Analysis an	nd Lin	ear Algebra									
Objectives of the	To know about w	vavelet	t transformat	ion and Fou	rier tr	ansfo	ormations Wavelet					
Course	series and Fourier	r serie	s, Cardinal s	pline spaces	and i	ts pro	operties, functions					
	and wavelets and	Cardiı	nal spline wa	velets.								
Course Outline	UNIT-I											
	An Over	view	: Fourier to	Wavelets -	Integr	al W	avelets Transform					
	and Time frequen	cy ana	alysis - Inve	rsion formul	as and	l dua	ls - Classification					
	of Wavelets - M	Aultire	esolution an	alysis - Sp	ines a	and	Wavelets. Fourier					
	Analysis : Fourier and Inverse Fourier Transformation - Continue											
	Convolution - The deltafunction - Fourier Transf											
	integrable functions											
	UNIT-II											
	Fourier	Fourier Analysis (contd): Fourier Series - Basic Convergence										
	Theory - Poisso	on Su	mmation Fo	ormula. Way	velet '	Trans	sforms and Time					
	Frequency Analys	sis : T	he Gabor Tra	ansforms -Sl	hort ti	me F	ourier Transforms					
	and the uncertain	nty pri	inciple - Th	e integral V	Vavele	t Tra	ansform - Dyadic					
	Wavelets - Invers	ion - I	Frames - Wa	velet Series.								
	UNIT-III											
	Cardina	al Spli	ine Analysis	: Cardinal S	Spline	spac	es -B-splines and					
	their basic proper	ties -	The time sca	ale relation a	nd an	inter	polating graphical					
	display algorithm	1 - E	B-Net repres	entations ar	nd co	mput	ation of cardinal					
	splines - Const	ruction	ns of cardi	nal splines	- cc	onstru	actions of spline					
	application formu	las - C	Construction	of Spline int	erpola	tion	formulas					
	UNIT-IV Eurotion	ond	Wavalata	· Multi ro	coluti	<b>.</b>	nalucia - Scaling					
	functions with fin	s and	i wavelets	ion - Direct	ion	um T	analysis -Scalling					
	functions with fin $L^2(\mathbf{P})$ Wavelets	ond th	o scale relat	ion - Direct	ion su	im I	Decompositions of					
	L(K) - wavelets	and u	ieli uuais									
	UNIT-V											
	Cardinal	Splin	nes Wavele	ets : Inter	polati	ng	splines wavelets					
	Compactly suppo	rted s	pline - Way	velets - Cor	nputat	ion o	of Cardinal spline					
	Wavelets - Euler	- Fre	benious Poly	nomials(12	hours)	. Ort	hogonal Wavelets					
	: Examples of ort	hogor	nal Wavelets	- Identifica	tion o	f ort	hogonal two scale					
	symbols - Constru	uction	of compactly	y supported	orthog	onal	wavelets.					
Extended Professional	Questions related	to the	above topic	s, from varic	ous co	mpeti	itive examinations					
Component	UPSC / TNPSC /	others	to be solved	ļ								
	(To be discussed of	during	the Tutorial	hour)								

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

Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency,									
this course	Professional Communication and Transferrable Skill									
<b>Recommended Text</b>	Content and Treatment as in Charles K. Chui, An introduction to Wavelets,									
	Academic Press, New York, 1992.									
<b>Reference Books</b>	1. Chui C. K. (ed) Approximation theory and Fourier Analysis, Academic									
	Press Boston, 1991.									
	2. Daribechies. I, Wavelets, CBMS-NSF Series in Appl, SIAM Philadelphia,									
	1992.									
	3. Schurnaker, L. L., Spline Functions : Basic Theory, Wiley, New York,									
	1981.									
	4. Nurnberger, G. Applications to Spline Functions, Springer Verlag, New									
	York. 1989.									
Wabsita and	1 https://archive.nptel.ac.in/courses/108/101/108101003/									
website and	1. <u>https://archive.npte1.ac.ht/courses/106/101/108101095/</u>									
e-Learning Source	2. <u>https://onlinecourses.nptel.ac.in/noc23_ee32/preview</u>									

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

Students will be able to

CLO1: Determine integral wavelet transform, Fourier and inverse Fourier Transformation

CLO2: Explain the concepts of Fourier and Wavelet series and their properties

CLO3: Understand about the spline and interpolation formula

**CLO4:** Analyze about the multi resolution analysis

CLO5: Determine about computation of cardinal spline Wavelets

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

Title of the	Course	MODELING AND SIMULATION WITH EXCEL									
Paper Num	lber	ELECTIVE						1			
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE26			
		Semester	Π			Cod	e				
							1				
Instruction	al Hours	Lecture	Tutorial		Lab Practi	ice	Total				
per week		3	1				4				
Course Out	tline	UNIT I Introdu	UNIT I Introduction- How Do We Classify Models? - An Example of								
		Deterministic M	lodelii	ng -Underst	anding the	Impo	rtant	Elements of a			
		Model									
		UNIT II Model	Build	ing with Ex	cel - Basic N	Model	- Sei	nsitivity Analysis -			
		Controls from the	Form	s Control To	ols- Scroll B	ars .	~ ~ ~				
		UNIT III Mo	delin	g and Sir	nulation:	Types	s of	Simulation and			
		Uncertainty -Inc	corpor	ating Unce	rtain Proces	ses in	n Mo	dels -The Monte			
		Carlo Sampling	Meth	nodology-Ir	nplementing	g Mo	nte (	Carlo Simulation			
		Methods-A Word About Probability Distributions -Modeling Arrivals									
		with the Poisson Distribution-VLOOKUP and HLOOKUP Functions.									
		UNIT-IV A Fin Example—Auto Worksheet - Approaches to Accuracy.	nancia bhaus Build o Po	al Example -Status of ing the ( isson Arr	—Income S Autohaus M Calculation ivals—Con	Stater Model Wo sidera	ment I -Bu rkshe ation	-An Operations hilding the Brain eet-Variation in of Modeling			
		UNIT V Suffi	cient	Sample S	ize - Build	ding	the	Data Collection			
		Worksheet -Solv	ver—	Constrained	l Optimizati	lon -E	Exam	ple—York River			
		Archaeology Budgeting –Scenarios									
Extended	Professional	Questions related	to the	above topic	s, from vario	ous co	mpet	itive examinations			
Component		UPSC /TNPSC /	others	to be solved							
		(To be discussed of	during	the Tutorial	hour)						
Skills acq	uired from	Knowledge, Prol	blem S	Solving, Ana	alytical abilit	ty, Pro	ofessi	onal Competency,			
this course		Professional Com	imunic	ation and Tr	ansferrable S	Skill					
Recommen	ded Text	1. Hector Guerro	ero . F	Excel Data /	Analysis Mo	odelir	ng and Simulation				
		Springer Heidelberg Dordrecht London New York.									
Website a	nd	http://mathforum	n.org.	http://ocw.	mit.edu/ocv	vweb	/Mat	hematics,			
e-Learning	g Source	http://www.oper	nsourc	ce.org, www	v.mathpage	s.com	1	,			

Title of the	Course	MACHINE LEARNING AND ARTIFICAL INTELLIGENCE									
Paper Num	ıber	ELECTIVE									
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE27			
		Semester	Π			Code					
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tota	1			
per week		3	1								
Pre-requisi	te						1				
Objectives	of the	To Learn about Machine Intelligence and Machine Learning									
Course		applications									
		To implement a	and a	pply machi	ne learning	algo	orithm	s to real-world			
		applications.									
		To identify and	apply	y the appro	priate macl	hine 1	learniı	ng technique to			
		classification, pa	attern	recognition	, optimizati	on an	d deci	ision problems.			
		To understand h	now to	o perform e	evaluation of	of lea	rning	algorithms and			
		model selection.									
		To understand a	To understand about the basic theory of problem solving paradigms								
		and search strate	egies i	n artificial	intelligence						
		To make the students familiar with knowledge representation,									
		planning, learnii	ng, na	tural langua	ige processi	ng an	d rob	otics			
Course Out	tline	UNIT I INTRODUCTION:Learning Problems – Perspectives and									
		Issues - Concept Learning - Version Spaces and Candidate									
		Eliminations – Inductive bias – Decision Tree learning –									
		Representation – Algorithm – Heuristic Space Search.									
		UNIT II NEURAL NETWORKS AND GEN ALGORITHMS: Neural Network Representation – Probl Perceptrons – Multilayer Networks and Back Propagation Algo – Advanced Topics – Genetic Algorithms– Hypothesis Space Se Genetic programming –Models of Evaluation and Learning.									
		UNIT - III BA	YES	IAN AND	COMPUT	ATIC	DNAL	LEARNING:			
		Bayes Theorem	1 –	Concept L	earning –	Max	imum	Likelihood –			
		Minimum Desc	riptio	n Length Pr	rinciple – E	Bayes	Optir	nal Classifier –			
		Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network –									
		EM Algorithm - Probability Learning - Sample Complexity -Finite									
		and Infinite Hyp	othes	is Spaces –	Mistake Bo	ound I	Model				

	UNIT - IV Introduction - Intelligent Agents- Problem Solving - by
	Searching - Informed Search Strategies-Optimization Problems -
	Adversarial Search-Knowledge and Reasoning - Logical Agents -
	First-Order Logic - Inference in First-Order Logic - Knowledge
	Representation
	UNIT - V Planning – Planning and Acting in the Real World -
	Uncertain knowledge and reasoning - Uncertainty - Probabilistic
	Reasoning - Probabilistic Reasoning over Time - Making Simple
	Decisions - Making Complex Decisions
Extended Professional	Questions related to the above topics, from various competitive examinations
Component	UPSC /TNPSC / others to be solved
	(To be discussed during the Tutorial hour)
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency,
this course	Professional Communication and Transferrable Skill
Recommended Text	1. Tom M. Mitchell,-Machine Learning, McGraw-Hill Education
	(India) Private Limited, 2013.
	2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern
	Approach," Third Edition, Prentice Hall of India, New Delhi, 2010.
Reference Books	1. Ethem Alpaydin,-Introduction to Machine Learning (Adaptive
	Computation and Machine Learning), The MIT Press 2004.
	2. Stephen Marsland,—Machine Learning: An Algorithmic
	Perspective, CRC Press,2009.
	3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, Andreas
	Beham, "Genetic Algorithms and Genetic Programming", CRC Press
	1 Iaylor and Francis Group.
	Edition, Tata McGraw-Hill, New Delhi, 2017.
	5. Eugene Charniak, Drew McDermott, "Introduction to Artificial
	Intelligence," Pearson, 2002.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

#### **OUTCOMES:**

On completion of the course students will be expected to:

• Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc

• Have an understanding of the strengths and weaknesses of many popular machine learning approaches

• Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning

• Be able to design and implement various machine learning algorithms in a range of real-world applications

• Understand the computation intelligence

• Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning

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

Title of the	Course	NEURAL NET	WOR	RKS							
Paper Num	lber	ELECTIVE									
Category	Elective	Year	Ι	Credits	3	Cou	rse	23PMAE28			
		Semester	II			Cod	e				
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tota	1			
per week		3	1				4				
Pre-requisi	te	Familiarity with	linear	algebra, mul	tivariate calc	culus a	nd pro	obability theory			
Objectives	of the	To know the mai	n func	lamental prin	nciples and t	echnio	ques c	of neural network			
Course		systems and invest	stigate	the principa	l neural netw	ork m	odels	and applications.			
		Acquire in-depth	cquire in-depth knowledge in Nonlinear dynamics. Apply neural networks								
		to classification and generalization problems.									
Course Out	tline	UNIT-I Neuron	Model	and Netwo	rk Architect	ures:					
		Mathematica	l N	leural Mo	del-Network	Ar	chitec	tures-Perceptron-			
		Hamming Networ	·k-Hop	ofield Netwo	rk-Learning	Rules	•				
		UNIT II Percept	ron A	rchitectures	:						
		Perceptron	Arch	itectures a	nd Learnin	g Rı	lles	with proof of			
		convergence-Supe	ervised	Hebbian Le	earning-Line	ar Ass	ociato	or.			
		<b>UNIT III Supervised Hebbian Learning:</b> The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-									
		Back Propagation-Multilaver Perceptrons.									
		UNIT IV Back Propagation:									
		Back Propagation algorithm-convergence and Generalization-									
		Performances surfaces and optimum points-Taylor series.									
		UNIT V Performance surface and performance optimizations:									
		Directional derivatives-Minima-Necessary conditions for optimality-									
		Quadratic functions-Performance optimizations-Steepest Descent Newton's									
		method-Conjugat	e Grad	lient.							
Extended	Professional	Questions related to the above topics, from various competitive examinations									
Component		UPSC / TNPSC /	other	s to be solv	red (To be d	liscuss	ed du	ring the Tutorial			
	wirad from	nour) Knowladza Brol	lam (	Solving And	lutical abilit	Dro	foncio	mal Compatanay			
this course	uneu nom	Professional Com	munic	polying, Ana	ansferrable S	y, Fic Skill	lessio	mai Competency,			
uns course		Tiolessional Com	munic			JKIII					
Recommen	ded Text	Martin T. Hagar	n, Hoy	ward B/Den	nuth and M	ark B	eale,	Neural Network			
		Design, Vikas Pu	blishir	ng House, Ne	ew Delhi, 20	02.					
Reference I	Books	1. James A.Free	eman,	David M.S	Skapura, Ne	ural	Netwo	orks Algorithms,			
		Applications and Programming Techniques, Pearson Education, 200									
		2. Robert J. Schal	koff, .	Artificial Ne	ural Networl	k, Mc	Graw-	Hill International			
		Edition, 1997.									
Website and	d	1. <u>https://np</u>	tel.ac.i	in/courses/11	7105084			0.000			
e-Learning	Source	2. <u>https://ww</u>	vw.dig	<u>gimat.in/npte</u>	I/courses/vid	$\frac{12}{12}$	<u>/1050</u>	<u>06/L01.html</u>			
		3. <u>https://ww</u>	vw.yo	utube.com/w	vatch?v=NeM	<u>1Axhl</u>	JvSak	&list=PLgMDN			
		ELGJICZ	<u>2n1399</u>	<u>9av/_U4VB</u>	SINJTIKSUA	1.14	10117				
		4. <u>https://wv</u>	vw.yo	utube.com/w	<u>atch?v=Qlhl</u>	<u>HqMn</u>	<u>d9Wo</u>				

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

Students will be able to

CLO 1: Understand and analyze different neutron network models

**CLO 2:** Understand the basic ideas behind most common learning algorithms for multilayer perceptions, radial basis function networks.

CLO 3: Describe Hebb rule and analyze back propagation algorithms with examples.

CLO 4: Study convergence and generalization and implement common learning algorithms.

**CLO 5:** Study directional derivatives and necessary conditions for optimality and to evaluate quadratic functions.

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

### Semester III : Elective V

**Elective V** to be chosen from Group E

Title of the	Course	ALGEBRAIC NUMBER THEORY									
Paper Num	ıber	ELECTIVE			-						
Category	Elective	Year	Π	Credits	3	Cou	rse	23PMAE31			
		Semester	III			Cod	e				
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ce	Tota	1			
per week		3	1				4				
Pre-requisi	te						1				
Objectives	of the	The course aims	to pr	ovide a stud	ly on modul	les ov	er rin	gs, finite fields,			
Course		algebraic extensi	ions, 1	number fiel	ds and cycle	otomi	c field	ls, Noetherian			
		rings and modul	es and	l Dedekind	rings.						
Course Out	tline	<ul> <li>UNIT I ALGEBRAIC BACKGROUND Rings and Field Factorization of Polynomials - Field Extensions - Symmet Polynomials - Modules - Free Abelian Groups.</li> <li>Chapter 1: Sec. 1.1 to 1.6</li> </ul>									
		<b>UNIT II ALGEBRAIC NUMBERS</b> Algebraic numbers - Conjugate and Discriminants - Algebraic Integers - Integral Bases - Norms an Traces - Rings of Integers									
		Chapters 2: Sec.	2.1 to	0 2.6							
		UNIT III QUA fields and cyclot factorization - Fa factorization inte	ADRA tomati actroi	ATIC AND ic fields : F zation into : lucibles.	<b>CYCLOT</b> actorization irreducibles	<b>OMI</b> n into - Exa	C <b>FIE</b> Irredu ample	<b>LDS</b> Quadratic ucibles : Trivial s of non-unique			
		Chapter 3: Sec. 3	3.1 an	d 3.2 ; Chaj	pter 4: Sec.	4.2 to	94.4				
		<b>UNIT IV</b> Prim Quadratic field Ramanujan -Nag	ne Fa s - 9 gell Tl	ctroization Consequenc heorem.	- Euclide ces of uni	an D ique	omain factor	ns - Euclidean rization - The			
		Chapter 4: Sec. 4	4.5 to	4.9							
		UNIT V IDEA Ideal - Non-uniq	LS F ue Fa	Prime Facto ctorization	rization of in Cyclotor	Ideal nic Fi	s - T elds	he norms of an			
		Chapter 5 : Sec.	5.2 to	5.4							
Extended Component	Professional	Questions related UPSC /TNPSC / o	to the others	above topic to be solved	s, from vario	ous co	mpetit	ive examinations			
		(To be discussed of	luring	the Tutorial	hour)						
Skills acq this course	uired from	Knowledge, Prot Professional Com	olem S munic	Solving, Ana ation and Tr	lytical abilit ansferrable S	y, Pro Skill	ofessio	nal Competency,			

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

<b>Recommended Text</b>	1. I. Steward and D.Tall. Algebraic Number Theory and Fermat's Last									
	Theorem (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002.									
Reference Books	1. Z.I.Bosevic and I.R.Safarevic, Number Theory, Academic Press,									
	New York, 1966.									
	2. J.W.S.Cassels and A.Frohlich, Algebraic Number Theory, Academic									
	Press, New York, 1967.									
	3. P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972.									
	4. P. Samuel, Algebraic Theory of Numbers, Houghton Mifflin									
	Company, Boston, 1970.									
	5. A.Weil. Basic Number Theory, Springer, New York, 1967.									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org, www.mathpages.com									

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

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

Title of the	Course	FLUID DYNAMICS							
Paper Num	ıber	ELECTIVE							
Category	Elective	Year	ΙΙ	Credits	3	Cou	rse	23PMAE32	
		Semester	III	_		Cod	e		
Instruction	al Hours	Lecture	Tuto	orial	Lab Practi	ice	Total		
per week		3	1				4		
Pre-requisi	te		1						
Objectives Course	of the								
Course Ou	tline	UNIT I Kin fluids - Velocity Steady and Uns	emat y of a steady	<b>ics of Flui</b> a fluid at a y flows - T	ds in Moti point –Stro he Velocity	ion: 1 eam 1 / Pote	Real ines ential	fluids and Ideal and path lines - I - The Vorticity	
		Continuity - Wo	Vector - Local and Particle Rates of Change - The Equation of Continuity - Worked Examples. (Chapter 2: Sections 2.1 - 2.8).						
		UNIT II Equa	ations	s of Motior	n of a Flui	d: Pre	essur	re at a point in a	
		fluid at rest - Pressure at a point in a moving fluid - Euler's equations							
		of Motion - Bernoulli's equation -Worked Examples - Discussion of							
		the case of steady motion under Conservative Body Forces - Some							
		flows involvin	ng a	ixial symi	metry(exam	ples	1	and 2 only).	
		(Chapters 3: Sec	ctions	3.1, 3.2, 3.4	- 3.7, 3.9).				
		UNIT III Som	e Th	ree-Dimens	sional Flow	vs: In	trodu	action - Sources,	
		Sinks and Dou	blets-	Images in	rigid infinit	e pla	ne -	Images in solid	
		spheres – Axis s	symm	etric flows.	(Chapter 4:	Secti	ons 4	4.1 - 4.4).	
		UNIT IV S	Some	Two-Dime	nsional Flo	ws: T	he S	tream Function -	
		The Complex	Veloc	ity Potentia	al for Two	Dim	ensio	onal Irrotational,	
		Incompressible	Flow	- Compl	ex Velocity	y Pot	entia	als for Standard	
		TwoDimensiona	al Flo	ws - Some	Worked Exa	ample	es - 7	Wo Dimensional	
		Image System	ns	- The	Milne-Thor	nson	Ci	ircle Theorem.	
		(Chapter 5: Sect	tions :	5.3 - 5.8).					

	UNIT V Viscous Fluid: Stress components in a real fluid - Relation
	between Cartesian Components of Stress - Translational motion of
	fluid element - The Coefficient of Viscosity and Laminar flow - The
	Navier- Stokes equation of a viscous fluid - Some solvable problems in
	viscous flow - Steady motion between parallel planes only. (Chapter 8:
	Sections 8.1 - 8.3, 8.8, 8.9 and 8.10.1).
Extended Professional	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
Component	of Se / HM Se / bluers to be solved
	(To be discussed during the Tutorial hour)
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency,
this course	Professional Communication and Transferrable Skill
Recommended Text	1. Frank Chorlton, Textbook of Fluid Dynamics, CBS Publishers &
	Distributors, 2004.
<b>Reference Books</b>	1. L.M. Milne-Thomson, Theoretical Hydrodynamics, Macmillan,
	London, 1955.
	2. G.K. Batchelor, An Introduction to Fluid Dynamics Cambridge
	Mathematical Library, 2000.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

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

Title of the Course	STOCHASTIC PROCESSES									
Paper Number	ELECTIVE									
Category Elective	Year	II	Credits	3	Cou	rse	23PMAE33			
		TTT	-		Cod	e				
	Semester	111								
Instructional Hours	Lecture	Tuto	rial	Lab Practi	ice	Total				
per week	3	1				4				
Pre-requisite						1				
Objectives of the Course										
Course Outline	UNIT I Introdu	iction	to stochast	ic process	(SP) ·	– cla	ssification of SP			
	according to state space and time domain. countable state markov									
	chain (MC). Ch	anma	n- Kolmog	orov equation	ons. (	Talcu	lation of 'n' step			
	transition proba	hility								
	UNIT II Discrete state space – continuous time MC. Kolmogorov									
	differential equations. Poisson process, birth and death process									
	.Application to	queue	s and storag	ge problem.	Rand	lom v	valk.			
	UNIT III Mar	kov p	process – c	ontinuous	time	and	continuous state			
	space - time ho	omoge	nous mark	ov process	– Ko	olmog	gorov's equation.			
	Wiener process	as a l	imit of rand	lom walk, f	irst p	assag	ge time Diffusion			
	process with Wi	ener p	process.							
	UNIT IV Stati	onary	process ar	nd time ser	ies- v	wide	sense and strict			
	sense stationary	proce	ess – movin	g average a	nd au	to re	gressive process.			
	Covariance fun	ction	- Bochner	's function	(stat	emei	nt), Khintchine's			
	representation o	f wide	e sense stati	onary proce	ess.					
	UNIT V Rene	wal t	heory – re	newal func	ction	and	its properties -			
	Elementary and	key r	enewal theo	orems.						
Extended Professional Component	Questions related UPSC /TNPSC /	to the others	above topic to be solved	s, from vario	ous co	mpet	itive examinations			
	(To be discussed	during	the Tutorial	hour)						
Skills acquired from this course	Knowledge, Pro Professional Com	blem S munic	Solving, Ana cation and Tr	alytical abili ansferrable S	ty, Pro Skill	ofessi	onal Competency,			

Recommended Text	<ol> <li>Medhi.J. (1982) Stochastic process, Wiley Eastern.</li> <li>Basu. A.K. (2003) Introduction to stochastic processes, Newsa Publishing House.</li> </ol>
Reference Books	<ol> <li>Ross. S.M. (1983) Stochastic Process, Wiley, New York.</li> <li>Karlin and First course in Stochastic Process-Vol.I&amp;II, Academic Press. Taylor.H.M. (1975)</li> </ol>
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

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

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

Title of the	e Course	MATHEMATICAL PYTHON								
Paper Num	ber	ELECTIVE								
Category	Elective	Year	Π	Credits	3	Cou	rse	23PMAE34		
		Semester	III			Cou	Coue			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practi	ice	Tot	al		
per week		3	1				4			
Pre-requisi	te	Basic computer skills, mathematical problem solving								
Objectives	of the	To demonstrate Problem Solving Techniques, Algorithmic Problem								
Course		Solving, Understanding of basic Python and Python functions in								
		mathematical problem solving								
						our		11 1 1		
Course Ou	line	UNIT-I : PRO	BLEN	1 SOLVING	J TECHNI	QUES	: P	roblem solving		
		Techniques -	Algo	orithm, flo	wchart, ps	seudo	code,	, programming;		
		Algorithms: pro	operti	es, quality	(time, sp	ace);	bui	lding blocks of		
		algorithms - stat	emen	ts, state, co	ntrol flow, f	functi	ons,	notation (pseudo		
		code, flow chart	, prog	gramming la	inguage)					
		UNIT-II :ALGO	RITHN	AIC PROBL	EM SOLVI	NG:	Algo	rithmic problem		
		solving, simple strategies for developing algorithms (iteration,								
		recursion), pseudocode for some Mathematical Problems - greatest of								
		two numbers, print n natural numbers, greatest common divisor,								
		fibonacci sequence upto n terms. Practical applications of								
		algorithms.								
		UNIT-III : INTRODUCTION TO PYTHON: Introduction to Python, Dython interpreter Modes of Dython Interpreter Values and Data								
		Python interpreter, Modes of Python Interpreter, Values and Data								
		Types, Variables, Keywords, Identifiers, Statements and Expressions,								
		Input and Out	put,	Comments,	Docstring	, Lir	ies a	and Indentation,		
		Quotation, Tup	le As	ssignment,	Operators	and	Туре	s of Operators,		
		Operator Preced	ence.			-	6.6			
			<b>DN FUNCTIONS:</b> Functions, Types of function, Function							
		definition (Sub program), Flow of Execution, Function Prototypes,								
		Parameters and	Argu	iments; Mo	dules; Cor	1011101	nais:	Boolean values		
		(if alif alap). Ita		onal (11), al	ternative (1)	l-eise	), Chà	anned conditional		
		(II-eIII-eise); Ite	ration	i: state, will	are local or	ak, co	bol a	ae, pass, Fruitiui		
		function compos	valu	recursion	ers, iocai all	iu gio	Dal S	cope,		
		UNIT V. STRING			S IN DVTH	ON: 9	String	as string slices		
		immutability str	ing fi	inctions and	1 methods	on: .	mod	28. sume suces,		
		arrays Lists 1	list o	netations	list slices	lict	met	hode list loop		
		mutability alia	sing	cloning 1	iste liet r	naram	eters	· Tunles· tunle		
		assignment tun	e as r	eturn value	15t5, 115t p	Jaram	cicis	, rupies. tupie		
Extended	Professional	Ouestions related	to the	above tonic	s. from vario	ous co	mpet	itive examinations		
Component		UPSC /TNPSC /	others	to be solved	, 110111 ( <b>u</b> 11)					
1										
		(To be discussed of	during	the Tutorial	hour)					
Skills aco	uired from	Knowledge, Prol	olem S	Solving, Ana	alytical abilit	ty, Pro	ofessi	onal Competency.		
this course		Professional Com	munic	cation and Tr	ansferrable S	Skill		· · · · · · · · · · · · · · · · · · ·		

<b>Recommended Text</b>	Allen B. Dowley, Think Python: How to Think Like a Computer Scientist,
	2 <sup>nd</sup> Edition.
<b>Reference Books</b>	1.Wes McKinney, Python for Data Analysis: Data Wrangling with
	Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018.
	2. Jake VanderPlas, Python Data Science Hand Book: Essential Tools
	for working with Data, O' Reilly, 2017.
	3. Wesley J. Chun, Core Python Programming, Prentice Hall, 2006.
	4. N.Safina Devi and C.Devamanoharan, Algorithmic Problem Solving
	and Python- A Beginner's Guide, Francidev Publications, 2023.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Students will be able to

CLO 1: Give mathematical model for real world problems

CLO 2: Design algorithms for mathematical models, analyse the efficiency and correctness of

algorithms.

**CLO 3:** Design implementable programs in Python.

**CLO 4:** Define and demonstrate the use of functions and looping using Python.

**CLO 5:**Design and implement a program to solve a real-world problem.

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

# Semester IV : Elective VI

**Elective VI** to be chosen from Group F

Title of the	e Course	ALGEBRAIC GEOMETRY								
Paper Num	ıber	ELECTIVE								
Category	Elective	Year	II	Credits	3	Course 23PMAE41				
		Semester	IV	_		Cod	e			
Instruction	al Hours	Lecture	Tuto	orial	Lab Pract	tice	Total			
per week		3	1				4			
Pre-requisi	te						1			
Objectives Course	of the									
Course Ou	tline	Unit I: Affine algebraic sets								
		Affine spaces	and	algebraic	sets, Noeth	erian	ring	s, Hilbert basis		
		theorem, affine algebraic sets as finite intersection of hypersurfaces;								
		Ideal of a set of points, coordinate ring, morphism between alg								
		sets, isomorphism. Integral extensions, Noether's normalization le								
		Unit II: Hilber	t's Ni	ıllstellensa	tz and app	licatio	ons			
		Correspondence	e betw	een radical	ideals and	algeb	raic s	ets, prime ideals		
		and irreducibl	e al	gebraic s	ets, maxi	mal	ideal	s and points,		
		contrapositive	equiv	alence be	tween affin	ne alg	gebra	s with algebra		
		homomorphism	s and	algebraic	sets with	morph	isms,	between affine		
		domains and irr	educi	ble algebra	uic sets, dec	compo	sition	of an algebraic		
		set into irreducible components. Zariski topology on affine spaces,								
		algebraic subsets of the plane.								
		Unit III: Projective spaces								
		Homogeneous c	coordi	nates, hype	erplane at in	nfinity	, pro	jective algebraic		
		sets, homogene	eous	ideals and	d projectiv	e Nu	llstel	lensatz; Zariski		
		topology on p	orojec	tive space	s. Twisted	cubi	c in	P_3(k). Local		
		properties of	plane	curves:	multiple p	points	and	tangent lines,		
		multiplicity and local rings, intersection numbers; projective plane								
		curves: Linear systems of curves, intersections of projective curves:								
		Bezout's theorem	m and	l applicatio	ns; group st	ructur	e on a	a cubic.		

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

	Unit IV: Introduction to sheaves of affine varieties
	Examples of presheaves and sheaves, stalks, sheafification of a
	presheaf, sections, structure sheaf, generic stalk and function fields,
	rational functions and local rings, Affine tangent spaces; Projective
	varieties and morphisms; Hausdorff axiom.
	Unit V: Prime spectrum of a ring: Zariskitopology, structiureaheaf,
	affine schemes, morphism of affine schemes. Elementary Dimension
	Theory, Fibres of a morphism, complete varieties, nonsingularity and
	regular local rings, Jacobian criterion, nonsingular curves and DVR's.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
	(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. W.Fulton Algebraic Curves: An introduction to algebraic geometry
	2. C. G. Gibson – Elementary Geometry of Algebraic Curves, CUP,
	3. D. S. Dummitt and R. M. Foote – Abstract Algebra, Wiley, Ch. 15.
<b>Reference Books</b>	1. J. Harris Algebraic Geometry, A first course, Springer
	2. M. Reid Undergraduate algebraic geometry, LMS 12, CUP
	3. K. Kendig – Elementary Algebraic Geometry, Springer
	4. D. Mumford – The Red Book of Varieties and Schemes, Springer
	5. I. R. Shafarevich – Basic Algebraic Geometry, Springer
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

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

Title of the	e Course	FINANCIAL MATHEMATICS									
Paper Num	ıber	ELECTIVE									
Category	Elective	Year	II	Credits	3	Cou Cod	rse e	23PMAE42			
		Semester	IV			Cou	C				
Instruction	al Hours	Lecture	Tutorial		Lab Practice		Total				
per week		3	1				4	4			
Pre-requisi	te										
Objectives	of the	•In this course,	the s	students are	on posed	to T	he ba	asic concepts of			
Course		Probability theory	ry, Th	e Central li	mit theoren	n.					
		• The concepts	of Ge	cometric Bro	ownian mot	ion, (	Optior	n pricing.			
		• The derivative	es of l	Blackschole	tormula an	id its	applic	cations.			
		• The concept of the volatility pa	of call	option on .	Dividend pa	ayıng	secur	ities, estimating			
		•The limitations	of A	rhitrage prid	ring the po	rtfolia	n sele	ction problem			
Course Out	tline	UNIT I Stocha	stic C	Order Relat	ions		5 5010				
		First-Order Stochastic Dominance -Using Coupling to Show Stochastic									
		Dominance - Li	kelih	ood Ratio (	Ordering -A	Sing	gle-Pe	riod Investment			
		Problem-Second	l-Ord	er Dominan	ce.						
		UNIT II Optim	izatio	on Models							
		Introduction- A	A De	terministic	Optimizat	ion 1	Mode	l -Probabilistic			
		Optimization Pr	oblen	18							
		UNIT III Stoch	astic	Dynamic P	rogrammi	ng					
		The Stochastic I	Dynar	nic Progran	nming Prob	lem -	Infini	ite Time Models			
		- Optimal Stopp	ing Pi	roblems							
		UNIT IV Exoti	c Opt	ions							
		Introduction -B	arrier	Options -	Asian and I	Lookt	back (	Options - Monte			
		Carlo Simulatio	n -P	Pricing Exc	tic Option	s hv	Sim	ulation - More			
		Efficient Simula	tion I	Estimators	de option	5 U y	SIII				
		Efficient Simulation Estimators									
		UNIT V Beyon	d Geo	ometric Bro	ownian Mo	tion I	Mode	ls			
		Introduction -C Comments.	rude	Oil Data - I	Models for	the C	rude	Oil Data - Final			

Extended Professional	Questions related to the above topics, from various competitive examinations				
Component	UPSC /TNPSC / others to be solved				
	(To be discussed during the Tutorial hour)				
Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency,				
this course	Professional Communication and Transferrable Skill				
<b>Recommended Text</b>	1. An Elementary Introduction to Mathematical Finance,2nd Edition				
	Sheldon M.Ross Cambridge University press 2005				
Reference Books	1. A First Course in Probability, S.M.Ross, Englewood cliffs Prentice				
	HallNJ 2002				
	2. Option Market , J.Cox M.Rubinstein, Englewood cliffs Prentice				
	HallNJ 1985				
	3. Theory of Financial decision Making ,J.E.Ingersill ,Lanjarn MD				
	Rowerman of Little Fields 1987				
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,				
e-Learning Source	http://www.opensource.org, www.mathpages.com				

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

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

Title of the	e Course	RESOURCE MANAGEMENT TECHNIQUES									
Paper Num	ıber	ELECTIVE									
Category	Elective	Year	Π	Credits	3	Cou	rse	23PMAE43			
		Semester	IV			Cod	le				
Instruction	al Hours	Lecture	Tutorial		Lab Practice		Total				
per week		3	1				4	4			
Pre-requisi	te										
Objectives Course	of the										
Course Ou	tline	UNIT I LINEAR PROGRAMMING									
		Principal compo	onents	s of decision	on problem	- M	lodeliı	ng phases – LP			
		Formulation and	d gra	phic soluti	on –Resou	rce a	llocat	ion problems –			
		Simplex method – Sensitivity analysis.									
		UNIT II DUALITY AND NETWORKS									
		Definition of dual problem - Primal - Dual relation ships - Dual									
		simplex methods - Post optimality analysis - Transportation and									
		assignment model - Shortest route problem.									
		UNIT III INTE	GER	PROGRA	MMING						
		Cutting plan al	lgorit	hm – Brai	nch and b	ound	meth	ods, Multistage			
		(Dynamic) prog	ramm	ing.							
		UNIT IV CLAS	<b>SSIC</b>	AL OPTIM	IISATION	THE	ORY				
		Unconstrained	exteri	nal problei	ns, Newto	n –	Ralpł	hson method –			
		Equality constra	ints –	Jacobean	methods – I	Lagra	ngian	method – Kuhn			
		– Tucker conditions – Simple problems.									
		UNIT V OBJECT SCHEDULING									
		Network diagram	m rep	resentation	– Critical	path 1	netho	od – Time charts			
		and resource lev	eling	– PERT.							
Extended Component	Professional	Questions related UPSC /TNPSC / o	to the others	above topic to be solved	es, from vari	ous co	ompeti	tive examinations			
		(To be discussed of	during	the Tutorial	hour)						
Skills acq this course	uired from	Knowledge, Prol Professional Com	olem S munic	Solving, Ana cation and Ti	alytical abili ansferrable	ity, Pro Skill	ofessio	onal Competency,			
Recommen	ded Text	1. H.A. Taha, "C	)perat	tion Researc	ch", Prentic	e Hal	l of In	ndia, 2002.			

<b>Reference Books</b>	1. Paneer Selvam, 'Operations Research', Prentice Hall of India, 2002								
	2. Anderson 'Quantitative Methods for Business', 8th Edition,								
	Thomson Learning, 2002.								
	3. Winston 'Operation Research', Thomson Learning, 2003.								
	4. Vohra, 'Quantitative Techniques in Management', Tata Mc Graw								
	Hill, 2002.								
	5. Anand Sarma, 'Operation Research', Himalaya Publishing House,								
	2003.								
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,								
e-Learning Source	http://www.opensource.org, www.mathpages.com								

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

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

Title of the	e Course	MATHEMATICAL PYTHON								
Paper Num	ber	ELECTIVE								
Category	Elective	Year	Π	Credits	3	Cou	rse	23PMAE34		
		Semester	III			Cou	Coue			
Instruction	al Hours	Lecture	Tutorial		Lab Practi	ice	Tot	tal		
per week		3	1				4			
Pre-requisi	te	Basic computer skills, mathematical problem solving								
Objectives	of the	To demonstrate Problem Solving Techniques, Algorithmic Problem								
Course		Solving Understanding of basic Python and Python functions in								
		methamatical problem solving								
0.0						our		11 1 1		
Course Ou	line	UNIT-I : PRO	BLEN	1 SOLVING	J TECHNI	QUES	: P	roblem solving		
		Techniques -	Algo	orithm, flo	wchart, ps	seudo	code,	, programming;		
		Algorithms: pro	operti	es, quality	(time, sp	ace);	bui	lding blocks of		
		algorithms - stat	emen	ts, state, co	ntrol flow, f	functi	ons,	notation (pseudo		
		code, flow chart	, prog	gramming la	inguage)					
		UNIT-II :ALGO	RITHN	AIC PROBL	EM SOLVI	NG:	Algo	rithmic problem		
		solving, simple	e str	ategies for	developin	ng a	Igori	thms (iteration,		
		recursion), pseudocode for some Mathematical Problems - greatest of								
		two numbers, print n natural numbers, greatest common divisor,								
		fibonacci sequence upto n terms. Practical applications of								
		algorithms.								
		UNIT-III : INTRODUCTION TO PYTHON: Introduction to Python,								
		Python interpreter, Modes of Python Interpreter, Values and Data								
		Types, Variables, Keywords, Identifiers, Statements and Expressions,								
		Input and Out	put,	Comments,	Docstring	, Lir	ies a	and Indentation,		
		Quotation, Tup	le As	ssignment,	Operators	and	Туре	s of Operators,		
		Operator Preced	ence.			-	6.6			
		UNIT-IV : PYTHON FUNCTIONS: Functions, Types of function, Function								
		definition (Sub	prog	ram), Flow	of Execut	tion,	Func	Declaration Prototypes,		
		Parameters and	Argu	iments; Mo	dules; Cor	1011101	nais:	Boolean values		
		(if alif alap). Ita		onal (11), al	ternative (1)	l-eise	), Chà	anned conditional		
		(II-eIII-eise); Ite	ration	i: state, will	are local or	ak, co	bol a	ae, pass, Fruitiui		
		function compos	valu	recursion	ers, iocai all	iu gio	Dal S	cope,		
		UNIT V. STRING			S IN DVTH	ON: 9	String	as string slices		
		immutability str	ing fi	inctions and	1 methods	on: .	mod	28. sume suces,		
		arrays Lists 1	list o	netations	list slices	lict	met	hode list loop		
		mutability alia	sing	cloning 1	iste liet r	naram	eters	· Tunles· tunle		
		assignment tun	e as r	eturn value	15t5, 115t p	Jaram	cicis	, rupies. tupie		
Extended	Professional	Ouestions related to the above topics from various competitive examinations								
Component		UPSC /TNPSC / others to be solved								
1										
		(To be discussed of	during	the Tutorial	hour)					
Skills aco	uired from	Knowledge, Prol	olem S	Solving, Ana	alytical abilit	ty, Pro	ofessi	onal Competency.		
this course		Professional Com	munic	cation and Tr	ansferrable S	Skill		· · · · · · · · · · · · · · · · · · ·		

<b>Recommended Text</b>	Allen B. Dowley, Think Python: How to Think Like a Computer Scientist,
	2 <sup>nd</sup> Edition.
<b>Reference Books</b>	1.Wes McKinney, Python for Data Analysis: Data Wrangling with
	Pandas, NumPy, and Ipython, O'Reilly, 2nd Edition, 2018.
	2. Jake VanderPlas, Python Data Science Hand Book: Essential Tools
	for working with Data, O' Reilly, 2017.
	3. Wesley J. Chun, Core Python Programming, Prentice Hall, 2006.
	4. N.Safina Devi and C.Devamanoharan, Algorithmic Problem Solving
	and Python- A Beginner's Guide, Francidev Publications, 2023.
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

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

Students will be able to

CLO 1: Give mathematical model for real world problems

CLO 2: Design algorithms for mathematical models, analyse the efficiency and correctness of

algorithms.

**CLO 3:** Design implementable programs in Python.

**CLO 4:** Define and demonstrate the use of functions and looping using Python.

**CLO 5:**Design and implement a program to solve a real-world problem.

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

#### 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 G (Skill Enhancement Courses) SEC

Title of the Course		MATHEM	ATIC	AL COMI	PUTATIC	ON WIT	TH SA	GEMATH	
Paper Number		SEC							
Category	Elective	Year	Credits		2	Course			
		Semester				Cou	Code		
Instruction	al Hours	Lecture	Tutorial		Lab Pra	ctice	Tota	1	
per week		1	1 1 2						
Pre-requisi	te				1		1		
Objectives Course	of the								
Course Out	tline	UNIT I First Steps							
		The Sage Program -Sage as a Calculator							
		UNIT II Analysis and Algebra							
		Symbolic Expressions and Simplification – Equations – Analysis -							
		Basic Linear Algebra							
		UNIT III Programming and Data Structures							
		Syntax –Algorit	hmics	-Lists and	Other Da	ta Struc	tures		
		UNIT IV Graphics							
		2D Graphics - 3D Curves							
		UNIT V Comp	utatio	nal Domai	ns				
		Sage is Object-Oriented- Elements, Parents, Categories-Domains							
		with a Normal F	Form-l	Expression	s vs Com	outation	al Do	mains	
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved							
		(To be discussed	during	the Tutorial	hour)				
Skills acq this course	uired from	Knowledge, Pro Professional Com	blem S munic	Solving, Ana ation and Tr	alytical ab ransferrabl	ility, Pro e Skill	ofessio	nal Competency,	
Recommen	ded Text	1. Mathematica	al Co	mputation	with Sa	geMath	,Pau	1 Zimmermann	
		Alexandre Casamayou.							

Reference Books	1.Uri M. Ascher and Linda R. Petzold, Computer Methods for							
	Ordinary Differential Equations and Differential-Algebraic Equations.							
	Society for Industrial and Applied Mathematics, 1998, ISBN							
	0898714128.							
	2. Noga Alon and Joel H. Spencer, The Probabilistic Method. Wiley-							
	Interscience, 2000, ISBN 0471370460.							
	3. Bernard Beauzamy, Robust mathematical methods for extremely							
	rare events. On-line, 2009. http://www.scmsa.eu/RMM/BB_rare_							
	events_2009_08.pdf, 20 pages.							
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,							
e-Learning Source	http://www.opensource.org, www.mathpages.com							

Title of the Course		ADVANCED LATEX									
Paper Number		SEC									
Category	Elective	Year	Credits		2	Cou	irse Code				
		Semester		-							
Instruction	al Hours	Lecture	Tutorial		Lab Pra	ctice	Total				
per week		1	1		2						
Pre-requisi	te										
Objectives	of the	The course aims	The course aims								
Course		➤ To create understanding of the LaTeX									
		$\succ$ To typeset ty	$\succ$ To typeset typical mathematical papers using the article style and								
		figure out LaTeX errors, download and use packages, create simple									
		diagrams.									
		$\succ$ To prepare a short presentation using the beamer class.									
Course Ou	Course Outline Unit – I :Introduction and the Structure of a LaTeX Doct							ument			
		Installation of the software LaTeX - Environments and commands -									
		Classes and pac	ckages	s – Errors -	Files cre	ated - ]	How to use LA	AEX at			
		CUED - Document Classes - Arara- Counters and Length parameters -									
		Document and page organization - Page breaks, footnotes.									
		Environments,	Matr	ix-like envi	ironments	. Char	pter - 1 and 2	in I &			
		Chapter - 1 in	II;C	Chapter – 4	in I & C	hapter	– 5 in II; Cha	pter -8			
		(Section 8.3) in	III								
		Unit – II : Disp	lay a	nd alignme	ent structu	ires					
		Display and al	ignmo	ent structur	res for equ	uations	Comparison v	with			
		standard LaTeX	C - A s	single equat	tion on on	e line -	- A single equa	tion			
		on several lines	: no a	lignment -	A Single	equatio	on on several li	nes:			
		with alignment	- Eq	uation gro	ups witho	ut alig	gnment - Equa	tion			
		groups with simple alignment- Multiple alignments: align and									
		flalign - Display	y envi	ronments a	s mini-pag	ges- Int	errupting displ	ays,			
		Variable symbol	ol cor	nmands - S	Symbols i	n form	nulas Chapter	- 8			
		(Section 8.2, 8.5, 8.6 and 8.9) in III									
		Unit – III : Fig	ures l	Directly in	LaTex						
		Inserting Image	es, Po	ositioning I	Images, L	ist of	Figures, Draw	ving			
		diagrams direct	ly in	LaTex, Tik	Z package	e, Grap	hics and PSTr	icks			
		Pictures and gr	aphic	s in LaTeX	K, simple	picture	es using PSTri	cks,			
		Plotting of function	tions								

	Unit – IV : Presentations (The beamer Class)
	Overlays -Themes Assignments and Examinations The exam Class
	- The exsheets Package - The probsoln Package - Using the data
	tool Package for Exams or Assignment Sheets - Random Numbers.
	Charts Flow Charts - Pie Charts - The datapie Package - The pgf-pie
	Package - Bar Charts - The bchart Package - The databar Package -
	Gantt Charts - Plots . Chapter – 8, 9 and 12 in II .
	Unit – V : Structuring Your Document
	Author and Title Information, Abstract, Chapters, Sections,
	Subsections, Creating a Table of Contents, Cross-Referencing,
	Creating a Bibliography, Page Styles and Page Numbering, Multi-
	Lingual Support: using the babel package. (5.1-5.7)
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved
	(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	I. Advanced LATEX by Tim Love, 2006
	II.http://www.h.eng.cam.ac.uk/help/documentation/docsource/latex_ad vanced.pdf
	III. LaTeX for Administrative Work by Nicola L. C. Talbot, Dickimaw
	Books, 2015, http://www.dickimaw-books.com/latex/admin/
	IV. The LaTeX Companion by Frank Mittelbach and Michel Goossens,
	Addison-Wesley, Library of Congress Cataloging-in-Publication Data
	(Second Edition)
	V. Nicola L. C. Talbot, LATEX for Complete Novices Version 1.4, Dickimaw Books http://www.dickimaw-books.com/2012.

<b>Reference Books</b>	1) Bindner, Donald & Erickson, Martin. (2011). A Student's Guide to
	the Study, Practice, and Tools of Modern Mathematics. CRC Press,
	Taylor & Francis Group, LLC.
	2) Lamport, Leslie (1994). LaTeX: A Document Preparation System,
	User's Guide and Reference Manual (2nd ed.). Pearson Education.
	Indian Reprint.
	3) George Gratzer, More Math into LATEX, 4th Edition, 2007
	Springer Science
	4) Frank Mittelbach, Michel Goossens, The LaTex Companion,
	Second Edition, Addision-Wesley, 2004
	5) A Primer, Latex, Tutorials, Indian TEX users group, Trivandrum,
	India.www.tug.org.in
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
e-Learning Source	http://www.opensource.org, www.mathpages.com

#### **Learning Outcomes:**

This course will enable the students to:

- ➤ Create and typeset a LaTeX document
- ➤ Typeset a mathematical document
- ➤ Draw pictures in LaTeX
- ≻ Create beamer presentations
- > Prepare the projects or dissertations in LaTeX

Title of the Course		OFFICE AUTOMATION AND ITC TOOLS								
Paper Number		SEC								
Category	Elective	Year		Credits	2	Cou	ourse Code			
		Semester		-						
Instruction	al Hours	Lecture	Tuto	rial	Lab Pra	ctice	Total			
per week		1	1				2			
Objectives Course	of the		1		1		1			
Course Ou	tline	UNIT I								
		Office Automat	ion-O	ffice and O	office Auto	omation	l			
		UNIT II								
		Computer Mail	Syste	ms - Teleco	ommunica	tion and	d Word Process	or		
		UNIT III								
		WP Hardware Configuration								
		UNIT IV								
		Reprographics-Electronic Mail and Electronic-Filing								
		UNIT V								
		Facsimile Transmission and Micrographics -Voice Technology								
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved								
		(To be discussed	during	the Tutoria	l hour)					
Skills acq this course	uired from	Knowledge, Pro Professional Con	blem nmunio	Solving, An cation and T	alytical ab ransferrabl	ility, Pro e Skill	ofessional Comp	etency,		
Recommen	ded Text	1.Office Automation Tools and Technology (Unit I & Unit-II)								
		2. Office Automation Tools ,Yatendra kumar & suitha varshney , Naveen prakashan pvt .Ltd								
Reference	Books	1.Office Automation Tools, Dr. Rizwan Ahmed, Naveen prakashan pyt								
		.Ltd					-			
		2.Office Automation Tools, Dr.Babasaheb Ambedkar								
Website a	nd	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,								
e-Learnin	g Source	http://www.opensource.org, www.mathpages.com								

Title of the Course		NUMERICAL ANALYSIS USING SCILAB							
Paper Number		SEC							
Category	Elective	Year		Credits	2	Cou	Course Code		
		Semester							
Instructional Hours		Lecture	Tuto	rial	Lab Pra	ctice	Total		
per week		1	1 2		2				
Objectives Course	of the								
Course Out	tline	UNIT I							
		Transcendental	and P	olynomial	Equations				
		UNIT II							
		System of Linear Algebric Equations and Eigenvalue Problems							
		UNIT III							
		Interpolation and Approximation							
		UNIT IV							
		Differentiation and Integration							
		UNIT V							
		Ordinary Differential Equations Initial Value Problems							
Extended Component	Professional	Questions related UPSC /TNPSC /	l to the others	above topi to be solved	cs, from va 1	rious co	ompetitive examinati	ions	
		(To be discussed	during	the Tutoria	l hour)				
Skills acq	uired from	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill							
Decommon	dod Toxt	1 Numerical Mat	hodaE	or Scientifi	And Engi	- onting	Computation by M	V	
Kecommen	ueu lexi	Jain, S. R. K. Iye	ngar A	nd R. K. Jai	in.	leering	Computation by M.	К.	
Reference I	Books	1. Numerical Me University Press	ethods	and princip	les analysis	and al	gorithms ,S.Pal ,Oxf	ford	
Website a	nd	http://mathforum	p://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,						
e-Learning	g Source	http://www.opensource.org, www.mathpages.com							

Title of the Course		DIFFERENTIAL EQUATIONS USING SCILAB							
Paper Num	lber	SEC							
Category	Elective	Year		Credits	2	Cou	rse Code		
		Semester							
Instruction	al Hours	Lecture	Lecture Tutorial Lab Practice Total		Total				
per week		1 1		2					
Pre-requisi	te		1						
Objectives	of the								
Course									
Course Out	tline	UNIT I							
		An Introduction to Scilab – Matrices							
		UNIT II							
		Scilab Programming							
		UNIT III							
		Functions –Plotting							
		UNIT IV							
		Solving Ordinary Differential Equations							
		UNIT V							
		Polynomials in S	cilab						
Extended Component	Professional	al Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved							
		(To be discussed during the Tutorial hour)							
Skills acq	uired from	Knowledge, Pro	blem S	Solving, An	alytical al	bility, Pro	ofessional Competency,		
		Professional Communication and Transferrable Skill							
Recommen	ded Text	1. PROGRAMMING USING SCILAB, AKHILESH KUMAR							
Reference I	Books	1.Ordinary Diff	erentia	al Equation	ns with So	cilab by	Gilberto E.Urroz		
Website an	nd	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,							
e-Learning	g Source	http://www.opensource.org, www.mathpages.com							

Title of the Course		INDUSTRIAL MATHEMATICS USING LATEST								
		PROGRAMMING PACKAGES								
Paper Num	ber	SEC								
Category	Elective	Year		Credits	2	Cou	Course Code			
		Semester		-						
Instruction	al Hours	Lecture	Tuto	rial	Lab Pı	ractice	Total			
per week		1	1				2			
Pre-requisi	te									
Objectives Course	of the									
Course Out	tline	UNIT I	UNIT I							
		Mathematics in industry- Overview of the case studies-Units and dimensions								
		- Diffusion equati	ions - l	Heat conduc	tion equa	ations				
		UNIT II								
		Boundary condi	tions	-Solving the	he heat	diffusion	equation -Sca	aling		
		equations - Dime	nsiona	l analysis						
		UNIT III								
		Continuous Cast	ing -	Introduction	n to the	case stu	udy problem -	The		
		Boltzmann simila	rity sc	olution- A mo	oving bo	undary pr	oblem - The pse	udo-		
		steady-state appr	oxima	te solution-	Solving	the cont	inuous casting	case		
		study								
		UNIT IV								
		Water Filtration	- Intr	oduction to	the cas	e study	problem -Stretc	hing		
		transformations	- Diff	usion from	a point	t source	-Solving the w	vater		
		filtration case stud	dy							
		UNIT V								
		Laser Drilling -	Introdu	uction to th	ne case	study pro	oblem - Metho	d of		
		perturbations -Boundary perturbations - Solving the laser drilling cas								
		study								
Extended Component	Professional	Questions related UPSC /TNPSC /	to the others	above topic to be solved	cs, from	various co	ompetitive exami	inations		
		(To be discussed	during	the Tutorial	hour)					
Skills acq this course	uired from	Knowledge, Prof Professional Com	blem S munic	Solving, Ana cation and Tr	alytical a ansferral	ıbility, Pro ble Skill	ofessional Comp	petency,		
Recommen	ded Text	Industrial Mather GLENN R. FULF	natics FORD	Case Studies PHILIP BR	s in the I OADBR	Diffusion of IDGE	of Heat and Matt	er,		

Reference Books											
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,										
e-Learning Source	http://www.opensource.org, www.mathpages.com										
Title of the	e Course	RESEARCH TOOLS AND TECHNIQUES									
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Paper Num	ber	SEC									
Category	Elective	Year		Credits	2	Cou	ırse Code				
		Somostor		-							
		Semester									
Instruction	al Hours	Lecture	Tuto	rial	Lab Pra	ctice	Total				
per week		1	1		2						
Pre-requisi	te										
Objectives Course	of the										
Course Out	tline	UNIT I									
		Research Proces	s- Re	search Desi	gn						
		UNIT II									
		Research Proble	m-Va	riables and	Their Ty	pes					
		UNIT III									
		Formulation of I	Hypot	hesis– Sam	pling- To	ols of l	Data Collection	l			
		UNIT IV									
		Data Analysis- Interpretation of Data									
		UNIT V									
		Research Methods - Descriptive or Survey Method - Experimental									
		Method									
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved									
		(To be discussed of	during	the Tutorial	hour)						
Skills acq this course	uired from	Knowledge, Prol Professional Com	blem S munic	Solving, Ana cation and Tr	alytical abi ansferrable	llity, Pr e Skill	ofessional Comp	petency,			
Recommen	ded Text	1.RESEARCH M Prabhat Pandey D	ETHO Pr. Mee	DOLOGY: enu Mishra I	TOOLS A Pandey © H	ND TE Bridge (	CHNIQUES Dr. Center, 2015				
Reference I	Books	1. Ackoff, Russell L. (1961). The Design of Social Research,									
		University of Ch	nicago	Press: Chi	cago.	-					
		2. Allen, T. Har	rell, (	1978). New	/ Methods	in So	cial Research, I	Praeger			
		Publication: New	w Yor	·k.							
		3. Baker, R.P. & Howell, A.C. (1958). The Preparation of						leports,			
		Ronald Press: New York.									
		4. Barzun, Jac	ques	& Graff.	F. (1990	)).The	Modern Rese	archer,			
		Harcourt, Brace	Publi	cation: Nev	v York.		_				
		5. Berelson Con	ard 8	c Colton, R	aymond.	(1978)	. Research and	Report			
***	_	Writing for Bus	iness	and Econor	nics, Rand	tom He	ouse: New Yorl	κ.			
Website a	nd	http://mathforun	<u>n.org</u> ,	http://ocw.	mıt.edu/o	cwweb	<u>Mathematics</u> ,				
e-Learning	g Source	http://www.opensource.org, www.mathpages.com									

#### EXTRA DISCIPLINARY COURSES FOR OTHER DEPARTMENTS (NOT FOR

#### MATHEMATICS STUDENTS)

Title of the	Course	MATHEMATICS FOR LIFE SCIENCES								
Paper Num	ber	EDI								
Category	ED I	Year		Credits	2	Cou	rse			
		Semester				Cod	e			
Instruction	al Hours	Lecture	Tuto	rial	Lab Practice		Tota	<u>l</u>		
per week		2	1		3					
Pre-requisi	te	Basic Mathematic	es				I			
Objectives Course	of the	ofthe1. The focus of the course is on scientific study of normal functions i living systems. The emphasis is on exposure to nonlinear different equations with examples such as heartbeat, chemical reactions and nerve impulse transmission.								
		2. The basic evolution	conce and g	epts of the presence of the pr	obability to also been a	unders	stand r	nolecular		
Course Out	tline	UNITI:Cell Gro growth or decay cell –Inhomogene	wth-E rates- cous D	xponential The method ifferential ed	growth and l of least squations.	Deca uares -	y – I - Nutr	Determination of ient Uptake by a		
		UNITII:Growth of a Microbial colony – Growth in a Chemo stat – Interacting Populations – Mutation and Reversion in Bacterial growth.								
		<b>UNITIII:</b> Enzyme Kinematics: The Michaelis – Menton Theory – Enzyme Substrate – Inhibitor system – Cooperative dimmer – Allosteric enzymes – Other alloseteric theories.								
		<b>UNITIV:</b> The Cooperative dimmer – Allosteric enzymes – Other alloseteric theories.								
		UNITV:Hemoglo Enzyme – Substra system.	obin – ate – N	Graph theor Iodifier syst	y and Steady em – Enzym	v state ] le Subs	Enzyn strate -	ne Kinetics – - Activator		
Extended Component	Professional	Questions related UPSC / TRB / TN	to the	above topic others to be	es, from vari solved	ous co	mpetit	tive examinations		
		(To be discussed of	during	the Tutorial	hour)					
Skills acq this course	uired from	Knowledge, Pro Transferrable Ski	fessio ll	nal Compet	ency, Profe	ssiona	l Con	nmunication and		
Recommen	ded Text	S. I. Rubinow, Introduction Mathematical Biology, Dover publications, New York, 1975.						ublications, New		
		Chapter I and Cha	apter 2	(Sections 2	.1,2.3, to 2.1	1).				
Reference I	Books									
Website an	nd	http://mathforum	n.org,	http://ocw.	mit.edu/ocv	wweb/	Math	ematics,		
e-Learning	g Source	http://www.oper	isourc	e.org, www	v.mathpage	s.com				

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

Students will be able to

**CLO 1:** analysis and interpretation of bio mathematical models such as population growth, cell division, and predator-prey models.

**CLO 2:** apply the basic concepts of probability to molecular evolution and genetics.

CLO 3: Identify and appreciate the unifying influence of mathematical modelling in different disciplines

**CLO 4:** Explain Allosteric enzymes

CLO 5: Analyze and translate a real-world problem into a mathematical problem

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

Title of the	Course	MATHEMATICS FOR SOCIAL SCIENCES									
Paper Num	ıber										
Category	ED II	Year		Credits	2	Cou	rse				
		Semester				Cou	e				
Instruction	al Hours	Lecture	Tuto	rial	Lab Pract	ice	Total				
per week		2	1 3				3				
Pre-requisi	te	Basic Mathematic	es								
Objectives Course	of the										
Course Ou	tline	UNIT I Propositional I quantifiers - Arg	<b>itiona</b> Logic umen <b>ions</b>	l <b>Logic an</b> Proposition ts and Valion	<b>d set Theor</b> onal Logic dity - Set Th	y -Ope neory	en p	ropositions and			
		The real number	r syste	em - Solvir	g equations	s and	inequ	alities; linear			
		and quadratic eq	Juatio	ns -Review	of relations	s and f	funct	ions			
		UNIT III									
		Real valued fun	octions	s and their	properties -	-Туре	s of	functions and			
		inverse of a fun	oction	- Polynom	ials, zeros	of pol	ynon	nials, rational			
		functions and th	eir gr	aphs							
		UNIT IV									
		Definition and ba	efinition and basic properties of logarithmic, exponential, trigonometric								
		functions and the	eir grap	bh							
		UNIT V Matric	ces an	d determi	nant						
		Definition of a	a mat	trix -Matri	x Algebra	-Typ	es o	f matrices -			
		Elementary row	oper	ations - Ro	ow echelon	form	and	reduced row			
		echelon form of	a mat	trix							
Extended Component	Professional	Questions related UPSC / TRB / TN	to the	above topic others to be	es, from vario	ous co	mpeti	tive examinations			
		(To be discussed	during	the Tutorial	hour)						
Skills acq this course	uired from	Knowledge, Pro Transferrable Ski	ofessio ll	nal Compet	ency, Profe	ssiona	1 Co	mmunication and			
Recommen	ded Text	1.Mathematics f Naizghi	for So	cial Science	es , Dr. Berl	hanu I	Bekel	e, Ato Mulugeta			
Reference I	Books										
Website a	nd	http://mathforum	n.org,	http://ocw.	mit.edu/ocv	wweb/	Math	nematics,			
e-Learning	g Source	http://www.opensource.org, www.mathpages.com									

Title of the	e Course	STATISTICS FOR LIFE AND SOCIAL SCIENCES							
Paper Nur	nber								
Category	ED III	Year		Credits	2	Cou	irse		
		Semester				Cod	le		
Instruction	nal Hours	Lecture	Tuto	rial	Lab Pract	tice	Tota	al	
per week		2 1 3							
Pre-requis	ite								
Objectives Course	of the	le							
Course Ou	ıtline	UNIT I							
		Definitions, and Introduction to S	l Scoj Set Th	pe of Statis eory I & II	stics -Appro- -Concepts o	oach of Log	to Da gic	ata Collection -	
		UNIT II							
		Diagrammatic Presentation of Data -Frequency Distribution - Graphical Presentation of Data - Measures of Central Tendency							
		UNIT III							
		Probability Theo Binominal Distr	ory I& ibutio	zII - Permut n	ation Theor	em -(	Comb	ination -	
		UNIT IV							
		Nature and Im Methodology I &	iporta & II	nce of Sta	ntistical Inc	quirie	s - ]	Basic Research	
		UNIT V							
		Nature of Science	ce -So	me Basic C	oncepts in S	Socia	l Stati	stics	
Extended Component	Professional	Questions related UPSC / TRB / NE	to the ET / U	above topic GC – CSIR /	s, from vario GATE / TN	ous co PSC /	mpetit others	tive examinations s to be solved	
		(To be discussed of	during	the Tutorial	hour)				
Skills acq this course	uired from	Knowledge, Prol Professional Com	blem S munic	Solving, Ana ation and Tr	lytical abilit ansferrable S	ty, Pro Skill	ofessio	onal Competency,	
Recommen	ded Text	1.BASIC STATISTI Reviewer) – Ber Editor) – NOUN	ICS FC Ison I	DR SOCIAL S dahosa Univ	SCIENCES ,D versity Dr. I	or. He Moses	enry C 5 Etila	Dbasogie (Course Shaibu (Course	

<b>Reference Books</b>	1.Osuala, E.C. (1982). Introduction to Research Methodology. Awka									
	Rd Onitsha, Nigeria: Africana-Fep Publisher Limited.									
	2.Okoro, E. (2002). Quantitative Techniqes in Urban Analysis. Ibadan:									
	Kraft Books Ltd. Kerlinger, Fred N. (1964)									
	3. Foundations of Behavioural Research. New York: Holt, Rinehart and									
	Winton. Whitney, F.L. (1968).									
	4. The Elements of Research. New York: Prentice- Hall.									
Website and	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,									
e-Learning Source	http://www.opensource.org, www.mathpages.com									

Title of the	e Course	GAME THEORY and STRATEGY							
Paper Nur	nber	ED IV							
Category	ED IV	Year		Credits	2	Cou Cod	rse		
		Semester				Cou	C		
Instruction	nal Hours	Lecture	Tuto	rial	Lab Practice		Tot	al	
per week		2	1 3						
Pre-requis	ite	UG level Linea	r prog	ramming					
<b>Objectives</b> <b>Course</b>	of the	<ol> <li>It focuses on fundamentals of game theory including basic concepts and techniques, various ways of describing and solving games, and various applications in economics, political sciences, and business.</li> <li>It will help students sharpen their understanding of strategic behavio in different situations involving many individuals. T</li> <li>The students will learn how to recognize and model strategic situations, to predict when and how their action will have an influence on others, and to exploit strategic situations for the benefit full.</li> </ol>							
Course Ou	ıtline	<b>UNIT I:</b> Game, game of strategy perfect informatic Chapter 1	Strate, - Rela on's	gy and Sado tions among	tle Point: In expectation	ntroduc 1s- Sac	ction- ddle	Description of a points-Game with	
		<b>UNIT II:</b> The Fu Graphical repres optimal mixed st proof of minimax Chapter 2	indamentatic entatic rategy theore	entals: Gam on of mixed – graphical em	e without sa 1 strategies representat	ddle p – the	ooints e min mini	-mixed strategies- nimax theorem – max theorem and	
		<b>UNIT III:</b> Proper properties of an operation on gam	rties of optin es – do	f Optimal St nal strategie ominated stra	rategies: Ma es – convez ategies – all	any op x set strateg	timal of o jies ad	strategies – some ptimal strategies- ctive.	
		Chapter 3 (Section 3.1 to 3.6)							
		<b>UNIT IV:</b> Metho and verify – Ex Graphical solution	d of S aminat ns of 3	olving game tion of subr x 3 games.	es: Solving f natrices – S	or opti Succes	imal : sive	strategies – Guess approximations –	
		Chapter 5 (Sectio	n 5.1 t	o 5.5)					
		UNIT V: Mapping method for solving games with constraints – method for solving games – solution of reconnaissance game by method. Chapter 5 (Section 5.6 to 5.8)							
Extended Component	Professional	Questions related UPSC / TRB / NE	to the ET / U	above topic GC – CSIR /	s, from vario GATE / TN	ous co PSC /	mpeti other	itive examinations rs to be solved	
		(To be discussed of	during	the Tutorial	hour)				

Skills acquired from	Knowledge, Problem Solving, Analytical ability, Professional Competency,
this course	Professional Communication and Transferrable Skill
Recommended Text	Melvin Dresher, Game of Strategy Theory and Application, Prentice-Hall- Inc, USA, 1961
Reference Books	<ol> <li>Kanti Swarup, P.K.Gupta and Man Mohan, "Operations Research, Eighth Edition", Sultan Chand &amp; Sons, New Delhi, 1999.</li> <li>S.Hillier and J.Liebermann, Operations Research, Sixth Edition, Mc Graw Hill Company, 1995.</li> <li>J. K. Sharma, Operations Research problems and solution, Third edition, Mackmillan Publishers India Ltd, India, 2012.</li> <li>Guillermo Owen, Game Theory, 2nd edition, Academic Press, 1982.</li> <li>Philip D. Straffin, Game Theory and Strategy, The Mathematical Association of America, USA, 1993.</li> </ol>
Website and	1. https://nptel.ac.in/courses/110101133
e-Learning Source	2. https://archive.nptel.ac.in/courses/110/104/110104063/

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

Students will be able to

CLO 1: distinguish a game situation from a pure individual's decision problem

CLO 2: explain graphical representation of mixed strategies.

CLO 3:explain concepts of dominant, dominated, and rationalizable strategies, pure and mixed strategies, and best responses

**CLO 4:** Analyse economic situations using game theoretic techniques

**CLO 5:**Solve simple games using mapping method.

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

Title of the	e Course	HISTORY OF MATHEMATICS						
Paper Nui	nber							
Category	ED V	Year		Credits	2 Course			
		Semester				Cod	le	
		Semester					1	
Instruction	nal Hours	Lecture	Tuto	orial	Lab Prac	ractice Total		
per week		2	1				3	
Pre-requis	ite							
Objectives Course	s of the							
Course Ou	ıtline	UNIT I						
		Early Number S	ystem	ns and Syml	ools			
		UNIT II						
		Mathematics in	Early	Civilization	ns			
	UNIT III							
		The Beginnings	of Gr	eek Mather	natics			
		UNIT IV						
		The Alexandrian School: Euclid						
		UNIT V						
		The Twilight of	Greel	k Mathemat	ics: Diopha	intus		
Extended Component	Professional	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved						
		(To be discussed	l durii	ng the Tutor	rial hour)			
Skills acq	uired from	Knowledge, Problem Solving, Analytical ability, Professional						
this course		Competency, Pr	ofessi	onal Comm	unication a	nd Tr	ansferra	ble Skill
Recommen	ded Text	1.The History of of New Hampshir	Mathe re	ematics, Sev	enth Edition	Davi	d M. Bu	rton University
Reference I	Books	<ol> <li>Aczel, Amer. The Artist and the Mathematician: The Story of Nicolas Bourbaki, the Genius Mathematician Who Never Existed. New York: Thunder's Mouth Press, 2006.</li> <li>Appel, Kenneth, and Haken, Wolfgang. "Every Planar Map Is Four Colorable." Journal of Recreational Mathematics 9 (1976–1977): 161–169.</li> </ol>						y of Nicolas w York: o Is Four 77): 161–169.
Website an	nd	http://mathforum	<u>n.org</u> ,	http://ocw.	mit.edu/ocv	vweb	/Mathen	natics,
e-Learning	g Source	http://www.opensource.org, www.mathpages.com						