THIRUVALLUVAR UNIVERSITY
SERKKADU, VELLORE–632115

FIVE- YEAR INTEGRATED PROGRAMME

M.SC MATHEMATICS

SYLLABUS
(University Department)

FROM THE ACADEMIC YEAR
2024 – 2025

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc., Mathematics**
Programme Code	
Duration	**5 years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors 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 Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **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.

Three domains:

(i) Cognitive Domain

(Lower levels: K1: Remembering; K2: Understanding; K3: Applying;

Higher levels: K4: Analysing; K5: Evaluating; K6: Creating)

(ii) Affective Domain

(iii) Psychomotor Domain

Template for Integrated M.Sc Mathematics Programmes

SEMESTER I-VI

S.No.	Study Components	Category	Ins. Hrs./ Week	Credit	Title of the Paper	Maximum Marks		
						CIA	Uni. Exam	Total
SEMESTER I								
1.	**Part 1**	**Language – Tamil**	6	3	Tamil-I	25	75	100
2.	**Part 2**	**English**	6	3	English-I	25	75	100
3.	**Part 3**	**Core –I**	6	5	CCI- Algebra and Trigonometry	25	75	100
		Core-II	5	5	CCII -Differential Calculus	25	75	100
		Elective I, II	4+3	3+2	[A1] Allied Physics I	25	75	100
					[A2] Physics Practical I	25	75	100
					(OR)			
					[B1] Numerical Methods I	25	75	100
					[B2] Numerical Practical I	25	75	100
		Skill Enhancement Courses I	**2**	**2**	Mathematics For Competive Examinations-I	25	75	100
4.	**Part 4**	**Foundation Course**	**2**	**2**	Bridge Mathematics	25	75	100
			34	**25**				
SEMESTER II								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni.**	**Total**

							Exam	
1.	Part 1	**Language – Tamil**	6	3	Tamil-II	25	75	100
2.	Part 2	**English**	6	3	English -II	25	75	100
3.	Part 3	**Core-III**	5	5	CC III – Analytical Geometry	25	75	100
		Core-IV	5	5	CC IV – Integral Calculus	25	75	100
		Elective III, IV	4+3	3+2	[A1] Allied Physics II [A2] Physics Practical II **(OR)** [B1] Numerical Methods II [B2] Numerical Practical II	25 25 25 25	75 75 75 75	100 100 100 100
4.	Part-4	**Skill Enhancement Courses II**	**2**	**2**	Mathematics For Competitive Examinations-II	25	75	100
		Skill Enhancement Courses III	**2**	**2**	Data Analysis using latest Package – Matlab (Practical)	25	75	100
			33	**25**				

SEMESTER III								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
1.	Part 1	**Language – Tamil**	6	3	Tamil-III	25	75	100
2.	Part 2	**English**	6	3	English -III	25	75	100
3.	Part 3	**Core V**	5	5	CC V Vector Calculus	25	75	100
		Core VI	5	5	CC VI Differential Equations	25	75	100
		Elective V	5	3	[A]:Mathematical Statistics I [B]: Data Structures	25	75	100
4.	Part 4	**Skill Enhancement Courses IV**	1	1	E-Commerce and Tally	25	75	100
		Skill Enhancement Courses V	2	2	Data Analysis using latest Package – Geogebra (Practical)	25	75	100
		EVS	2	2	Environmental Studies	25	75	100
			32	**24**				

SEMESTER IV								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
1.	Part 1	**Language – Tamil**	6	3	**Tamil-IV**	25	75	100
2.	Part 2	**English**	6	3	**English-IV**	25	75	100
3.	Part 3	**Core VII**	5	5	**CC VII** : Optimization Techniques	25	75	100
		Core-VIII	5	5	**CC-VIII** : Elements of Mathematical Analysis	25	75	100
		Elective VI	6	3	[A]: Mathematical Statistics II [B]: Web Designing	25	75	100
4.	Part4	Skill Enhancement Courses VI	2	2	Computing Skills (Office Automation)	25	75	100
		Skill Enhancement Courses VII	**2**	**2**	R Language for Statistics	25	75	100
			32	**23**				

SEMESTER V								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
1.	Part-3	**Core – IX**	5	4	**CC IX: Abstract Algebra**	25	75	100
		Core –X	5	4	**CC-X** : Real Analysis	25	75	100
		Core-XI	5	4	**CC-XI** : Mathematical Modeling	25	75	100
		Core-XII	5	4	**CC-XII** : Project with viva-voce	25	75	100
		Elective VII	4	3	A[1]: Transform Techniques A[2]: Fuzzy sets and its applications	25	75	100
		Elective VIII	4	3	B[1]: Graph Theory and Applications **B[2]:** Differential Equations with	25	75	100

					Applications			
2.	Part 4	Value Education	2	2	Value Education (Algorithms)	25	75	100
			-	2	Summer Internship/ Industrial Training (carried out II Year summer vacation)			
			30	**26**				
SEMESTER VI								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
1.	**Part 3**	**Core-XIII**	6	4	**CC-XIII** : Linear Algebra	25	75	100
		Core-XIV	6	4	**CC-XIV** : Complex Analysis	25	75	100
		Core-XV	6	4	**CC-XV** : Mechanics	25	75	100
		Elective IX	5	3	A: Python Programming with practical B: Financial Analytics	25	75	100
		Elective X	5	3	A: Discrete Mathematics B: Cloud Computing	25	75	100
2.	**Part 4**	Extension Activity	-	1	Extension Activity	Performance based assessment		
	Part 5	Professional Competency Skill	2	2	Professional Competency Skill	Internal assessment		
			30	**21**				
TOTAL CREDITS : 144								
SEMESTER VII-X								
SEMESTER VII								
1	**Part-3**	**Core –XVI**	7	5	**CC-XVI** : Algebraic Structures	25	75	100
		Core-XVII	7	5	**CC-XVII** : Real Analysis – I	25	75	100
		Core-XVIII	6	4	**CC-XVIII** : Ordinary Differential Equations	25	75	100
Elective - XI Group A: (PM/AP/IC/ITC) (Choose any one)								
2	**Part3**	**Elective XI**	5	3	A[1]: Graph Theory and Applications	25	75	100

					A[2]: Formal Languages and Automata Theory **A[3]: Programming in C++ and Numerical Methods**			
Elective – XII Group B:(PM/AP/IC/ITC)(Choose any one)								
3	**Part 3**	**Elective XII**	5	3	B[1]: Mathematical Programming **B[2]: Calculus of Variations & Integral Equations** B[3]: Discrete Mathematics	25	75	100
			30	**20**				
SEMESTER VIII								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
4	**Part-3**	**Core-XIX**	6	5	**CC-XIX** : Advanced Algebra	25	75	100
		Core-XX	6	5	**CC-XX** : Real Analysis - II	25	75	100
		Core-XXI	6	4	**CC-XXI** : Partial Differential Equations	25	75	100
Elective XIII– Group C:**(PM/AP/IC/ITC)** (Choose any one)								
5	**Part-3**	**Elective XIII**	3	3	C[1]: Algebraic Topology **C[2]: Mathematical Statistics** C[3]: Statistical Data Analysis using R Programming	25	75	100
Elective-XIV Group D :(PM/AP/IC/ITC)(Choose any one)								
6	**Part-3**	**Elective XIV**	3	3	**D[1]: Modelling and Simulation with Excel** D[2]: Machine Learning and Artificial Intelligence D[3]: Neural Networks	25	75	100
7	**Part-4 Compulsory Paper**	Human Rights	2	2	Human Rights	25	75	100
		Mooc Course	-	2				100

Skill Enhancement Course – VIII								
8	**Part-4**	**SEC VIII**	4	2	**G[1]: Mathematical Documentation using LATEX/other packages** G[2]: Office Automation and ICT Tools G[3]: Differential equations using SCILAB	Internal assessment		
			30	**26**				
SEMESTER IX								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni. Exam**	**Total**
9	**Part-3**	**Core-XXII**	6	5	**CC-XXII** : Complex Analysis	25	75	100
		Core-XXIII	6	5	**CC-XXIII** : Probability Theory	25	75	100
		Core-XXIV	6	5	**CC-XXIV** : Topology	25	75	100
		Core-XXV	6	4	**CC-XXV** : **Industry Modules - Resource Management Techniques**	25	75	100
Elective – XV Group E: (PM/AP/IC/ITC)(Choose any one)								
10		**Elective XV**	3	3	E[1]: Algebraic Number Theory **E[2]: Fluid Dynamics** E[3]: Stochastic Processes	25	75	100
Skill Enhancement Course – IX								
11	**Part-4**	**SEC - IX**	3	2	Professional Communication Skill: Term paper & Seminar presentation	Internal assessment		
12		**Internship / Industrial Activity**	-	2	(Carried out in Summer Vacation at the end of I year–30 hours) Summer Internship Report to be submitted to the Department.			
			30	**26**				
SEMESTER X								
S.No.	**Study Components**	**Category**	**Ins. Hrs./ Week**	**Credit**	**Title of the Paper**	**Maximum Marks**		
						CIA	**Uni.**	**Total**

							Exam	
13	**Part-3**	**Core-XXVI**	6	5	**CC-XXVI** : Functional Analysis	25	75	100
		Core-XXVII	6	5	**CC-XXVII** : Differential Geometry	25	75	100
		Core-XXVIII	10	7	CC-XXVIII: Project with Viva Voce	25	75	100
Elective – XVI Group F:(PM/AP/IC/ITC)(Choose any one)								
14	**Part-3**	**Elective XVI**	4	3	F[1]: **Number Theory and Cryptography** F[2]: Financial Mathematics F[3]: Mathematical Python	25	75	100
Skill Enhancement Course – X (Choose any one)								
15	**Part-4**	**SEC-X**	4	2	Professional Competency Skill Enhancement Course 1.Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) 2.General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)	Internal assessment		
16	**Part – 5**	**Extension Activity**		**1**	Performance based assessment			
			30	**23**				
TOTAL CREDITS: 95								

Template for Curriculum Design for Five- Year Integrated Programme

M.Sc Mathematics

Credit Distribution for Five- Year Integrated Programme

M.Sc Mathematics

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	15	18
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		25	**34**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	15	17
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		25	**33**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	15
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	2	2
		24	**32**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
		23	**32**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Elective Based	22	28
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	**32**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part 1	3	3	3	3	-	-	12
Part 2	3	3	3	3	-	-	12
Part 3	15	15	13	13	22	18	92
Part 4	4	4	5	4	4	1	22
Part 5	-	-	-	-	-	2	2
Total	25	25	24	23	26	21	**144**

Credit Distribution for Semester VII to X for Five-Year Integrated Programme

M.Sc Mathematics

	Fourth Year Semester-VII	**Credit**	**Hours per week(L/T/P)**
Part 3	CC XVI- Algebraic Structures	5	7
	CCXVII- Real Analysis I	5	7
	CCXVIII- Ordinary Differential Equations	4	6
	Elective XI(Generic / Discipline Specific)(One from Group A)	3	5(4L + 1T)
	Elective XII(Generic / Discipline Specific)(One from Group B)	3	5(4L + 1T)
	Total	**20**	**30**
	Semester-VIII	**Credit**	**Hours per week(L/T/P)**
Part 3	CC XIX – Advanced Algebra	5	6
	CC XX – Real Analysis II	5	6
	CC XX1 - Partial Differential Equations	4	6
	Elective XIII (Generic / Discipline Specific)(One from Group C)	3	3
	Elective-XIV(Computer / IT related) (One from Group D)	3	3
Part 4	Skill Enhancement Course -SEC VIII (One from Group G)	2	4
	Human Rights	2	2
	Mooc Course	2	-
	Total	**26**	**30**
	Fifth Year - Semester- IX	**Credit**	**Hours per week(L/T/P)**
Part 3	CC XXII - Complex Analysis	5	6
	CCXXIII - Probability Theory	5	6
	CCXXIV – Topology	5	6
	CC XXV - Industry Modules	4	6

	Elective XV(Generic / Discipline Specific)(One from Group E)	3	3
Part 4	Skill Enhancement Course -SEC IX :Professional Communication Skill -Term paper & Seminar presentation	2	3
	Internship / Industrial Activity (Carried out in Summer Vacation at the end of I year – 30 hours)	2	-
	Total	**26**	**30**
	Semester-X	**Credit**	**Hours per week (L/T/P)**
Part 3	CC XXVI–Functional Analysis	5	6
	CC XXVII– Differential Geometry	5	6
	CC XXVIII Project with viva voce	7	10
	Elective XVI(Generic / Discipline Specific)(One from Group F)	3	4
Part 4	Professional Competency Skill Enhancement Course X Training for Competitive Examinations • Mathematics for NET / UGC – CSIR/ SET / TRB Competitive Examinations (2 hours) • General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)	2	4
Part 5	Extension Activity	1	**-**
	Total	**23**	**30**

TOTAL CREDITS: 95

Consolidated Table for Credits Distribution

	Category of Courses	Credits for each Course	Number of Courses	Number of Credits in each Category of Courses	Total Credits	Total Credits for the Programme
PART 3	Core	5 4	9 2	45 08 = 53	82	88 (CGPA)
	Project with viva voce	7	1	7		
	Industry aligned Programmes-	4	1	4		
	Elective (Generic and Discipline Centric)	3	6	18		
PART 4 (i)	Skill Enhancement (Term paper and Seminar & Generic / Discipline - Centric Skill Courses) (Internal Assessment Only)	2	3	6	6	
(ii)	Ability Enhancement (Soft skill) (Human Rights & Mooc Course)	2	2	4	6	6
(iii)	Summer Internship	1	2	2		
PART 5	Extension Activity	1	1	1	1	1
						95

Five- Year Integrated Programme

M.Sc Mathematics

1. Programme Specific Outcomes:

SEMESTER I-VI

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.

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

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

SEMESTER VII-X

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

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

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

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

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

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

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

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

Value Additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Mathematics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong mathematical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of mathematical models in the respective sectors
IV	Industrial Statistics	• Exposure to industry moulds students into solution

		providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Mathematics for Advanced Explain' component will comprise of advanced topics in Mathematics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honours degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

2 b. Structure of Course (4,5 yrs)

Course Code	Course Name		Credits
Lecture Hours: (L) per week	**Tutorial Hours : (T) per week**	**Lab Practice Hours: (P)per week**	**Total: (L+T+P) per week**
Course Category :	**Year & Semester:**	**Admission Year:**	
Pre-requisite			
Links to other Courses			
Learning Objectives: (for teachers: what they have to do in the class/lab/field)			
Course Outcomes: (for students: To know what they are going to learn) **CO1:** **CO2:** **CO3:** **CO4:** **CO5:**			
Recap: (not for examination) Motivation/previous lecture/ relevant portions required for the course) [This is done during 2 Tutorial hours)			

Units	Contents	Required Hours
I		**18**
II		**18**
III		**18**
IV		**18**
V		**18**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Learning Resources:

- **Recommended Texts**
- **Reference Books**
- **Web resources**

Board of Studies Date:

3. Learning and Teaching Activities

3.1 Topic wise Delivery method

Hour Count	Topic	Unit	Mode of Delivery

3.2 Work Load

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

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

1. **Tutorial Activities**

Tutorial Count	Topic

2. **Laboratory Activities**
3. **Field Study Activities**
4. **Assessment Activities**

Assessment Principles:

Assessment for this course is based on the following principles

1. Assessment must encourage and reinforce learning.
2. Assessment must measure achievement of the stated learning objectives.

3. Assessment must enable robust and fair judgments about student performance.
4. Assessment practice must be fair and equitable to students and give them the opportunity to demonstrate what they learned.
5. Assessment must maintain academic standards.

Assessment Details:

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

CONTENTS

i. Faculty Course Assessment Report(FCAR)
j. Course Evaluation Sheet
k. Teaching Materials(PPT, OHP etc)
l. Lecture Notes
m. Home Assignment Questions
n. Tutorial Sheets
o. Remedial Class Record, if any.
p. Projects related to the Course
q. Laboratory Experiments related to the Courses
r. Internal Question Paper
s. External Question Paper
t. Sample Home Assignment Answer Sheets
u. Three best, three middle level and three average Answer sheets
v. Result Analysis (CO wise and whole class)
w. Question Bank for Higher studies Preparation (GATE/Placement)
x. List of mentees and their academic achievements

Different Types of Courses (1 to 3 years)

1. Algebra and Trigonometry
2. Differential Calculus
3. Analytical Geometry
4. Integral Calculus
5. Vector Calculus
6. Differential Equations
7. Optimization Techniques
8. Elements of Mathematical Analysis
9. Abstract Algebra
10. Real Analysis
11. Mathematical Modelling
12. Project with viva- voce
13. Linear Algebra

14. Complex Analysis
15. Mechanics

Topics of the Generic Elective Course (Allied)

1. Allied Physics – I
2. Allied Physics – II
3. Numerical Methods – I
4. Numerical Methods – I
5. Mathematical Statistics – I
6. Mathematical Statistics –II

Topics of the Discipline Specific Elective Courses

1. Transform Techniques
2. Special Functions
3. Graph Theory and its Applications
4. Number Theory
5. Programming in C++
6. Financial Analytics
7. Discrete Mathematics
8. Big Data Analysis

Topics of the Discipline Skill Enhancement Courses

1. Mathematics for Competitive Examinations – I
2. Mathematics for Competitive Examinations - I
3. Geogebra
4. Maxima
5. Python Programming
6. R-Programming for Statistics

Different Types of Courses (4,5 years)

(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 and more

(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 and more

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

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.

Ability Enhancement Courses

- Soft Skill courses

Instructions for Course Transaction

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

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 (problems)	Either-or Type Both parts of each question from the same UNIT
	Question 11(a) or 11(b) To **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,

1. [CO1 : K2] Question xxxx
2. [CO3 : K1] Question xxxx

Core Courses

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ALGEBRA & TRIGONOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE - CC I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Basic ideas on the Theory of Equations, Matrices and Number Theory.
• Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">Unit I: Reciprocal Equations-Standard form–Increasing or decreasing the roots of a given equation- Removal of terms, Approximate solutions of roots of polynomials by Horner’s method – related problems.</td></tr>
<tr><td colspan="8">Unit II: Summation of Series: Binomial– Exponential –Logarithmic series (Theorems without proof) – Approximations - related problems.</td></tr>
<tr><td colspan="8">Unit III: Characteristic equation –Eigen values and Eigen Vectors-Similar matrices - Cayley –Hamilton Theorem (Statement only) - Finding powers of square matrix, Inverse of a square matrix up to order 3, Diagonalization of square matrices - related problems.</td></tr>
<tr><td colspan="8">Unit IV: Expansions of sinnθ, cosnθ in powers of sinθ, cosθ - Expansion of tannθ in terms of tan θ, Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$ –Expansions of $\tan(\theta_1+\theta_2+,\ldots,+\theta_n)$-Expansions of sinθ, cosθ and tanθ in terms of θ - related problems.</td></tr>
<tr><td colspan="8">Unit V: Hyperbolic functions – Relation between circular and hyperbolic functions Inverse hyperbolic functions, Logarithm of complex quantities, Summation of trigonometric series - related problems.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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 transferable skill.
Recommended Text	1. W.S. Burnstine and A.W. Panton, Theory of equations 2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007 3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005 4. C.V.Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003 5. J.Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012. 6. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Classify and Solve reciprocal equations

CLO 2: Find the sum of binomial, exponential and logarithmic series

CLO 3: Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix

CLO 4: Expand the powers and multiples of trigonometric functions in terms of sine and cosine

CLO 5: Determine relationship between circular and hyperbolic functions and the summation of trigonometric series

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">DIFFERENTIAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• The basic skills of differentiation, successive differentiation, and their applications.
• Basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Successive Differentiation: Introduction (Review of basic concepts) – The n^{th} derivative – Standard results – Fractional expressions – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula for the n^{th} derivative of a product – Feynman's method of differentiation.</td></tr>
<tr><td colspan="8">UNIT-II: Partial Differentiation: Partial derivatives – Successive partial derivatives – Function of a function rule – Total differential coefficient – A special case – Implicit Functions.</td></tr>
<tr><td colspan="8">UNIT-III:Partial Differentiation (Continued): Homogeneous functions – Partial derivatives of a function of two variables – Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.</td></tr>
<tr><td colspan="8">UNIT-IV:Envelope: Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in the parameter.</td></tr>
<tr><td colspan="8">UNIT-V:Curvature: Definition of Curvature – Circle, Radius and Centre of Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-ordinates.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / / 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. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010. 3. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
Reference Books	1. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989. 2. T. Apostol, Calculus, Volumes I and II. 3. S. Goldberg, Calculus and mathematical analysis.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with PLOs and PSOs)

Students will be able to

CLO 1: Find the nth derivative, form equations involving derivatives and apply Leibnitz formula

CLO 2: Find the partial derivative and total derivative coefficient

CLO 3: Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers

CLO 4: Find the envelope of a given family of curves

CLO 5: Find the evolutes and involutes and to find the radius of curvature using polar co-ordinates

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ANALYTICAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To understand and apply the concept of homogeneous equations of second degree to represent straight lines in different forms.
• To derive polar equations for straight lines, circles, and conic sections, and analyze their geometric properties.
• To formulate general equations of planes, calculate angles between two planes, and determine perpendicular distances.
• To calculate the angle between a line and a plane, determine the length of perpendiculars, and analyze coplanar and skew lines.
• To originate equations of spheres, determine lengths of tangents, and analyze sections of spheres.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="8">Unit - I: Pair of Straight lines
Introduction – Homogeneous equation of second degree – Angle between the lines – Equation for the bisector of the angle between the lines – Condition for a second degree equation to represent a pair of straight lines.
(Chapter 3: Sections 3.1 - 3.5 Pages: 89 - 129).</td></tr>
<tr><td colspan="8">Unit - II: Polar Coordinates
Introduction –Definition of polar coordinates – Relation between Cartesian coordinates and Polar coordinates – polar equation of a straight line – circle – Polar equation of a conic.
(Chapter 9: Sections: 9.1 – 9.7.1 Pages: 480 - 500).</td></tr>
<tr><td colspan="8">Unit - III: Plane
Introduction – General equations of plane – Angle between two planes – Perpendicular distance – Plane passing through: Three given points, Intersection of two given planes – Condition for a second degree equation to represent a pair of planes.
(Chapter 12: Sections: 12.1 – 12.12 Pages 585 - 629).</td></tr>
</table>

	Unit - IV: Straight Lines Introduction – Equations of straight Lines – Angle between a line and plane – Length of the perpendicular – Coplanar lines – Skew lines – Intersection of three planes. (Chapter 13: Sections: 13.1 – 13.12 Pages: 630 – 647, 648 - 686).
	Unit - V: Sphere Equations of sphere – Length of the tangent – Section of a sphere – Equation of circle – Intersection of two spheres – Condition for the orthogonality – Radical planes. (Chapter 14: Sections: 14.1 – 14.11 Pages: 687 – 695, 699 - 727).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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	P.R.Vittal, Analytical Geometry 2D and 3D, Pearson Publications, Chennai.
Reference Books	1. P.Duraipandian and LaxmiDuraipandian, Analytical Geometry Twodimensions, Emerald Publication. 2. Shanti Narayan and P.K.Mittal, Analytical Solid Geometry of 3D, S. Chand Publications. 3. ManicavasagamPillay&Natarajan, Analytical Geometry of Twodimensions, S. Viswanathan (printers & publication) Pvt Ltd. 4. ManicavasagamPillay&Natarajan, Analytical Geometry of Threedimensions, S. Viswanathan (printers & publication) Pvt Ltd.
Website and e-Learning Source	**https://mathworld.wolfram.com/ ,** **http://www.univie.ac.at/future.media/moe/galarie.html/**

Course Learning Outcome (for Mapping with POs and PSOs)

CO Number	CO Statement	Knowledge Level
CO1	Understand and apply the concept of homogeneous equations of second degree to represent straight lines in different forms.	K1,K2
CO2	Derive polar equations for straight lines, circles, and conic sections, and analyze their geometric properties.	K4, K5
CO3	Formulate general equations of planes, calculate angles between two planes, and determine perpendicular distances.	K5,K6
CO4	Calculate the angle between a line and a plane, determine the length of perpendiculars, and analyze coplanar and skew lines.	K5,K6
CO5	Formulate equations of spheres, determine lengths of tangents, and analyze sections of spheres.	K4,K5,K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	3	3	2	3	3	3	3	2	2.8
2	3	3	3	3	2	3	3	3	3	2	2.8
3	3	3	3	3	2	3	3	3	3	1	2.7
4	3	3	3	3	1	3	3	3	3	1	2.6
5	3	3	3	3	1	3	3	2	3	1	2.5

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INTEGRAL CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE – CC IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
• Knowledge about Beta and Gamma functions and their applications.
• Skills to Determine Fourier series expansions.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Reduction formulae -Types, integration of product of powers of algebraic and trigonometric functions, integration of product of powers of algebraic and logarithmic functions - Bernoulli’s formula, Feyman’s technique of integration.</td></tr>
<tr><td colspan="6">UNIT-II: Multiple Integrals - definition of double integrals - evaluation of double integrals – double integrals in polar coordinates - Change of order of integration.</td></tr>
<tr><td colspan="6">UNIT-III: Triple integrals –applications of multiple integrals - volumes of solids of revolution - areas of curved surfaces–change of variables - Jacobian.</td></tr>
<tr><td colspan="6">UNIT-IV: Beta and Gamma functions – infinite integral - definitions– recurrence formula of Gamma functions – properties of Beta and Gamma functions- relation between Beta and Gamma functions - Applications.</td></tr>
<tr><td colspan="6">UNIT-V: Geometric and Physical Applications of Integral calculus.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 3. D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd. 4. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer Undergraduate Mathematics Series, 2001 (second edition).
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae

CLO 2: Evaluate double and triple integrals and problems using change of order of integration

CLO 3: Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution

CLO 4: Explain beta and gamma functions and to use them in solving problems of integration

CLO 5: Explain Geometric and Physical applications of integral calculus

	POs						PSOs		
	1	2	3	4	5	6	1	2	3

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">VECTOR CALCULUS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE COURSE – CC V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions.
• Skills in evaluating line, surface and volume integrals.
• The ability to analyze the physical applications of derivatives of vectors.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I: Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors - Derivative of a product of a scalar and a vector point function - Derivative of a scalar product and vector product.</td></tr>
<tr><td colspan="6">UNIT-II: The vector operator ‘del’, The gradient of a scalar point function - Divergence of a vector - Curl of a vector - solenoidal and irrotational vectors – simple applications.</td></tr>
<tr><td colspan="6">UNIT-III:Laplacian operator, Vector identities - Line integral - simple problems.</td></tr>
<tr><td colspan="6">UNIT-IV: Surface integral - Volume integral – Applications.</td></tr>
<tr><td colspan="6">UNIT-V: Gauss divergence Theorem, Stoke’s Theorem, Green’s Theorem in two dimensions.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	P. Duraipandiyan and KayalalPachaiyappan, Vector Analysis, S.Chand& Co. Ltd.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Find the derivative of vector and sum of vectors, product of scalar and vector point function and to determine derivatives of scalar and vector products

CLO 2: Applications of the operator 'del' and to Explain soleonidal and ir-rotational vectors

CLO 3: Solve simple line integrals

CLO 4: Solve surface integrals and volume integrals

CLO 5: Verify the theorems of Gauss, Stoke's and Green's(Two Dimension)

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Knowledge about the methods of solving Ordinary and Partial Differential Equations.
• The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I:Ordinary Differential Equations: Variable separable - Homogeneous Equation-Non-Homogeneous Equations of first degree in two variables -Linear Equation - Bernoulli’s Equation-Exact differential equations.</td></tr>
<tr><td colspan="8">UNIT-II: Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y-Equation solvable for x-Clairauts’ form - Linear Equations with constant coefficients-Particular integrals of algebraic, exponential, trigonometric functions and their products.</td></tr>
<tr><td colspan="8">UNIT-III: Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Method of Variation of Parameters.</td></tr>
<tr><td colspan="8">UNIT-IV: Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions – complete integral – singular integral-General integral-Lagrange’s Linear Equations –Simple Applications.</td></tr>
<tr><td colspan="8">UNIT-V: Special methods – Standard forms-Charpit’s Methods – Simple Applications</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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	T.K. ManicavachagomPillay, T. Natarajan, K.S. Ganapathy, Calculus Volume-II, S. Viswanathan Printers and Publishers Pvt. Ltd, 2012.
Reference Books	1. D.A. Murray, Introductory course in Differential Equations, Orient and Longman 2. H.T. H.Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985. 3. Horst R. Beyer, Calculus and Analysis, Wiley, 2010. 4. Braun, M. Differential Equations and their Applications. (3rd Edn.), Springer- Verlag, New York. 1983. 5. TynMyint-U and LognathDebnath. Linear Partial Differential Equations for Scientists and Engineers. (4th Edn.) Birhauser, Berlin. 2007. 6. 6.. Boyce, W.E. and R.C.DiPrima. Elementary Differential Equations and Boundary Value Problems. (7th Edn.) John Wiley and Sons, Inc., New York. 2001. 7. Sundrapandian, V. Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt.Ltd. New Delhi, 2013
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Determine solutions of homogeneous equations, non-homogeneous equations of degree one in two variables, solve Bernoulli's equations and exact differential equations

CLO 2: Find the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions and their products

CLO 3: Find solutions of simultaneous linear differential equations, linear equations of second order and to find solutions using the method of variations of parameters

CLO 4: Form a PDE by eliminating arbitrary constants and arbitrary functions,
find complete, singular and general integrals, to solve Lagrange's equations

CLO 5: Explain standard forms and Solve Differential equations using Charpit's method

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">Optimization Techniques</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To develop the skill of formulation of LPP and different techniques to solve it. To know the applications of Transportation and Assignment problems. To study the optimizing problems in Sequencing, Networking and Inventory control.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">Unit – I Linear Programming Problem
Introduction – Formulation of the Problem – Illustration on Mathematical Formulation of LPPs. Graphical Solution Method – Simplex method — Duality theory.
(Chapters 2, 3, 4, 6(6.1 – 6.3))

Unit – II Transportation Problem
Transportation –Balanced and Unbalanced problems – Assignment Problem – Balanced and Unbalanced problems.
(Chapter 8, Sections -8.1, 8.2, 8.3, 8.4 8.5; ,Chapter 9, Sections: 9.1, 9.2, 9.3, 9.4, 9.5;)

Unit – III Sequencing Problem
Problems with n jobs through 2 machines - Problems with n jobs through 3 machines- Problems with n jobs through k machines.
(Chapter 12: Sections 12.1 -12.5)

Unit –IV Inventory Control
Inventory models: Introduction – Deterministic models- single item static models with and without shortages- Inventory Models with Probabilistic Demand.
(Chapter 14, Sections: 14.1 - 14.8)

Unit –V Network Scheduling by PERT/CPM
Introduction –Basic terms – Rules of Network Construction – Numbering the events - Time Analysis - Critical Path Method (CPM) – Programme Evaluation and Review Technique (PERT).
(Chapter 13, Sections: 13.1-13.8)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication, Transferrable Skill and designing mathematical models towards solving mathematical applications
Recommended Text	S. Kalavathy, Operations Research – Vikas Publishing House Pvt. Ltd., 4th Edition, Second Reprint 2018.
Reference Books	1. Hamdy A. Taha, Operations Research – An Introduction, Pearson, Seventh edition, 2014. 2. P. K Gupta, Problems in Operations Research, 2-e, S. Chand & Sons, New Delhi, 1983. 3. R. Pannerselvam, Operations Research, Prentice Hall of India Pvt. Ltd., New Delhi, 2005. 4. S. D. Sharma, Operations Research, KedarNath Ram Nath and Co, Meerut, 1998. 5. J. K. Sharma, Operations Research Theory & Applications – Trinity Press, India, Sixth edition, 2016. 6.KantiSwarup, P. K. Gupta, Man Mohan, Operations Research – Sultan Chand & Sons, Reprint 2013.
Website and e-Learning Source	http://cs.bme.hu/fcs/operations research.pdf

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	describe the concepts involved in solving linear programming problems which are widely used in business operations.	K1
CO2	apply mathematical techniques used in optimizing transportation and assignment problems.	K2
CO3	solve job sequencing problems.	K3
CO4	breakdown different inventory models	K4
CO5	evaluate PERT, CPM problems and develop applications	K5, K6

	CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	

	1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
	2	3	3	2	2	2	3	2	2	2	2	2	3	2.33
	3	3	2	2	2	3	3	2	3	3	2	2	3	2.5
	4	3	3	2	3	3	3	2	3	3	3	2	2	2.67
	5	3	2	2	3	3	2	2	3	3	2	2	3	2.5

Title of the Course	**ELEMENTS OF MATHEMATICAL ANALYSIS**					
Paper Number	**CORE COURSE – CC VIII**					
Category Core	**Year**	II	**Credits**	5	**Course Code**	
	Semester	IV				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	5		--	5		
Pre-requisite	12th Standard Mathematics					
Objectives of the Course	• Identify and characterize sets and functions and Understand, test and analyze the convergence and divergence of sequences, series. • Understand metric spaces with suitable examples					
Course Outline	**UNIT-I:** Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability- real numbers- least upper bounds.					
	UNIT-II: Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences–divergent sequences- bounded sequences-monotone sequences					
	UNIT-III: Operations on convergent sequences – operations on divergent sequences – limit superior and limit inferior-Cauchy sequences.					
	UNIT-IV: Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series-conditional convergence and absolute convergence- tests for absolute convergence.					
	UNIT-V: Limits and Metric Spaces: Limit of a function on a real line - Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces: Function continuous at a point on there a line-Function continuous on a metric space.					

Extended Professional Component (is a part ofinternal component only, Not to be included in the External Examination question paper)	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. Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020). 2. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer, 2011. 3. G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon Press, New York, 1965.
Reference Books	1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002. 2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000. 3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983. 4. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain in detail about sets and functions, equivalence and countability and the LUB axiom

CLO 2: Explain Sequence and Subsequence of real numbers and to find the limit of sequence to test for convergent, divergent, bounded and monotone sequences

CLO 3: Explain the operations on convergent and divergent sequences and to Explain the concepts of limit superior and limit inferior and the notion of Cauchy sequences

CLO 4: Classify the series of real numbers and the alternating series and their convergence and divergence, the conditional convergence and absolute convergence and solve problems on convergence of the sequences

CLO 5: Explain about the metric spaces and functions continuous on a Metric space

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ABSTRACT ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Concepts of Sets, Groups and Rings.
• Construction, characteristics and applications of the abstract algebraic structures</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange’s Theorem-A counting principle – Examples</td></tr>
<tr><td colspan="8">UNIT-II: Normal subgroups and Quotient group- Homomorphism-Automorphism -Examples.</td></tr>
<tr><td colspan="8">UNIT-III:Cayley’s Theorem-Permutation groups - Examples</td></tr>
<tr><td colspan="8">UNIT-IV:Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.</td></tr>
<tr><td colspan="8">UNIT-V: The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Topics in Algebra–I.N.Herstein, Wiley Eastern Ltd. Second Edition (1st January 2006)</td></tr>
</table>

Reference Books	1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002. 2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011. 3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain groups, subgroups and cyclic groups

CLO 2: Explain about Normal subgroup, Quotient groups, Homomorphisms and Automorphisms and verify the functions for homomorphism and automorphism properties

CLO 3: Explain Permutation groups and apply Cayley's theorem to problems

CLO 4: Explain Rings, Ideals and Quotient Rings and examine their structure

CLO 5: Discuss about the field of quotient of an integral domain and to Explain in detail about Euclidean Rings

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">REAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Real Numbers and properties of Real–valued functions.
• Connectedness, Compactness, Completeness of Metric spaces.
• Convergence of sequences of functions, Examples and counter examples</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Continuous Functions on Metric Spaces: Open sets– closed sets–Discontinuous function on R^1. Connectedness, Completeness and Compactness: More about open sets-Connected sets.</td></tr>
<tr><td colspan="8">UNIT-II: Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.</td></tr>
<tr><td colspan="8">UNIT-III: Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral-properties of Riemann integral.</td></tr>
<tr><td colspan="8">UNIT-IV:Derivatives-Rolle’s theorem, Law of mean, Fundamental theorems of calculus.</td></tr>
<tr><td colspan="8">UNIT-V: Taylor’s theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Methods of Real Analysis-Richard R.Goldberg (John Wiley & sons, 2nd edition) (Indian edition –Oxford and IBH Publishing Co, New Delhi, 1st January 2020)
Reference Books	1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017). 2. Mathematical Analysis Tom M A postal, Narosa Publishing House, 2nd edition (1974), Addison-Wesley publishing company, New Delhi.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain the concepts of Continuous and Discontinuous functions, open and close sets, Connectedness, Completeness and Compactness

CLO 2: Explain the concepts of bounded and totally bounded sets, continuity of inverse functions and Uniform continuity

CLO 3: Define the sets of measure zero, to Explain about the existence and properties of Riemann integral

CLO 4: Explain the concept of differentiability and to Explain Rolle's theorem, Law of mean, and Fundamental theorem of calculus

CLO 5: Explain the point wise and uniform convergence of sequence of function and to derive the Taylor's theorem

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL MODELLING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE – CC XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2"></td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Construction and Analysis of Mathematical models found in real life problems.
• Modelling through differential and difference equations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I:Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.</td></tr>
<tr><td colspan="6">UNIT-II:Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.</td></tr>
<tr><td colspan="6">UNIT-III:Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.</td></tr>
<tr><td colspan="6">UNIT – IV:Introduction to difference equations.</td></tr>
<tr><td colspan="6">UNIT-V:Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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	J N Kapur, Mathematical Modeling, New Age International publishers(2009).
Reference Books	1. Mathematical Modeling by Bimalk. Mishra and DipakK.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009) 2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014 3. Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017 4. Mark M. Meerschaert: Mathematical Modeling, Elsevier Publ., 2007. 5. Edward A. Bender: An introduction to mathematical Modeling, CRC Press,2002 6. Walter J. Meyer, Concepts of Mathematical Modeling, Dover Publ., 2000
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain simple situations requiring Mathematical Modelling and to Determine the characteristics of such models

CLO 2: Model using differential equations in-terms of linear growth and Decay models

CLO 3: Model using systems of ordinary differential equations of first order, to discuss about various models under the categories ‘Epidemics’ and ‘Medicine’

CLO 4: Explain in detail about difference equations

CLO 5: Model using difference equations

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

Title of the Course		PROJECT WITH VIVA VOCE					
Paper Number		CORE COURSE – CC XII					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		5		-		--	5

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">LINEAR ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">6</td><td colspan="2"></td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Vector Spaces, linear dependence and independence of vectors .Dual spaces, Inner product and norm – orthogonalization process.
• Linear transformations. Various operators on vector spaces</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced - Echelon form.</td></tr>
<tr><td colspan="8">UNIT-II: Linear Dependence and Linear independence – Bases – Dimensions</td></tr>
<tr><td colspan="8">UNIT-III: Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces</td></tr>
<tr><td colspan="8">UNIT – IV: Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem</td></tr>
<tr><td colspan="8">UNIT-V: Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th edition (2018) Pearson
Reference Books	1. I.N.Herstein, Topics in Algebra, Wiley EasternLtd. Second Edition, 2006. 2. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd. 3. John B.Fraleigh, First course in Algebra, Addison Wesley. 4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004. 5. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. 6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005. 7. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Acquire a detailed knowledge about vector spaces and subspaces

CLO 2: Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis

CLO 3: Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces

CLO 4: Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation

CLO5: Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE COURSE – CC XIV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">6</td><td></td><td>--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• Apply concept and consequences of analyticity and C-R equations.
• Understand the concept of mappings and transformations.
• Compute complex contour integrals and applying Cauchy‘s integral in various versions.
• Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Analytic functions: Functions of a Complex variable –Limits –Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions.</td></tr>
<tr><td colspan="7">UNIT-II:Conformal mapping: Mappings – Mapping by exponential function – Linear transformation – The transformation w= $\frac{1}{z}$– Mappings by $\frac{1}{z}$ – Linear fractional transformations (bilinear)</td></tr>
<tr><td colspan="7">UNIT-III:Complex Integration: Contour integrals– Some examples – Simply and Multiply connected domains– Cauchy integral formula – Formula for derivatives– Liouville’s theorem –Fundamental theorem of Algebra– Maximum modulus principle.</td></tr>
</table>

	UNIT – IV:Sequences and Series: Convergence of sequences – Convergence of series– Taylor's series – Laurent series– Absolute and uniform convergence of power Series – Continuity of sums of power series–Integration & differentiation of power series
	UNIT-V:Residues and Poles: Isolated singular points – Residues– Cauchy Residue theorem –Residue at infinity– The three types of isolated singular points –Residues at poles – Zeros of analytical functions – Zeros and poles – Evaluation of real improper integrals (excluding poles on the real axis).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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	S. Arumugam, A. ThangapandiIssac, A. Somasundaram, Complex Analysis, Scitech Publications, Pvt. Ltd, Chennai.

Reference Books	1. Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008 2. Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997. 3. Richard A. Silverman, Introductory Complex Analysis. Dover Publications, 1972. 4. S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006. 5. Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Explain about analytic functions, their differentiation and continuity and to verify the Harmonic functions using analyticity conditions

CLO 2: Explain the concept of Conformal mappings and mappings by linear transformations and linear fractional transformations

CLO 3: Explain about the integrations of functions over simply and multiply connected domains and to derive the Cauchy integral formula, Liouvlle's theorem, Fundamental theorem of Algebra and Maximum Module Principle

CLO 4: Find the convergence the sequences and series, to derive Taylor's and Laurent's series

CLO 5: Find the nature of singularities, to find the residue of a given function at a given singular point, to Explain about zeros and poles and to evaluate real improper integrals (Excluding poles on the real axis)

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

CLO3	3	3	3	2	1	-	3	3	2
CLO4	3	3	3	2	1	-	3	3	2
CLO5	3	3	3	2	1	-	3	3	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MECHANICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">6</td><td colspan="2"></td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• Equilibrium of a particle under the action of given forces
• Simple Harmonic Motion
• Projectiles</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I:Force: Newton’s laws of motion – Resultant of two forces on a particle - Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane.</td></tr>
<tr><td colspan="8">UNIT-II:Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces – Forces acting along a Triangle - A specific reduction of Forces: Reduction of coplanar forces into a force and couple – Problems involving frictional forces.</td></tr>
<tr><td colspan="8">UNIT-III:Work, Energy and Power: Work – Conservative field of force – Power -Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.</td></tr>
<tr><td colspan="8">UNIT – IV:Projectiles: Forces on a projectile – Projectile projected on an inclined plane</td></tr>
<tr><td colspan="8">UNIT-V:Central Orbits: General orbits – Central orbit – Conic as a centered orbit</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	P. Duraipandiyan, LaxmiDuraipandian, MutthamizhJayapragasam, Mechanics, S.Chand Publications, Pvt. Ltd, New Delhi, 2005.
Reference Books	1. J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012. 2. J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8thedn, Wiley and sons Pvt ltd., New York, 2015. 3. A. K. Dhiman,P.Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics) ,McGraw Hill Education(India) Private Limited, New Delhi, 2015.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will able to

CLO 1: Define Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle, Limiting equilibrium of a particle on an inclined plane.

CLO 2: Define Moment of a force and Couple with examples. Define Parallel Forces and Forces acting along a Triangle, Solve problems on frictional forces

CLO 3: Define work, energy, power, rectilinear motions under varying forces. Define Simple Harmonic Motion and find its Geometrical representation.

CLO 4: Define Projectile, impulse, impact and laws of impact. Prove that the path of a projectile is a parabola. Find the direct and oblique impact of smooth elastic spheres

CLO 5: Define central orbits, explain conic as centered orbits and solve problems related to central orbits

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

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

Title of the Course	**ALGEBRAIC STRUCTURES**						
Paper Number	**CORE COURSE – CC XVI**						
Category Core	**Year**	IV	**Credits**	4	**Course Code**		
	Semester	VII					
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	4	1	--	5			
Pre-requisite	UG level Modern Algebra						
Objectives of the Course	To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms						
Course Outline	**UNIT-I :** Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only). **Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)**						
	UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules **Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)** **Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)** **Chapter 4: Section 4.5**						
	UNIT-III : Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations. **Chapter 6: Sections 6.4, 6.5**						
	UNIT-IV : Jordan form - rational canonical form. **Chapter 6 : Sections 6.6 and 6.7**						
	UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form. **Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)**						

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.
Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 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

	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 Course	**REAL ANALYSIS I**					
Paper Number	**CORE COURSE – CC XVII**					
Category Core	**Year**	IV	**Credits**	4	**Course Code**	
	Semester	VII				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	4	1	--	5		
Pre-requisite	UG level real analysis concepts					
Objectives of the Course	To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.					

Course Outline	**UNIT-I : Functions of bounded variation** - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded 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 : Sections 8.8, 8.15, 8.17, 8.18
	UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison 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 – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals. Chapter - 7 : 7.15 to 7.26
	UNIT-IV : Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – 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 - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
Reference Books	1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976. 2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976. 3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991. 4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991. 5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964. 6. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.
Website and 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)

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.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XVIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VII</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
4</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Linear equations with constant coefficients
Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.
Chapter 2: Sections 1 to 6</td></tr>
<tr><td colspan="8">UNIT-II : Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators.
Chapter 2 : Sections 7 to 12.</td></tr>
<tr><td colspan="8">UNIT-III : Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.
Chapter : 3 Sections 1 to 8 (Omit section 9)</td></tr>
<tr><td colspan="8">UNIT-IV :Linear equation with regular singular points
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)</td></tr>
<tr><td colspan="8">UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.
Reference Books	4. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967. 5. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974. 6. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. 7. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971 8. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001 9. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.
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)

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.

	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

<table>
<tr><td>Title of the Course</td><td colspan="6">ADVANCED ALGEBRA</td></tr>
<tr><td>Paper Number</td><td colspan="6">CORE COURSE – CC X1X</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td>Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>5</td><td>1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">Algebraic Structures</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2</td></tr>
<tr><td colspan="6">UNIT-II : Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="6">UNIT-III : Elements of Galois theory.
Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="6">UNIT-IV : Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)</td></tr>
<tr><td colspan="6">UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.
Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
Chapter 7 : Sections 7.3 and 7.4</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">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)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td>Recommended Text</td><td colspan="6">I.N. Herstein. Topics in Algebra (II Edition) Wiley EasternLimited, New Delhi, 1975.</td></tr>
</table>

Reference Books	1. M.Artin, *Algebra,* Prentice Hall of India, 1991. 2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition) 3. I.S.Luther and I.B.S.Passi, *Algebra,* Vol. I –Groups(1996); Vol. II *Rings,*Narosa Publishing House , New Delhi, 1999 4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997. 5. N.Jacobson, *Basic Algebra,* Vol. I & II Hindustan Publishing Company, New Delhi.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 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.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE – CC XX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">4</td><td>1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)</td></tr>
<tr><td colspan="6">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)</td></tr>
<tr><td colspan="6">UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
</table>

	UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1 **Chapter 12 : Section 12.1 to 12.14 (Apostol)**
	UNIT-V : Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem- The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions. **Chapter 13 : Sections 13.1 to 13.7 (Apostol)**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II) 2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Reference Books	1. Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press, 1951. 2. Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.1971. 3. Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988. 4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979. 5. Malik,S.C. and Savita Arora. *Mathematical Analysis,* Wiley Eastern Limited. New Delhi, 1991. 6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 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.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XXI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td>Course Code</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)</td></tr>
<tr><td colspan="8">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 4 : Sections 4.1 to 4.11</td></tr>
<tr><td colspan="8">UNIT-III :Method of separation of variables: Separation of variable-Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)</td></tr>
<tr><td colspan="8">UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.
Chapter 8 : Sections 8.1 to 8.9</td></tr>
</table>

	UNIT-V : Green's Function: The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem. **Chapter 10 : Section 10.1 to 10.9**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	TynMyint-U and Lokenath Debnath, *Partial Differential Equations 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, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations 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, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
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)

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XXII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Complex Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy’s theorem and evaluation of definite integral and harmonic functions</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Cauchy’s Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:
Removable Singularities-Taylors’s Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3
Chapter 4 : Section 3 : 3.1 to 3.4</td></tr>
<tr><td colspan="8">UNIT-II :The general form of Cauchy’s Theorem : Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy’s Theorem - Proof of Cauchy’s theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7
Chapter 4 : Section 5: 5.1 and 5.2</td></tr>
<tr><td colspan="8">UNIT-III :Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3
Chapter 4 : Sections 6 : 6.1 to 6.3</td></tr>
<tr><td colspan="8">UNIT-IV :Harmonic Functions and Power Series Expansions:
Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor’s Series – Laurent series .
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3</td></tr>
<tr><td colspan="8">UNIT-V: Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen’s formula – Hadamard’s Theorem
Chapter 5 : Sections 2.1 to 2.4
Chapter 5 : Sections 3.1 and 3.2</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
Reference Books	8. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 9. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 10. E. Hille, *Analytic function Thorey* (2 vols.), Gonm& Co, 1959. 11. M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XXIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2 : Sections 2.1 to 2.9</td></tr>
<tr><td colspan="8">UNIT-II : Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8</td></tr>
<tr><td colspan="8">UNIT-III: Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4 : Sections 4.1 to 4.7</td></tr>
<tr><td colspan="8">UNIT-IV : Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)</td></tr>
<tr><td colspan="8">UNIT-V: Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz, *Probability Theory and Mathematical Statistics,* John Wiley 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, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996. 5. V.K.Rohatgi*An 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 e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course Learning Outcome (for Mapping with POs and PSOs)

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE COURSE – CC XXIV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Topological spaces : Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.
Chapter 2 : Sections 12 to 17</td></tr>
<tr><td colspan="8">UNIT-II :Continuous functions: Continuous functions – the product topology – The metric topology.
Chapter 2 : Sections 18 to 21 (Omit Section 22)</td></tr>
<tr><td colspan="8">UNIT-III :Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness.
Chapter 3 : Sections 23 to 25.</td></tr>
<tr><td colspan="8">UNIT-IV : Compactness : Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.</td></tr>
<tr><td colspan="8">UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">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)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	James R. Munkres, *Topology* (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)
Reference Books	1. J. Dugundji ,*Topology* , 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, *General Topology*, Van Nostrand, Reinhold Co., New York 4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970. 5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 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

<table>
<tr><td colspan="2">itle of the Course</td><td colspan="7">RESOURSE MANAGEMENT TECHNIQUES</td></tr>
<tr><td colspan="2">PaperNumber</td><td colspan="7">CORE COURSE – CC XXV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">CORE X</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2" rowspan="2">InstructionalHours perweek</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">LabPractice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG Level Linear Programming</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The main objectives of this course are to:
To introduce the methods of optimization techniques.
To understand the theory of optimization techniques for solving various types of optimization problems.
To provide with basic skills and knowledge of optimization techniques and their applications.
To make the students familiar in solving techniques, analysing the results and propose recommendations to the decision-making processes.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="7">UNIT-I : Linear programming: Formulation – graphical solution. Simplex method. Chapter 6</td></tr>
<tr><td colspan="7">UNIT-II Transportation problem: Mathematical Formulation. Basic Feasible solution. North WestCorner rule, Least Cost Method, Vogel‟s approximation. Optimal Solution. Chapter 9
.</td></tr>
<tr><td colspan="7">UNIT-III : Sequencing problem: n jobs on 2 machines – n jobs on 3 machines – two jobs on m machines – n jobs on m machines. Chapter 10</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV Game theory : Two-person Zero-sum game with saddle point – without saddle point –dominance – solving 2 x n or m x 2 game by graphical method. Chapter 12</td></tr>
</table>

	UNIT-V : Network: Project Network diagram – CPM and PERT computations. Chapter 13
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
RecommendedText	: Operations Research, by R.K.Gupta , Krishna Prakashan India (p),Meerut Publications
ReferenceBooks	1. Gauss S.I. Linear programming , McGraw-Hill Book Company. 2. Gupta P.K. and Hira D.S., Problems in Operations Research , S.Chand& Co. 3. Kanti Swaroop, Gupta P.K and Manmohan , Problems in Operations Research, Sultan Chand & Sons 4. Ravindran A., Phillips D.T. and Solberg J.J., Operations Research, John wiley& Sons. 5. Taha H.A. Operation Research, Macmillan pub. Company, New York. 7. Linear Programming, Transporation, Assignment Game by Dr.Paria, Books and 6.
Websiteand e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Outcomes:

At the completion of the Course, the Students will able to

- **CLO1:** Formulate a real-world problem as linear programming and queuing models.
- **CLO2:** Assess the existence and uniqueness of solutions and derive necessary and sufficient optimality conditions for a given optimization problem.
- **CLO3:** Understand the mathematical tools that are needed to solve optimization problems.
- **CLO4:** Ability to apply the theory of optimization methods and algorithms to develop and solving various
  Types of optimization problems
- **CLO5:** Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Functional Analysis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE COURSE – CC XXVI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>X</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td>--</td><td colspan="3">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student’s skills and confidence in mathematical analysis and proof techniques.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I :Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.
Chapter 9:Sections 46-51</td></tr>
<tr><td colspan="6">UNIT-II :Hilbert Spaces: The definition and some simple properties– Orthogonal complements–Ortho normal sets–The conjugate space H^*-The adjoint of an operator–self-adjoint operators-Normal and unitary operators – Projections.
Chapter10:Sections52-59</td></tr>
<tr><td colspan="6">UNIT-III : Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.
Chapter 11:Sections 60-62</td></tr>
</table>

	UNIT-IV : General Preliminaries on Banach Algebras**:** The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity. **Chapter 12:Sections 64-69**
	UNIT-V: The Structure of Commutative Banach Algebras: The Gelfand mapping – Application of the formula $r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand-Neumark theorem. **Chapter 13:Sections 70-73**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International,1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

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.

	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 Course	**DIFFERENTIAL GEOMETRY**							
Paper Number	**CORE COURSE – CC XXVII**							
Category Core	**Year**	V	**Credits**	4	**Course Code**			
	Semester	X						
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**		**Total**	
	4		1		--		5	
Pre-requisite	Linear Algebra concepts and Calculus							
Objectives of the Course	This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored							
Course Outline	**UNIT-I : Space curves:** Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies. **Chapter I : Sections 1 to 9.**							

	UNIT-II :Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties. **Chapter II: Sections 1 to 9.**
	UNIT-III : Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss-Bonnet Theorem – Gaussian curvature- surface of constant curvature. **Chapter II: Sections 10 to 18.**
	UNIT-IV : Non Intrinsic properties of a surface: The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces. **Chapter III: Sections 1 to 8.**
	UNIT-V :Differential Geometry of Surfaces : Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics. **Chapter IV : Sections 1 to 8 (Omit 9 to 15).**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	T.J.Willmore, *An Introduction to Differential Geometry,* Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)

Reference Books	5. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950. 6. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry,* Inter science Publishers, 1963. 7. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 8. J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag 1979.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, 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 surface

	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 Course		**PROJECT WITH VIVA VOCE**					
Paper Number		**CORE COURSE – CC XXVIII**					
Category	Core	**Year**	V	**Credits**	4	**Course Code**	
		Semester	X				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		4		--	5		
Pre-requisite		UG Level Mathematics					

Generic Elective Courses (Allied Courses)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">A. Allied Physics-I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE COURSE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2"></td><td></td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. To understand the basics of gravitation and to study the properties of matter.
2. To learn the law of thermo electric circuits and thermoelectric diagrams.
3. To teach the growth and decay of a transient current and magnetometer.
4. To explain production of ultrasonics and reverberation time.
5. To know the basics of laser and fibre optics principles and applications.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-1 : PROPERTIES OF MATTER
Gravitation: Acceleration due to gravity -Determination of ‘g’ by Simple pendulum -Drawbacks of simple pendulum –Determination of time period of compound pendulum - ‘g’ by compound

pendulum -Centre of Oscillation and Centre of Suspension are interchangeable-Determination of ‘g’ by Bar/compound pendulum.

Elasticity: Bending of beams-Expressionforbendingmoment-CantileverDepressionattheloaded end of a cantilever Expression for Young’s modulus -non–uniform bending-Pin and microscope method.

Torsion : Torsion couple – Potential energy in a twisted wire – Torsional pendulum – Time period-Determination of rigidity modulus by Torsional oscillation (without masses).

Viscosity: Viscosity of a liquid -Viscous force - Co-efficient of viscosity of a liquid – Poiseuille’s formula-Experimental</td></tr>
</table>

	method using Burette-Effect of temperature and pressure on viscosity-applications. Surface Tension: Surface tension of a liquid-Surface Tension and interfacial surface tension by the method of drops-applications.
	UNIT-2 THERMO ELECTRICITY Seeback, Peltier and Thomson effects - laws of thermoelectric circuits -Peltier coefficient - Thomson coefficient- application of the thermodynamics to a thermocouple and expressions for Peltier and Thomson coefficients- thermoelectric power and thermo electric diagrams.
	UNIT-3 **TRANSIENT CURRENT AND MAGNETISM** Growth and decay of current in a circuit containing resistance and inductance- Growth And decay of charge in circuit containing resistance and capacitor- growth and decay of charge in a LCR circuit– condition for the discharge to be oscillatory– frequency of oscillation. Magnetism -Magnetic moment and pole strength of a magnet – Deflection magnetometer – Tan C Position-Vibration magnetometer –Theory–Period of Oscillation–Determination of M and B_H using the deflection magnetometer and the vibration magnetometer.
	UNIT-4 **ACOUSTICS** Sound: Transverse vibration of strings-Velocity and frequency of vibrations of a stretched string- laws-Sonometer- A.C.Frequency-Steel wire-Brass wire. Introduction to Ultrasonics – Piezo electric effect–production by Piezo electric method – properties– applications-Acoustics of buildings –reverberation time–derivation of Sabine's formula– determination of absorption coefficient-Acoustic aspects of halls and auditoria.

	UNIT-5 Lasers and Fibre Optics Teaching h Laser: Introduction - Principles of laser - Einstein's explanation for stimulated emission – Differences between stimulated and spontaneous emission-Population inversion–Properties of laser - Types of lasers-He-Ne Laser –Semiconductor Laser-Applications of laser Fibre optics: Basic principle of an optical fibre -Total internal reflection-Basic structure of an optical fibre -Numerical aperture –Coherent bundle – Attenuation and dispersion -classification of optical fibres- step index and graded index fibers– single mode and multimode fibers- Fibre optic communication system block diagram.-applications .
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired From this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Text	**Unit1and Unit4** 1. R. Murugesan and Kiruthiga Sivaprasath, Properties of Matter and Acoustics, S.Chand & Co. New Delhi, Kindle edition. Unit2and Unit3 1. Murugesan, Electricity& Magnetism, S.Chand & Co.New Delhi,2019. Unit5 1. N Subrahmanyam, BrijLal and M.NAvadhanulu, AText Book of Optics, S.Chand & Co. New Delhi, Revised Edition as per UGC model syllabus.
Reference Books	1. BrijLal and N Subrahmanyam, Electricity and Magnetism, S Chand & Company Pvt Ltd, NewDelhi, 2000. 2. D.C.Tayal, Electricity and Magnetism ,Himalaya Publishing

	House,Bombay,2014. 3. BrijLal and N.Subrahmanyam, A Text Book of Sound,Vikas Publications,NewDelhi. 4. C.L.Arora, Physics for Degree Students B.Sc First Year, S.Chand Publishing,2013. 5. K.Thyagarajan and Ajay Ghatak, Introduction to Fibre optics-, CambridgeUniversity. 6. Ajay Ghatak and K.Thyagarajan, Fiber optics and Lasers- The two revolutions,Macmillan,2006. 7. K.Thyagarajan and Ajay Ghatak, Lasers; Fundamentals and applications, Springer. 8. Modern Physics –R,Murugeshan, Kiruthiga Sivaprasath,S.Chand &Co,NewDelhi,2016.

E-Materials

1. https://courses.lumenlearning.com/physics/chapter/16-4-the-simple-pendulum/
2. https://www.youtube.com/watch?v=aw0_seEt4v0
3. https://en.wikipedia.org/wiki/Thermoelectric_effect
4. https://www.youtube.com/watch?v=S0I37M2sx_0
5. https://physicscatalyst.com/elecmagnetism/growth-and-delay-charge-R-C-circuit.php
6. https://www.youtube.com/watch?v=PLQQPXot6vE
7. https://www.youtube.com/watch?v=d0_Eff4MXwM
8. https://www.techglads.com/cse/sem1/production-of-ultrasonics-by-piezoelectricmethods/
9. https://thefactfactor.com/facts/pure_science/physics/optical-fibre/5159/
10. https://www.youtube.com/watch?v=auk1OS0SVWc(Tamilvideo)

Course Learning Outcome (for Mapping with POs and PSOs)

1. After studied unit-1,the student will be able to find the acceleration due to gravity at a place using simple pendulum and compound pendulum. Also can know the properties
of matter like elasticity, viscosity and surface tension.

2. After studied unit-2, the student will be able to learn thermo emf using Seebeck and Peltier effects and hence understand thermo electric circuits.
3. After studied unit-3, the student will be able to explain growth and decay of a transient current in a circuit containing resistance-inductance, resistance-capacitance and LCR in series. Also will be able to determine the horizontal components of earth's magnetic induction at a place using deflection magnetometer in Tan C position.
4. Afterstudiedunit-4, the student will be able to derive the expression for the

velocity of a sound in a stretched string and hence they can determine the frequency of A.Cmains.

5. Afterstudiedunit-5, the student will be able to understanding the principle of laser and can demonstrate the working of He-Ne laser and applications of laser. Also, the student will be able to learn the fibre optics, structure and application in communication.

Matching table (Put Yes/No in the appropriate box)

Unit	(i)Remembering	(ii)Understanding	(iii)Applying	(iv)Analyzing	(v)Evaluating	(vi)Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	No	Yes	No	No

Mapping with Programme Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	M	S	S
CO2	S	S	S	M	M	M	S	M	S	S
CO3	S	S	S	S	S	M	S	M	S	S
CO4	S	S	S	S	S	M	S	M	S	S
CO5	S	S	S	M	S	M	S	M	S	S

CO–Course Outcome PO–Programme Outcom eS – Strong M- Medium L-Low(Low has to be avoided)

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

Elective II: Allied Physics Practical -I

(2024-2025 onwards)

Semester: I **Paper type: Allied Practical**

Paper code: **Name of the Paper:** **Allied Physics Practical I** **Credit: 2**

Total Hours per Week: 3 **Practical Hours: 45**

…… List of

Experiments (Any 7 Experiments only)

1. Determination of 'g' using Compound pendulum.
2. Young's modulus- Non-Uniform bending –Pin &microscope
3. Rigidity Modulus –Torsional oscillation method (without masses).
4. Rigidity Modulus–Static Torsion method using Scale and Telescope.
5. Surface tension and inter facial surface tension by Drop Weight method.
6. Sonometer–Frequency of a Tuning fork.
7. Sonometer–Determination of A.C.frequency –using steel and brass wire
8. Air Wedge –Determination of thickness of a thin wire
9. Newton's Rings–Radius of Curvature of a convex lens.
10. Spectrometer–Refractive index of a liquid –Hollow prism.

TextBooks

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, S.Viswanathan, Printers & Publishers PrivateLtd,Chennai,2018.
2. M.N.Srinivasan,S. Balasubramanian,R. Ranganathan,AText Book of Practical Physics ,Sultan Chand & Sons, NewDelhi, 2015.

ReferenceBooks

1. Dr.S. Somasundaram, Practical Physics, Apsara publications, Tiruchirapalli, 2012.
2. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">B. NUMERICAL METHODS with Applications- I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE - I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">ELECTIVE</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per Week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th StandardMathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">➢ To know the methods of solving simultaneous linear equations.
➢ To acquire knowledge about forward differences and Backward differences and their relationship.
➢ Knowledge about central difference operators and problems based on various central differences formulae.
➢ To study Newton's divided difference formula and problems based on Lagrange's interpolation formula.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UnitI:Solutions of Algebraic and Transcendental Equations: Bisection Method- Iteration Method- Regula-Falsi Method- Newton-Raphson Method.
Chapter 1 :Section 1.1 to1.4</td></tr>
<tr><td colspan="7">UnitII:Solutions of Simultaneous Linear Equations: Gauss-Elimination Method, Gauss-Jordan Method, Crout's Method.
Chapter 2 :Section 2.1 to 2.3</td></tr>
<tr><td colspan="7">Unit III: Finite Differences: E Operators and Relation between them-Differences of Polynomial-Factorial Polynomials.
Chapter 3 :Section 3.1 to 3.4</td></tr>
<tr><td colspan="7">UnitIV: Interpolation with Equal Intervals: Newton's Forward and Backward Interpolation formulae.
Central Differences Formulae: Gauss-Forward and Backward Formulae-Stirling's Formula and Bessel's Formula.
Chapter 4 :Section 4.1to 4.3 (omit 4.1a)
Chapter 5 :Section 5.1to 5.6</td></tr>
<tr><td colspan="7">UnitV: Interpolation with Unequal Intervals: Divided Differences - Newton's Divided Differences Formula for Interpolation -Lagrange's Formula for Interpolation-Inverse Interpolation-Lagrange's method Reversion of Series method.
Chapter 6 :Section 6.1, 6.2, 6.5&6.7</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	P.Kandasamy, K.Thilagavathy (2003) Calculus of Finite differences & Numerical Analysis, S. Chand & Company Ltd., New Delhi-55.
Reference Books	1.B.D. Gupta.(2001) *Numerical Analysis.*Konark Pub. Ltd., Delhi 2. M.K. Venkataraman. (1992) *Numerical methods for Science and Engineering* National Publishing Company, Chennai. 3. S. Arumugam. (2003) *Numerical Methods*, New Gamma Publishing, Palayamkottai. 4. H.C. Saxena. (1991) *Finite differences and Numerical analysis* S.Chand& Co., Delhi
Website and e-Learning Source	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/ https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: After studied unit -1, the student will be able to solve Iteration method- Regula-falsi method- Newton-Raphson method.

CLO2: After studied unit -2, the student will be able to calculate interpolation values by applying Gauss-Elimination method, Gauss-Jordan method.

CLO3: After studied unit -3, the student will be able to calculate Differences of a polynomial-Factorial polynomials.

CLO4: After studied unit -4, the student will be able to estimate Central Differences Formulae.

CLO5: After studied unit -5, the student will be able to estimate the interpolation value for unequal intervals based on Lagrange's formula of inverse interpolation.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3

CLO1	3	1	3	2	4	-	3	2	1
CLO2	2	1	3	1	4	-	3	2	1
CLO3	3	1	3	1	2	-	3	2	1
CLO4	3	1	3	2	4	-	3	2	1
CLO5	3	1	3	2	4	-	3	2	1

<table>
<tr><td>Title of the Course</td><td colspan="6">A. Allied Physics II</td></tr>
<tr><td>Paper Number</td><td colspan="6">ELECTIVE COURSE III</td></tr>
<tr><td rowspan="2">Category Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2"></td><td colspan="2"></td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">1. To study the concept of special theory of relativity.
2. To expose the structure of atom with different models.
3. To know the definition of binding energy and to study about nuclear models
4. Tolearnthedifferentnumbersystemindigitalelectronicsandlogic gates
5. To give an introduction about nanomaterial.</td></tr>
<tr><td>Course Outline</td><td colspan="6">UNIT-1

SPECIAL THEORY OF RELATIVITY
Frames of reference-inertial frames and non-inertial frames-Galilean transformations -Michelson- Morley experiment-interpretation of results - postulates of special theory of relativity Lorentz transformation equations -length contraction - time dilation – transformation of velocities – variation of mass with velocity-Mass-energy equation.</td></tr>
<tr><td></td><td colspan="6">UNIT-2

ATOMIC PHYSICS
Bohr atom model – Critical Potentials - Experimental determination of critical potentials -Franck
and Hertz’s experiment -Sommerfield’s Relativistic atom model The vector atom model – spatial quantization– spinning of an electron –quantum numbers associated with the vector atom model – coupling schemes –LS and jj coupling – the Pauli's exclusion principle –Stern and Gerlach experiment</td></tr>
<tr><td></td><td colspan="6">UNIT-3

NUCLEAR PHYSICS
Binding energy-Binding energy per nucleon-Packing fraction-Nuclear models – liquid Drop model–semi empirical mass formula –merits and</td></tr>
</table>

	demerits-shell model-evidences for shell model – nucl ear radiation detectors – ionization chamber – G. M Counter-Wilson cloud chamber- Particle accelerators-Cyclotron-Betatron.
	Unit-4 **DIGITAL ELECTRONICS** Number systems -Decimal, Binary, Octal and Hexadecimal system – Conversion from One number system to another- Binary Arithmetic - Addition –Subtraction- 1's and 2's complement- Binarycodes-BCDcode– Excess3code,Graycode.NAND,NORandEXOR– functions and Truth tables. NAND & NOR as universal gates-Half adder and Full adder- Half subtractor and Full subtractor using NAND gate only.
	UNIT-5 **NANOMATERIAL** Need and origin of Nano -- Nano and energetic – Top-down and bottom-up approaches– Introductory ideas of 1D, 2D and 3D nanostructured materials – Quantum dots -- Quantum wire – Quantum well-Carbon materials – Allotropes of carbon – Structure of carbon nanotubes – Types of CNTs -Electronic properties of CNTs-synthesis of metal oxide nanomaterial by sol-gel method- Morphology-Scanning Electron Microscope (SEM)- Principle and Instrumentation- Applications of nanomaterial in electronics & communication, healthcare, sensors, clothes, paints.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)

Skills acquired From this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Text	1. Modern Physics–R, Murugeshan, KiruthigaSivaprasath, S. Chand&Co, New Delhi,2016 Unit4 1. V.Vijayendran, Introduction to Integrated Electronics (Digital & Analog), S.Viswanathan, Printers & Publishers Private Ltd, Chennai,2007 Unit5 1. V.Raghavan, *Material Science and Engineering*, PrenticeHallIndia.,2004.2.
Reference Books	1. Allied Physics–R.Murugesan S.Chand &Co. New Delhi,2005. 2. A Textbook of Digital electronics–R.S.Sedha, S.Chand&Co,2013 3. Malvino and Leech, Digital Principles and Application, 4th Edition, Tata McGrawHill, New Delhi, 2000. 4. Dr.M.N. Avadhanulu, *Materialscience*, S.Chand&Company,NewDelhi,2014. 5. M.Arumugam, *Materialscience*, Anuradhapublishers,1990. 6. V.Rajendran, *MaterialScience*,Tata McGraw Hill Ltd,NewDelhi,2001. 7. D.C.Tayal, NuclearPhysics, Himalaya Publishing House,2009.

Course Learning Outcome (for Mapping with POs and PSOs)

E-Materials

1. https://en.wikipedia.org/wiki/Galilean_transformation
2. https://www.youtube.com/watch?v=NH3_IlkSB9s
3. https://www.youtube.com/watch?v=EEWuUst2GK4
4. https://en.wikipedia.org/wiki/Vector_model_of_the_atom
5. https://www.tutorialspoint.com/what-is-a-geiger-muller-counter
6. https://www.youtube.com/watch?v=jxY6RC52Cf0
7. https://www.tutorialspoint.com/digital_circuits/digital_circuits_number_systems.htm
8. https://www.youtube.com/watch?v=4ae9sJBBkvw
9. https://en.wikipedia.org/wiki/Nanomaterials
10. https://www.youtube.com/watch?v=mPxoJz6treE(Tamilvideo)

Course Outcomes

1. After studied unit-1, the student will be able to study the frames of reference, Galilean transformation equations and special theory of relativity.
2. After studied unit-2, the student will be able to describe the different atomic

models and Stern and Gerlach Experiment.

3. After studied unit-3, the student will be able to explain binding energy, liquid drop model, G.Mcounter and particle accelerators.

4. After studied unit-4, the student will be able to know the conversion of number systems from one to other and also will be able to design universal gates using NANDandNOR gates.
5. After studied unit-5,the student will be able to understanding the basics of nanomaterial, synthesis and its applications.

Matching table (Put Yes/ No in the appropriate box)

Unit	(i)Remembering	(ii)Understanding	(iii)Applying	(iv)Analyzing	(v)Evaluating	(vi)Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	No	Yes	No	No
3	Yes	Yes	No	Yes	No	No
4	Yes	Yes	Yes	Yes	No	Yes
5	Yes	Yes	Yes	Yes	No	Yes

Mapping with Programme Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	S	M	S	M
CO2	S	S	S	M	M	M	S	M	S	S
CO3	S	S	S	M	M	M	S	M	S	S
CO4	S	S	S	S	S	M	S	M	S	S
CO5	S	S	S	M	M	M	S	M	S	S

CO–Course Outcome PO–Programme Outcome S-Strong M-Medium

THIRUVALLUVAR UNIVERSITY, VELLORE – 632 115

Elective IV: Allied Physics Practical -II

(2024-2025 onwards)

Semester: II **Paper type: Allied Practical**

Paper code: **Name of the Paper:** **Allied Physics Practical II** **Credit: 2**

Total Hours per Week: 3 **Practical Hours: 45**

…… List of

Experiments (Any 7 Experiments only)

1. Spectrometer grating–Minimum Deviation-Wavelength of Mercury lines.
2. Potentiometer–Calibration of low range voltmeter.
3. Deflection magnetometer and Vibration magnetometer-Tan C Position-Determination of M and B_H.
4. Figure of merit-Table galvanometer.
5. Construction of AND, OR gates using diodes and NOT gate using a transistor.
6. NAND/ NOR as universal gate.
7. Half adder and Full adder using NAND gate.
8. Half subtractor and Full subtractor using NAND gate.
9. Lasers: Study of laser beam parameters.
10. Measurement of Numerical aperture (NA) of a telecommunication graded index optic fiber.

Text Books

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, S.Viswanathan, Printers & Publishers PrivateLtd,Chennai,2018.
2. M.N.Srinivasan,S. Balasubramanian,R. Ranganathan,AText Book of Practical Physics ,Sultan Chand & Sons, NewDelhi, 2015.

Reference Books

1. Dr.S. Somasundaram, Practical Physics, Apsara publications, Tiruchirapalli, 2012.
2. R. Sasikumar, Practical Physics, PHI Learning Pvt. Ltd, New Delhi, 2011.

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">B. NUMERICAL METHODS with Applications – II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE – III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">InstructionalHours perweek</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>LabPractice</td><td>Total</td></tr>
<tr><td colspan="2">6</td><td colspan="2">--</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">12th StandardMathematics</td></tr>
<tr><td colspan="2">Objectives of theCourse</td><td colspan="7">➢ To evaluate derivatives using Newton’s forward and backward differences formulae.
➢ To acquire the knowledge about evaluation of numerical integration.
➢ To evaluate the solution of linear homogeneous difference equations with constant coefficients.
➢ To obtain numerical solutions to the ordinary differential equations.</td></tr>
<tr><td colspan="2">CourseOutline</td><td colspan="7">UnitI:Numerical Differentiation: Derivatives using Newton’s Forward and Backward Difference Formulae Derivatives using Stirling’s Formula- Derivatives using Divided Difference Formula- Maxima and Minima using the above Formulae.
Chapter 7 :Section 7.1 to 7.4 & 7.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UnitII: Numerical Integration: Trapezoidal Rule-Simpson’s One-Third Rule - Simpson’s Three-Eighth Rule- Weddle’s Rule.
Chapter 7 :Section 7.9 & 7.13 to 7.15</td></tr>
<tr><td colspan="2"></td><td colspan="7">Unit III: Difference Equations: Linear Homogenous and Non Homogenous Difference Equation with constant coefficients- particular integrals for a^x, x^m,$\sin kx, \cos kx\,, a^x F(x)$.
Chapter 8 :Section 8.1 to 8.4 & 8.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UnitIV: Numerical solution of Ordinary Differential Equations
(I order only): Taylor’s series method- Picard’s method.
Chapter 9: Section 9.5 ,9.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UnitV:Numerical solution of Ordinary Differential Equations
(I order only): Euler’s Method- Modified Euler’s Method-Runge-Kutta Method (Fourth Order only).
Chapter 9 : Section 9.7,9.9 to 9.11</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	P.Kandasamy, K.Thilagavathy (2003) Calculus of Finite differences & Numerical Analysis, S. Chand & Company Ltd., New Delhi-55.
Reference Books	1.B.D. Gupta.(2001) *Numerical Analysis.*Konark Pub. Ltd., Delhi 2. M.K. Venkataraman. (1992) *Numerical methods for Science and Engineering* National Publishing Company, Chennai. 3. S. Arumugam. (2003) *Numerical Methods*, New Gamma Publishing, Palayamkottai. 4. H.C. Saxena. (1991) *Finite differences and Numerical analysis* S.Chand& Co., Delhi
Websiteand e-LearningSource	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/ https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/

Learning O

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	discuss and analyze the concept of gradient, divergence and curl and its properties.	K2, K4
CO2	recognize the importance of Green's, Gauss and Stoke's theorem in vector integrals.	K1
CO3	find solution of first order linear partial differential equations using Lagrange's method.	K5
CO4	solve the ordinary differential equations by using Laplace Transform.	K3
CO5	develop Fourier series of the periodic functions.	K6

Mapping of CO with PO and PSO												
Programme Outcomes (PO)							**Programme Specific Outcomes (PSO)**					**Mean Scores of COs**
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
2	2	1	3	2	2	1	3	3	3	2	2	2.17
2	3	2	2	3	2	3	2	3	2	3	2	2.42
3	3	2	2	3	3	3	2	3	2	3	2	2.58
3	3	2	2	3	1	3	3	2	3	2	1	2.33
3	2	1	2	1	2	2	2	2	2	1	3	1.92

CourseLearningOutcome(forMappingwith POs and PSOs)

Studentswillbeable to

CLO1: After studied unit -1, the student will be able to evaluate derivatives by applying Newton's forward and backward differences formulae.

CLO2: After studied unit -2, the student will be able to evaluate integrations by applying the trapezoidal rule, Simpson‟s rules, and Weddle‟s rule.

CLO3: After studied unit -3, the student will be able to find a complete solution to linear difference equations.

CLO4: After studied unit -4, the student will be able to estimate approximate numerical solutions of ordinary differential equations by Euler, Picard and Taylor.

CLO5: After studied unit -5, the student will be able to estimate approximate numerical solutions of ordinary differential equations by Runge-Kutta methods.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">[A] MATHEMATICAL STATISTICS – I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective – V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To make the students to gain wide knowledge in the fundamental concepts of Statistics
• To understand the idea of random variables and its types
• To derive certain values in corporated with random variables
• To relate the statistical distributions with the real life situations
• To apply statistical techniques to get the solutions to real life problems</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">Unit I: Random variables: Distribution function-Discrete random variable-Continuous random variable.</td></tr>
<tr><td colspan="8">Unit II:Mathematical expectation-Expectedvalueoffunctionofarandomvariable-Propertiesof expectation - Properties of variance – Covariance.</td></tr>
<tr><td colspan="8">Unit III:Moment generating function–Properties of cumulants-Chebychev’sinequality-Binomial distribution.</td></tr>
<tr><td colspan="8">Unit IV:Poissondistribution: Properties, Moments of Poisson distribution–Geometric distribution: Moment generating function of Geometric distribution.</td></tr>
<tr><td colspan="8">Unit V: Norma ldistribution: Momentgeneratingfunction of Normal distribution, Mean deviation about mean – Gamma distribution - Exponential distribution.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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 transferable skill.
Text Book	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.
Recommended Text	1. Vittal,P.R.(2004).*Mathematicalstatistics*.MarghamPublications. 2. Kapur, J. N &Saxena, H. C. (2010). *Mathematical statistics* (20thed.). S. Chand & Company Ltd.
Website and e-Learning Source	https://nptel.ac.in

CourseOutcomes		
CO No.	**CO-Statements** Onsuccessfulcompletionofthiscourse,studentswillbe able to	**Cognitive Levels (K- Level)**
CO1	Acquiretheknowledgeofbasicconceptsinstatistics	**K1**
CO2	beabletounderstandvarioustypesofrandomvariablesand the distributions	**K2**
CO3	calculatemoments,cumulants,momentgeneratingfunction andvariousconstantsofprobabilitydistributions	**K3**
CO4	illustratethetheoryofrandomvariables,distribution functionsandprobabilitydistributionswithsuitable	**K4**
CO5	beabletoevaluatesolutionofreal-lifeproblemsunderthe concept of probability and probability distributions.	**K5**

Relationship Matrix											
Course Outcomes	ProgrammeOutcomes (POs)					ProgrammeSpecificOutcomes(PSOs)					Mean Scoreof COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	1	3	3	2	1	2	2.2
CO2	3	3	2	2	1	3	3	2	1	2	2.2
CO3	3	2	2	2	1	3	3	2	1	2	2.1
CO4	3	3	2	2	1	3	3	2	1	2	2.2
CO5	3	3	3	2	1	3	3	2	1	2	2.3

Subject Code	Title of the Paper	Category	Semester	Hours	Credits	Marks		
						CIA	External	Total
	ELECTIVE V: [B] DATA STRUCTURES	**ELECTIVE V**	III	5	3	25	75	100

Learning Objectives	
LO1	Understand the meaning asymptotic time complexity analysis and various data structures
LO2	To enhancing the problem solving skills and thinking skills
LO3	To write efficient algorithms and Programs
LO4	To make the students learn best practices in data structures.
LO5	To understand how to handle the files in Data Structure

UNIT	Contents	No. Of. Hours
I	**Arrays and ordered Lists:** Abstract data types – asymptotic notations – complexity analysis- Linked lists: Singly linked list – doubly linked lists - Circular linked list, General lists- stacks – Queues – Circular Queues – Evaluation of expressions	**15**
II	**Trees and Graphs:** Trees – Binary Trees – Binary Tree Traversal – Binary Tree Representations – Binary Search Trees - threaded Binary Trees - Application of trees (Sets). Representation of Graphs – Graph implementation – graph Traversals - Minimum Cost Spanning Trees – Shortest Path Problems-Application of graphs	**15**
III	**Searching and Sorting:** Sorting – Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Selection Sort. Searching – Linear search, Binary search	**15**
IV	**Greedy Method and Dynamic programming:** Greedy Method: Knapsack problem– Job Sequencing with deadlines – Optimal storage on tapes. General method – Multistage Graph Forward Method– All pairs shortest path – Single source shortest path – Search Techniques for Graphs – DFS – Connected Components – Bi-Connected Components	**15**
V	**Backtracking:** General Method – 8-Queen‟s – Sum Of Subsets – Graph Colouring – Hamiltonian Cycles – Branch And Bound: General Method – Travelling Sales Person Problem	**15**
	TOTAL HOURS	**75**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	To understand the asymptotic notations and analysis of time and space complexity To understand the concepts of Linked List, Stack and Queue.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To understand the Concepts of Trees and Graphs Perform traversal operations on Trees and Graphs.	PO1, PO2, PO3, PO4,

	To enable the applications of Trees and Graphs.	PO5, PO6
CO3	To apply searching and sorting techniques	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To understand the concepts of Greedy Method To apply searching techniques.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO1, PO2, PO3, PO4, PO5, PO6

	Textbooks
1	Seymour Lipshutz(2011),Schaum‟s Outlines - Data Structures with C, Tata McGraw Hill publications.
2	Ellis Horowitz and SartajSahni (2010), Fundamentals of Computer Algorithms, Galgotia Publications Pvt., Ltd.
3	Dr. K. Nagesware Rao, Dr. Shaik Akbar, ImmadiMurali Krishna, Problem Solving and Python Programming(2018)
	Reference Books
1.	Gregory L.Heileman(1996), Data Structures, Algorithms and Object-Oriented Programming, McGraw Hill International Edition, Singapore.
2.	A.V.Aho, J.D. Ullman, J.E.Hopcraft(2000). Data Structures and Algorithms, Addison Wesley Publication.
3.	Ellis Horowitz and SartajSahni, Sanguthevar Raja sekaran (2010) ,Fundamentals of Computer Algorithms, Galgotia Publications Pvt.Ltd.
	Web Resources
1.	https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2.	https://www.programiz.com/dsa
3.	https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	1	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	2
Weightageof coursecontributedtoeachPSO	15	15	15	15	13	14

S-Strong-3 M-Medium-2 L-Low-1

<table>
<tr><td>Title of the Course</td><td colspan="6">[A]: MATHEMATICAL STATISTICS – II</td></tr>
<tr><td>Paper Number</td><td colspan="6">Elective – VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td>Instructional Hours per week</td><td colspan="2">Lecture
5</td><td>Tutorial
1</td><td>Lab Practice
--</td><td colspan="2">Total
6</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">• To test the significance of sampling
• Finding the Goodness of Fit
• To derive the various measures of t and Fdistributions
• To Analyze the correlation coefficient and Regression lines</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="6">Unit I: Introduction-TypesofSampling-ParameterandStatistic-Testsofsignificance-Procedure for testing of hypothesis - Test of significance for large samples - Sampling ofattributes-Sampling of variables.</td></tr>
<tr><td colspan="6">Unit II:Introduction - Student’s t - distribution - Applications of t-distribution</td></tr>
<tr><td colspan="6">Unit III:-F-distribution -Applicationsof F-distribution.</td></tr>
<tr><td colspan="6">Unit IV: Meaning of Correlation –Scatter Diagram – Karl Pearsons’sCoeficient of Correlation – Rank Correlation</td></tr>
<tr><td colspan="6">Unit V:Introduction - Linear regression</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC /others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
Text Book	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019. **UnitI**: *Ch 14 (Full)* **UnitII**: *Ch 16 (Sec16.1-16.3.3)* **UnitIII** : *Ch 16 (Sec16.5-16.6.5)* **UnitIV**: *Ch10(Sec10.1-10.4, 10.7.1)* **UnitV**: *Ch.11 (Sec11.1-11.2.5)*
Recommended Text	1. Vittal,P.R.(2004).*Mathematicalstatistics*.MarghamPublications. 2. Kapur, J. N &Saxena, H. C. (2010). *Mathematical statistics* (20thed.). S. Chand & Company Ltd.
Website and e-Learning Source	https://nptel.ac.in

CONo.	**CO-Statements** Onsuccessfulcompletionofthiscourse,studentswillbeableto	**Cognitive Levels (K-levels)**
CO-1	Recognizetheparametersandstatisticstotestthesignificanceofsampling	**K1**
CO-2	Finding the Goodness of Fit	**K2**
CO-3	Derivethevarious measuresofChi-square, tandFdistributions	**K3**
CO-4	Correlation coefficients between Observed and Estimated values	**K4**
CO-5	AnalysetheRegression lines	**K4**

Semester	**Course Code**	**Titleofthe Course**	**Hours**	**Credits**
II	**21UMA23AC02**	**ALLIED–2:STATISTICS-II**	**6**	**4**

CourseOutcomes↓	**ProgrammeOutcomes(PO)**					**ProgrammeSpecificOutcomes(PSO)**					**Mean Scores ofCOs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO-1	1	2	2	2	2	3	3	2	2	2	2.1
CO-2	2	3	1	2	2	2	2	3	3	2	2.2
CO-3	2	3	2	1	3	2	2	3	2	2	2.2
CO-4	3	2	3	3	1	2	2	2	3	2	2.3
CO-5	3	1	2	2	2	2	3	2	2	3	2.2

Subject Code	Subject Name	Category	SEM	HOURS	Credits	Marks		
						CIA	External	Total
	ELECTIVE VI: [B] WEB DESIGNING	ELECTIVE	IV	6	3	25	75	100

Course Objective	
C1	Understand the basics of HTML and its components
C2	To study about the Graphics in HTML
C3	Understand and apply the concepts of XML and DHTML
C4	Understand the concept of JavaScript
C5	To identify and understand the goals and objectives of the Ajax

UNIT	Details	No. of Hours	Course Objective
I	HTML: HTML-Introduction-tag basics- page structure-adding comments working with texts, paragraphs and line break. Emphasizing test- heading and horizontal rules-list-font size, face and color-alignment links-tables-frames.	6	C1
II	Forms & Images Using Html: Graphics: Introduction-How to work efficiently with images in web pages, image maps, GIF animation, adding multimedia, data collection with html forms textbox, password, list box, combo box, text area, tools for building web page front page.	6	C2
III	XML & DHTML: Cascading style sheet (CSS)-what is CSS-Why we use CSS-adding CSS to your web pages-Grouping styles-extensible markup language (XML).	6	C3
IV	Dynamic HTML: Document object model (DCOM)-Accessing HTML & CSS through DCOM Dynamic content styles &positioning-Event bubbling-data binding. JavaScript: Client-side scripting, What is JavaScript, How to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition,	6	C4
V	Advance script, JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations.	6	C5
	Total	**60**	

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	

1	Develop working knowledge of HTML	PO1, PO3, PO6, PO8
2	Ability to Develop and publish Web pages using Hypertext Markup Language (HTML).	PO1,PO2,PO3,PO6
3	Ability to optimize page styles and layout with Cascading Style Sheets (CSS).	PO3, PO5
4	Ability to develop a java script	PO1, PO2, PO3, PO7
5	An ability to develop web application using Ajax.	P02, PO6, PO7
	Text Book	
1	Pankaj Sharma, "Web Technology", SkKataria& Sons Bangalore 2011.	
2	Mike Mcgrath, "Java Script", Dream Tech Press 2006, 1st Edition.	
3	Achyut S Godbole&AtulKahate, "Web Technologies", 2002, 2nd Edition.	
	Reference Books	
1.	Laura Lemay, RafeColburn , Jennifer Kyrnin, "Mastering HTML, CSS &Javascript Web Publishing", 2016.	
2.	DT Editorial Services (Author), "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)", Paperback 2016, 2nd Edition.	
	Web Resources	
1.	NPTEL & MOOC courses titled Web Design and Development.	
2.	https://www.geeksforgeeks.org	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S		M			L		M
CO 2	S	M	L			M		
CO 3			S		M			
CO 4	S	M	M				L	
CO 5		M				L	M	

S-Strong M-Medium L-Low

<table>
<tr><td colspan="2">TitleoftheCourse</td><td colspan="8">A. TRANSFORM TECHNIQUES</td></tr>
<tr><td colspan="2">PaperNumber</td><td colspan="8">ELECTIVECOURSE–VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours PerWeek</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">LabPractice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">-</td><td colspan="2">-</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th StandardMathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">➢ The basic knowledge about Laplace Transforms and its inverse
➢ Apply Laplace Transform in solving ODE
➢ To solve problems in Fourier Series and Fourier Transforms</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="8">UnitI: Laplace Transforms: Definition–Sufficient Condition for the Existence of Laplace Transforms (Without Proof) – Laplace Transform of Periodic Functions – Some General Theorems –Evaluation of Integrals Using Laplace Transform– Problems.
Chapter:5Sections 1–5</td></tr>
<tr><td colspan="8">Unit II: The Inverse Laplace Transforms: The Inverse Laplace Transforms–Problems.
Chapter:5 (Sections6&7)</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="8">Unit III: Fourier Series: Fourier Series – Expansion of PeriodicFunctionsofPeriod2–ExpansionofOddandEvenFunctions– Problems.
Chapter:6 (Sections 1–3)</td></tr>
<tr><td colspan="8">UnitIV: Fourier Transforms: Fourier Transform–Infinite Fourier Transform (Complex Form) –Properties of Fourier Transforms.
Chapter:6 (Sections8–10)</td></tr>
<tr><td colspan="2"></td><td colspan="8">Unit V:FourierTransforms(Continued):Fourier Cosine and Sine Transform– Properties-Problems.
Chapter :6 (Sections11&12)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC /TNPSC /others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
Recommended Text	CalculusVolumeIIIbyS.NarayananandT.K.ManickavachagomPillay,S.ViswanathanPublishersPvt.Ltd. 2006
ReferenceBooks	1. Engineering Mathematics Volume III, P.Kandasamy and Others, (S.ChandandCo) 2. Advanced Engineering Mathematics–Stanley Grossman and William R. Devit 3. Engineering Mathematics III, A.Singaravelu, Meenakshi Agency, Chennai 2008.
Websiteand e-Learningsource	https://nptel.ac.in https:www.mathhelp.com/

Discipline Specific Electives

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Find the Laplace Transform and evaluation of integrals using Laplace Transform

CLO2: Find the Inverse Laplace Transforms

CLO3: Expansion of Periodic Functions of Period 2, Expansion of Odd and Even Functions

CLO4: Find the Fourier Transforms ,Infinite Fourier Transforms and their properties

CLO 5: Evaluate Fourier sine and cosine transform

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

<table>
<tr><td colspan="2">TitleoftheCourse</td><td colspan="8">B. SPECIALFUNCTIONS</td></tr>
<tr><td colspan="2">PaperNumber</td><td colspan="8">ELECTIVECOURSE–VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours PerWeek</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">LabPractice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">-</td><td colspan="2">-</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th StandardMathematics</td></tr>
<tr><td colspan="2">Objectives of theCourse</td><td colspan="8">1. To develop computational skills in certain special functions which are frequently occurring in higher mathematics and mathematical physics.
2. Learn the concepts of simultaneous linear differential equations and some solvable types of nonlinear equations.
3. Basic knowledge about numerical solutions using the Taylor series.
4. To understand the concepts of Bessel functions, Legendre functions, and their properties.
5. To give an insight about Fourier integral, term by term differentiation of Fourier series and Legendre series.</td></tr>
<tr><td colspan="2" rowspan="2">CourseOutline</td><td colspan="8">UNIT-I:
Properties of Linear Operators-Simultaneous Linear Differential Equations- Special Solvable Types of Nonlinear Equations.</td></tr>
<tr><td colspan="8">UNIT-II:
Numerical Solutions Using Taylor Series-Adams and Modified Adams Method-Extrapolation with Differences</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="8">UNIT-III:
Properties of Power Series-Examples-Singular Points of Linear Second Order Differential Equations - Method of Frobenius.</td></tr>
<tr><td colspan="8">UNIT-IV:
Bessel Functions-Properties-Legendre Functions.</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-V:
Term by Term Differentiation of Fourier Series, Legendre Series-Fourier Integral.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	F.B.Hildebrand.(1977)AdvancedCalculusforApplications.PrenticeHall.NewJersey.
ReferenceBooks	1. J.N.SharmaandR.K.Gupta(1998)SpecialFunctions,KrishnaPrakashanMandir, Meerut. 2. SatyaPrakash.(2004)MathematicalPhysics.Sultan&Sons.NewDelhi. 3. B.D.Gupta(1978)MathematicalPhysics,VikasPublishingHouse.
Websiteand e-Learningsource	https://nptel.ac.in https:www.mathhelp.com/

CourseOutcomes

1. After studied unit-1,the student will be able to acquire the concept of linear operators, and solve simultaneous linear differential equations.
2. After studied unit-2, the student will be able to interpret Adams and Modified Adams method and extrapolation techniques.
3. After studied unit-3, the student will be able to understand the concept of power series solution.

TitleoftheCourse		**A. GRAPH THEORY AND APPLICATIONS**					
PaperNumber		**ELECTIVECOURSE–VIII**					
Category	Elective	**Year**	III	**Credits**	3	**Course Code**	
		Semester	V				
Instructional Hours PerWeek		**Lecture**		**Tutorial**	**LabPractice**		**Total**
		4		-	-		4
Pre-requisite		12^{th}StandardMathematics					

Objectives of theCourse	To study and develop the concepts of Graphs, sub graphs,Trees, Connectivity, Eulerian, Hamiltonian graphs, Matchings and Planar graphs.
CourseOutline	**UnitI**: Graphs, Degrees, Subgraphs, Isomorphism of graphs, Ramsey Numbers, Independent sets and Coverings. (Sec 2.1, 2.2, 2.3, 2.4, 2.5, 2.6)
	UNIT-II : Intersection graphs and line graphs, Matrices, Operations on graphs, Degree Sequence, Graphic Sequence. (Sec 2.7, 2.8, 2.9, 3.1, 3.2)
	UNIT-III: Walks, Trails, Paths, Connectedness and Components, Cut point, Bridge, Block, Connectivity. (4.1, 4.2, 4.3, 4.4)
	UNIT-IV: Eulerian graphs, Hamiltonian graphs, Characterization of Trees, Centre of a Tree (5.1, 5.2, 6.1, 6.2)
	UNIT-V: Matchings, Matchings in Bipartite Graphs, Definition and properties of a planar graphs, characterization of planar graphs. (7.1, 7.2, 8.1, 8.2)
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	S.ArumugamandS.Ramachandran,"InvitationtoGraphTheory", SCITECHPublications India Pvt. Ltd., 7/3C, Madley Road, T.Nagar, Chennai - 17
ReferenceBooks	1. Douglas B.West 'Introduction to Graph Theory',PearsonEducation,Inc.Pearson Prentice Hall,London. 2. S.A.Choudham,AFirstCourseinGraphTheory,MacmillanIndiaLtd. 3. RobinJ.Wilson,IntroductiontoGraphTheory,LongmanGroup Ltd. 4. J.A.BondyandU.S.R.Murthy,GraphTheorywithApplications,Macmillon,London.

Websiteand e-Learningsource	https://nptel.ac.in https:www.mathhelp.com/

4. Afterstudiedunit-4,thestudentwillbeabletoexplaintheconceptsof Bessel functions, Legendre functions, and their properties.
5. After studied unit -5, the student will be able to analyze term-by-term differentiation of the Fourier series and Legendre series.

MappingwithProgramme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	3	3	2	3	2
CO2	3	2	3	3	2	3	3	3	2	3
CO3	2	2	3	3	3	3	2	3	3	2
CO4	3	3	2	3	3	2	3	2	3	3
CO5	2	3	3	2	3	3	3	3	2	2

Discipline Specific Electives

<table>
<tr><td>Title of the Course</td><td colspan="6">B. NUMBER THEORY</td></tr>
<tr><td>Paper Number</td><td colspan="6">ELECTIVECOURSE–VIII</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td>Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">• Apply the various techniques of solving puzzles in applications.
• Know the connections of number theory with other branches.
• Gain competence in solving problems.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="6">UNIT-I Introduction– Basic binary Operations on the set of Integers– Ordering of Integers –Well Ordering Principle–Mathematical Induction. (Simple problems only)</td></tr>
<tr><td colspan="6">UNIT-II: Divisibility Theory: Greatest common Divisor- Relatively Prime integers– Algorithm to find G.C.D: Investigation of the set of integers{bx+cy}-Least Common Multiple. (Simple problems only)</td></tr>
<tr><td colspan="6">UNIT-III: Linear Diophantine Equations: Linear Diophantine Equations – The Equation ax+by=c – Diophantine Equations in Three or More Unknowns(Statements and simple problems only)</td></tr>
<tr><td colspan="6">UNIT-IV: Quadratic Residues: Introduction, quadratic residues, Elementary Properties. (Simple problems only)</td></tr>
<tr><td colspan="6">UNIT-V: Perfect Numbers: Introduction, Perfect Numbers, Necessary and Sufficient Conditions for a positive Integer to be an even Perfect number, Mersenne Numbers, Fermat Numbers. (Simple problems only)</td></tr>
<tr><td>Extended Professional Component (is a part of Question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC /others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, problem solving, analytical ability, professional competency, professional communication and transferable skill.
Recommended Text	TheoryofNumbers, Dr.Sudhir,K.Pundir, PragatiPrakashanPublications,thirdrevisededition2012.
Reference Books	1. An introductionto theTheoryofNumbers(Vthedition)byIvanNiven,HerbertS.ZuckarmanandHughL.MontgometryJohnWiley&Sons,Inc.2001. 2. Elementary theory of numbers,cy.Hsiung,Alliedpublishers, 1995. 3. Elementary NumberTheory, AllynandBaconInc., Boston, 1980.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand the fundamental concepts of Mathematical Induction.

CLO 2: Evaluate the Greatest common Divisor and Least common multiple using the algorithms.

CLO 3: Determine and understand the Diophantine equations for three or more unknowns.

CLO 4: Demonstrate the quadratic residues, elementary Properties

CLO 5: Evaluate and analyse the perfect numbers using the Mersenne and Fermat Numbers.

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

Subject Code	Title of the Paper	Category	Semester	Hours	Credits	Marks		
						CIA	External	Total
	ELECTIVE IX: PYTHON PROGRAMMING	**ELECTIVE**	VI	5	3	25	75	100

Learning Objectives	
LO1	To make students understand the concepts of Python programming.
LO2	To apply the OOPs concept in PYTHON programming.
LO3	To impart knowledge on demand and supply concepts
LO4	To make the students learn best practices in PYTHON programming
LO5	To know the costs and profit maximization

UNIT	**Contents**	**No. of Hours**
I	**Basics of Python Programming:** History of Python-Features of Python-Literal-Constants-Variables - Identifiers–Keywords-Built-in Data Types-Output Statements – Input Statements-Comments – Indentation- Operators-Expressions-Type conversions. **Python Arrays:** Defining and Processing Arrays – Array methods. **Exercise :** **1. Program using variables, constants, I/O statements in Python.** **2. Program using Operators in Python**	**15**
II	**Control Statements:** Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. **Iterative Statements**: while loop, for loop, else suite in loop and nested loops. **Jump Statements:** break, continue and pass statements**. Classes :** Creating classes – Inheritance – Polymorphism. **Exercise :** **1. Program using Conditional Statements.** **2. Program using Loops such as** **a) For loop** **b) While loop**	**15**
III	**Functions:** Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. **Function Arguments**: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion. **Python Strings:** String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. **Modules**: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules. **Exercise :** **1. Program using Jump Statements.** 2. **Program using Functions**	**15**
IV	**Lists:** Creating a list -Access values in List-Updating values in Lists-Nested lists -Basic list operations-List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples– Difference between lists and tuples. **Dictionaries:** Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries. **Exercise :** **1. Program using Recursion.** 2. **Program using Arrays**	**15**

V	**Python Error & Exception Handling:** Introduction – Exception Handling – Multiple exception block.**Python File Handling:** Types of files in Python - Opening and Closing files-Reading and Writing files: write() and writelines() methods- append() method – read() and readlines() methods – with keyword – Splitting words – File methods - File Positions- Renaming and deleting files. **Exercise :** **1. Program for File Handling such as** **a) Read & Write** b) **Rename & Deletion**	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Learn the basics of python, Do simple programs on python, Learn how to use an array.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop program using selection statement, Work with Looping and jump statements, Do programs on Loops and jump statements.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Concept of function, function arguments, Implementing the concept strings in various application, Significance of Modules, Work with functions, Strings and modules.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Work with List, tuples and dictionary, Write program using list, tuples and dictionary.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	ReemaThareja, "Python Programming using problem solving approach", First Edition, 2017, Oxford University Press.
2	Dr. R. Nageswara Rao, "Core Python Programming", First Edition, 2017, Dreamtech Publishers.

Reference Books

1.	VamsiKurama, "Python Programming: A Modern Approach", Pearson Education.
2.	Mark Lutz, "Learning Python", Orielly.
3.	Adam Stewarts, "Python Programming", Online.
4.	Fabio Nelli, "Python Data Analytics", APress.
5.	Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication.

Web Resources

1.	https://www.programiz.com/python-programming
2.	https://www.guru99.com/python-tutorials.html
3.	https://www.w3schools.com/python/python_intro.asp
4.	https://www.geeksforgeeks.org/python-programming-language/
5.	https://en.wikipedia.org/wiki/Python_(programming_language)

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	2	3
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	3
CO 5	3	2	3	3	3	3
Weightageof coursecontributedtoeachPSO	15	14	15	15	13	14

S-Strong-3 M-Medium-2 L-Low-1

<table>
<tr><td>Title of the Course</td><td colspan="6">B.FINANCIAL ANALYTICS</td></tr>
<tr><td>Paper Number</td><td colspan="6">ELECTIVECOURSE–IX</td></tr>
<tr><td>Category</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td></td><td>Semester</td><td>VI</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td>Total</td><td colspan="2"></td></tr>
<tr><td></td><td>5</td><td>-</td><td>--</td><td>5</td><td colspan="2"></td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">The course aims to provide students with a comprehensive understanding of the various aspects of financial analytics, emphasizing the stock market, portfolio management, risk assessment and management, fraud analytics, and financial modeling.</td></tr>
<tr><td>Course Outline</td><td colspan="6">UNIT I Data manipulation
Data Manipulation using Python: Introduction to Python, IDE’s (Jupyter, Spyder), custom environment settings, Data Structure: basic data types (numeric, string, float, date timestamp), aggregate functions, conditions (if-elif-else), looping (for, while), inbuilt functions for data conversion, writing user defined functions.
UNIT II Concepts of packages
Concepts of packages – important packages like NumPy, scikit-learn, scipy, sympy, math, Pandas, Matplotlib, etc. importing packages using pip, reading and writing data from/to different formats: Data frame, arrays, list of list, series, sets, dictionaries, plotting, functions, list comprehensions (index comprehension). Application of machine learning algorithm for solving problem in financial markets.
UNIT III Machine learning
Machine learning: Introduction, Definitions, Supervised, unsupervised, python libraries for machine learning, Sci-kit learn, Applications of Machine learning in Financial Technology (FinTech).
UNIT IV Regression
Regression: Linear regression univariate and multivariate, nonlinear regression, over-fitting and regularization, logistic regression, Case studies based on regression techniques (using financial market data)
UNIT V Clustering
Clustering: Partial based clustering, hierarchical clustering, intensity based clustering, Neural Network: Single layer perceptron, multi-layer perceptron, back propagation algorithm applying neural network on financial market data.</td></tr>
</table>

Course Outcome:

Upon completion of the course, students will:

CO 1: Grasp Financial Analytics Fundamentals: Understand the significance and relevance of financial analytics, recent trends, and the application of analytical tools and techniques in finance.

CO 2: Comprehend Stock Market Dynamics: Gain a comprehensive understanding of the stock market, its history, functions, and the roles played by different market participants and regulatory bodies.

CO 3: Apply Portfolio Management Principles: Acquire the skills necessary to construct portfolios based on Modern Portfolio Theory, analyze asset allocation, employ fundamental and technical analysis, and monitor and adjust portfolios.

CO 4: Assess and Manage Financial Risks: Identify different types of financial risks, understand risk and return relationships, and apply various risk assessment and management techniques.

CO 5: Understand Fraud Analytics and Prevention: Recognize different types of financial fraud, apply ethical considerations in fraud detection, and develop strategies to prevent and manage fraud.

The course is designed to provide a holistic understanding of financial analytics, preparing students to navigate the complex landscape of the stock market, risk management, fraud detection, and decision-making through modeling and forecasting in finance.

CO-PSO-PO Mapping

	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	2	3	1
CO3	3	3	2
CO4	3	2	2
CO5	2	3	3

(Low-1; Moderate-2; High-3; No Correlation -0)

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	2	1	2
CO2	2	3	3	1	2	3
CO3	3	2	2	2	3	1
CO4	2	3	2	2	1	3
CO5	3	2	1	2	2	3

<table>
<tr><td>Title of the Course</td><td colspan="6">A. DISCRETEMATHEMATICS</td></tr>
<tr><td>Paper Number</td><td colspan="6">ELECTIVECOURSE–X</td></tr>
<tr><td rowspan="2">Category</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>VI</td><td colspan="4"></td></tr>
<tr><td>Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>5</td><td>-</td><td>--</td><td colspan="3">5</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">This course aims to develop mathematical maturity and ability to deal with abstraction and to develop construction and verification of formal logical manipulation.</td></tr>
<tr><td>Course Outline</td><td colspan="6">UNIT I: RECURRENCE RELATIONS AND GENERATING FUNCTIONS
Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations.
(Chap V . Sections:1 to 5)</td></tr>
<tr><td></td><td colspan="6">UNIT II: MATHEMATICAL LOGIC
TF Statements - Connectives - Atomic and Compound Statements - Well-formed [StatementFormulae]- Truth Table of a Formula-Tautology -Tautological Implications and Equivalence of Formulae.
(Chap IX . Sections:1 to 8)</td></tr>
<tr><td></td><td colspan="6">UNIT III: MATHEMATICAL LOGIC [CONTD..]
Replacement process - Functionally complete sets of connectives and Duality law – NormalForms-PrincipalNormalForms.(Chap IX . Sections: 9 to 12)</td></tr>
<tr><td></td><td colspan="6">UNIT IV: LATTICES
Lattices [omit example 15 PpNo.10.6]- Some properties of Lattices - New Lattices (omit remark Pp 10.14)-Modular and Distributive Lattices (omit theorem 10 and 17,Example 4-Pp10.23, Example 11-Pp10.24) (Chap X . Sections:1 to 4)</td></tr>
<tr><td></td><td colspan="6">UNIT-V BOOLEAN ALGEBRA
Boolean Algebra (omit theorem 25) - Boolean Polynomials- Karnaugh Maps (omit K- map for 5 and 6 variables) (Chap X . Sections:5 to 7)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	M.K.Venkataraman, N.Sridharan and N.Chandrasekaran, [2003] Discrete Mathematics, The National Publishing company, chennai.
Reference Books	1. Oscar Levin, Discrete Mathematics, 3rd Edition,2016. 2. B. A. Davey & H. A. Priestley (2002). *Introduction to Lattices and Order* (2nd edition). Cambridge University Press. 3. Edgar G. Goodaire& Michael M. Parmenter (2018). *Discrete Mathematics withGraph Theory* (3rd edition). Pearson Education. 4. Rudolf Lidl& Günter Pilz (1998). *Applied Abstract Algebra* (2nd edition). Springer. 5. Kenneth H. Rosen (2012). *Discrete Mathematics and its Applications***:** *WithCombinatorics and Graph Theory* (7th edition). McGraw-Hill. 6. C. L. Liu (1985). *Elements of Discrete Mathematics* (2nd edition). McGraw-Hill.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	Analyse and perceive various graph theoretic concepts and familiarize with their applications.	K4, K5
CO2	Describe about partially ordered sets, Boolean algebra, lattices and their types.	K1
CO3	Apply Karnaugh map for simplifying the Boolean expression	K3
CO4	Demonstrate the skill to construct simple mathematical proofs and to validate.	K2, K6
CO5	Achieve greater accuracy, clarity of thought and language.	K6

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	2	2	2	3	3	3	2	2	2	2	3	2.42
3	2	2	2	2	3	3	3	3	3	3	2	3	2.58
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
												Mean Overall Score	2.57
												Result	High

Course code		B. CLOUD COMPUTING	SEMESTER	HOURS	CREDITS
Elective		X	VI	5	3
Pre-requisite		Basics of Cloud and its Applications			

Course Objectives:

The main objectives of this course are:

1. Gain knowledge on cloud computing, cloud services, architectures and applications.
2. Enable the students to learn the basics of cloud computing with real time usage
3. Understand store and share, in and from cloud
4. To learn the social networks cloud
5. To understand the Storage and sharing in clouds

ExpectedCourseOutcomes:

Onthesuccessfulcompletion ofthecourse,studentwillbeableto:

CO1	Understandthe conceptsofCloudanditsservices	K1-K6
CO2	CollaborateCloudforEvent&ProjectManagement	
CO3	Analyzeoncloudin–WordProcessing,SpreadSheets,Mail,Calendar, Database	
CO4	Analyzecloudinsocial networks	
CO5	Explorecloud storageand sharing	

K1-Remember;**K2**-Understand;**K3**-Apply;**K4**-Analyze;**K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	12hours

INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

Unit:2	CLOUDCOMPUTING	12hours

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloudcomputing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

Unit:3	CLOUDSERVICES	12hours

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

Unit:4	OUTSIDETHECLOUD	12hours

OUTSIDETHECLOUDEvaluatingwebmailservices,Evaluatinginstantmessaging, Evaluatingwebconferencetools,creatinggroupson social networks,Evaluatingonline groupware,collaboratingviablogsandwikis.		
Unit:5	**STORINGAND SHARING**	**10hours**
STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.		
Unit:6	**ContemporaryIssues**	**2 hours**
Expertlectures,onlineseminars –webinars		
	TotalLecturehours	**60hours**

TextBooks

1 Miller, Michael. *Cloud computing: Web-based applications that change the way you work and collaborate,* Pearson Publishing, 2008.
UNIT III: (Chapters: 1, 2,3)
UNIT IV: (Chapters: 4,5,6)
UNIT V: (Chapters: 7,8,9,10,11,12,13,14)
UNIT IV: (Chapters: 18,19,20)
UNIT V: (Chapters: 15,16,17)

ReferenceBooks

1 Velte, Anthony T., et al. "Cloud computing: a practical approach." (2010).

RelatedOnlineContents[MOOC,SWAYAM,NPTEL,Websitesetc.]

1	https://nptel.ac.in/courses/106/105/106105167/
2	https://www.tutorialspoint.com/cloud_computing/index.htm
3	https://www.javatpoint.com/cloud-computing-tutorial

MappingwithProgrammingOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong;M-Medium;L-Low

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 VII : Elective XI and Elective XVI

Elective XI to be chosen from Group A and **Elective XII** to be chosen from Group B

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE XI - Group A:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study and develop the concepts of graphs, sub graphs, trees, connectivity, Euler tours, Hamilton cycles, matching, coloring of graphs, independent sets, cliques, vertex coloring, and planar graphs</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I: Graphs, Subgraphs and Trees

Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices- Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

Chapter 1 (Section 1.1 - 1.7) ; Chapter 2 (Section 2.1 - 2.3)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II: Connectivity, Euler Tours and Hamilton Cycles

Connectivity - Blocks - Euler tours – Hamilton

Chapter 3 (Section 3.1 -3.2) ; Chapter 4(Section 4.1 - 4.2)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III: Matchings, Edge Colourings
Matchings - Matchings and Coverings in Bipartite Graphs –

Edge Chromatic Number - Vizing’s Theorem.

Chapter 5 (Section 5.1 - 5.2) ; Chapter 6 (Section 6.1 - 6.2)</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV:Independent Sets and Cliques, Vertex Colourings

Independent sets - Ramsey’s Theorem – Chromatic Number - Brooks’</td></tr>
</table>

	Theorem - Chromatic Polynomials. **Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4)**
	UNIT-V: Planar Graphs Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem andthe Four-Colour Conjecture. **Chapter 9 (Section 9.1 - 9.3, 9.6)**
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC / 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	J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London,1976.
Reference Books	1.J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi,1995. 2.R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989. 3.A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge,1989. 4.R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley andSons, New York, 1989. 5.R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004,Indian Print. 6.S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.
Website and e-Learning Source	https://nptel.ac.in/courses/111106050/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Acquire the knowledge of elementary graph theory

CLO2: Apply various cryptosystems and understand the concepts of quadratic, residuesand reciprocity

CLO3: Develop the idea of public key cryptography, RSA Algorithms.

CLO4: Solve problems using the continued fraction method and the quadratic sieve method.

CLO5: Demonstrate ability to apply concepts of Fermat factorization and factor bases.

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

Title of the Course		**FORMAL LANGUAGES AND AUTOMATA THEORY**					
Paper Number		**ELECTIVE XI - Group A:(PM/AP/IC/ITC)**					
Category	Elective	**Year**	IV	**Credits**	3	**Course Code**	
		Semester	VII				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	1		--	5	
Objectives of the Course		1.The purpose of this course is to acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages. 2.Classify machines by their power to recognize languages. Employ finite state machines to solve problems in computing. 3.Explain deterministic and non-deterministic machines.					
Course Outline		**UNIT-I: Finite Automata and Regular Expressions** Finite state systems- Deterministic Finite state Automata- Non deterministic Finite Automata- Finite Automata with Epsilon-Transitions – Regular Expressions- Finite Automata and Regular Expressions.					

	UNIT-II: Properties of Regular Languages The Pumping Lemma for Regular Languages – Application of the Pumping Lemma – Closure Properties of Regular Languages – Reversal – Homomorphism – Decision properties of Regular Languages – Converting NFA's to DFA'S – Minimization of DFA's.
	UNIT-III: Context Free Grammars and Languages Context Free Grammars – Parse Trees – Normal forms for Context Free Grammars – Chomsky Normal Form – Greibach Normal Form.
	UNIT-IV: Pushdown Automata Definition – The languages of a PDA – Equivalence of PDA's and CFG's – Deterministic Pushdown Automata.
	UNIT-V: Properties of Context-Free Languages The Pumping Lemma for Context-free Languages – Closure Properties of Context- Free Languages – Decision properties of CFL's.
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. 2.Introduction to Theory of Computation - Sipser 2nd edition Thomson
Reference Books	1.Languages and Computation, Pearson Education, 2013. A Salomaa , Formal Languages , Academic press , New York , 1973 2.John C. Martin, Introduction to Languages and theory of Computations (2nd Edn), Tata – McGraw Hill company Ltd., New Delhi, 1997. 3.Dr. Rani Siromoney , Formal Languages and Automata, The Christian Literature Society, 1979.
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)

Students will be able to

CLO1: To gain knowledge of fundamental concepts of automata.

CLO2: To know properties of regular languages.

CLO3: To know finite automata theory.

CLO4: To Understand the concept of context free grammars and normal form.

CLO5: To know push down automata and context free languages.

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

<table>
<tr><td>Title of the Course</td><td colspan="8">PROGRAMMING IN C++ AND NUMERICAL METHODS</td></tr>
<tr><td>Paper Number</td><td colspan="8">ELECTIVE XI - Group A:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category Elective</td><td>Year</td><td>IV</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="3"></td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="5"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level C and C++</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. Implementation of numerical methods in computer programming using C or C++ language.
2. Apply mathematics in engineering problems.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="7">Unit I: Tokens, Expressions and Control Structures
Evolution of C++ - applications of C++ - structure of C++ program. Tokens – keywords – identifiers and constants – basic data types – constant pointers and pointers to constants – symbolic constants –type compatibility – declaration of variables – dynamic initialization of variables– operators in C++ .</td></tr>
<tr><td colspan="7">Unit II: Functions and classes in C++
The main function – function prototyping – call by reference – return by reference – inline functions– const arguments – function overloading. Managing Console I/O Operations: C++ streams. Specifying a class – defining member functions – making an outside function inline – nesting of member functions – private member functions – arrays within a class– arrays of objects – objects as function arguments – friend functions– const member functions.</td></tr>
<tr><td colspan="7">Unit III: Solving Nonlinear Equations
Newton’s method — fixed point iteration. Numerical Differentiation : Derivatives from differences tables – Higher-order derivatives – Divided difference, Central difference formulas</td></tr>
<tr><td colspan="7">Unit IV: Ordinary Differential Equations
Taylor series method – Euler and modified Euler methods – Runge-Kutta methods</td></tr>
</table>

	Unit V: Boundary value problems and Partial Differential Equations The shooting method – Solution through a set of equations – Derivative boundary conditions – Characteristic-value problems – Eigen values of a matrix by iteration. Representation as a difference equation – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow -The Crank Nicolson method
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Object Oriented programming with C++ - E.Balagurusamy (McGraw Hill 3rd Edition 2006.) 2. Object oriented programming in Turbo C++ - Robert Lafore (Galgotia publications Pvt.Ltd, New Delhi-,2002) 3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Seventh Edition, Addison Wesley, Reading, 1998.
Reference Books	1. M.K. Jain, S.R.K. Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi 2. C.E. Froberg, Introduction to Numerical Analysis, Second Edition, Addison-Wesley Publishing Company, 1972. 3. S. Azmy Ackleh , Edward James Allen , R. Baker Kearfott , Padmanabhan Seshaiyer, Classical and modern Numerical Analysis: Theory, Methods and Practice, CRC Press , Taylor& Francis Group, 2009.
Website and e-Learning Source	https://swayam.gov.in/nd2_cec20_ma11/preview https://nptel.ac.in/courses/111/106/111106101/ http://www.math.ust.hk/~mamu/courses/231/hom.htm

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know about class structure, member functions & data members, inheritance, types and example problems.

CLO 2: Understand how **C++** improves C with object-oriented features.

CLO 3: Design, investigate and implement of numerical methods for solving different types of problems like initial and boundary value problems of ordinary and partial differential equations.

CLO 4: Determines that the numerical integration and differentiation by using some basic rules.

CLO 5: Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research

	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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE XII - Group B:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course introduces advanced topics in Linear and non-linear Programming.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Integer Linear Programming
Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory‘s All Integer Cutting Plane Method - Gomory‘s mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming. Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP.
Chapter-7: 7.1 - 7.7 Chapter-20: 20.1 - 20.5</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II : Classical Optimization Methods
Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe‘s modified Simplex Methods - Beale‘s Method
Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Theory of Simplex Method
Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution.
Chapter-25: 25.1 - 25.4, 25.6-25.9</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV: Revised Simplex Method
Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm
Chapter-26: 26.1 - 26.4 Chapter-28: 28.1, 28.2</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Parametric Linear Programming
Variation in the coefficients cj , Variations in the Right hand side, bi . Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.
Chapter-29: 29.1 - 29.3</td></tr>
</table>

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	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 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)

Students will be able to

CLO 1: To know about integer programming.

CLO 2: To know about optimization methods for solving non linear programming problems.

CLO 3: To know simplex method for solving linear programming problems.

CLO 4: To know revised simplex method for solving linear programming problems.

CLO 5: To know parametric linear programming problems.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="10">CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="10">ELECTIVE XII - Group B:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="4"></td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="6"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="10">UG level Differential Equations and Integral Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="10">1. The aim of the course is to introduce to the students the concept of Calculus of Variation and its applications.
2. Introduce various types of integral equations and how to solve these equations.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="10">Unit I: Variational problems with fixed boundaries
The concept of variation and its properties – Euler’s equation – Variational problems for Functionals – Functionals dependent on higher order derivatives – Functions of several independent variables – Some applications to problems of Mechanics.
Chapter 1: 1.1 - 1.7 (Text Book - 1)</td></tr>
<tr><td colspan="10">Unit II: Variational problems with moving boundaries
Movable boundary for a functional dependent on two functions – one-sided variations – Reflection and Refraction of extremals – Diffraction of light rays.
Chapter 2: 2.1 - 2.5 (Text Book - 1)</td></tr>
<tr><td colspan="10">Unit III: Integral Equation
Introduction – Types of Kernals – Eigen values and Eigen functions – connection with differential equations – Solution of an integral equation – Initial value problems – Boundary value problem.
Chapter 1: 1.1 - 1.3 & 1.5 - 1.8 (Text Book - 2)</td></tr>
<tr><td colspan="10">Unit IV: Solution of Fredholm intergral equation
Second kind with separable kernel – Orthogonality and reality eigen function – Fredholm Integral equation with separable kernel – Solution of Fredholm Integral Equation by successive substitution – Successive approximation – Volterra integral equation – Solution by successive substitution.
Chapter 2: 2.1 - 2.3 and Chapter 4: 4.1 - 4.5 (Text Book - 2)</td></tr>
</table>

	Unit V: Hilbert – Schmidt Theory Complex Hilbert space – Orthogonal system of function – Gram-Schmit orthognalization process – Hilbert-Schmidt theorems – Solutions of Fredholm of integral equation of first kind. **Chapter 3: 3.1 - 3.4 & 3.8 - 3.9 (Text Book - 2)**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. A.S. Gupta, Calculus of Variations with Application, Prentice Hall of India, New Delhi, 2005. 2. Sudir K. Pundir and RimplePundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut, 2005.
Reference Books	1. L. Elsgolts, Differential Equations and the Calculus of Variations Mir Publishers, Moscow, 1973. 2. Ram P. Kanwal, Linear Integral Equations. Academic Press, New York, 1971.
Website and e-Learning Source	https://www.classcentral.com/course/youtube-mathematics-calculus-of-variations-and-integral-equations-47612, https://www.open.edu/openlearn/science-maths-technology/introduction-the-calculus-variations/content-section-0, http://www.infocobuild.com/education/audio-video-courses/mathematics/CalculusOfVariations-IIT-Kanpur/lecture-23.html, https://www.online.colostate.edu/courses/MATH/MATH535.dot,

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Students know the concept and properties of variational problems with fixed and moving boundaries, functions of dependent and independent variables and also solve some applications problems in mechanics.

CLO 2: Able to solve differential equations and integral equation problems. Find the solution of eigen value, eigen functions.

CLO 3: Implementation of various methods to solve Fredholm Intergral equation.

CLO 4: Students gain acquire knowledge about Hilbert – Schmidt Theory

CLO 5: Deriving the complex Hilbert space – Orthogonal system of function and Solutions of Fredholm of Integral equation of first kind

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DISCRETE MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE XII - Group B:(PM/AP/IC/ITC)</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>IV</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td></td><td></td><td>Semester</td><td>VII</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1.Introduce the algebraic structures of lattices and Boolean algebra. Construct the switching circuits with applications.
2.Educate the finite fields and its mathematics properties.
3.Inculcate the polynomials over finite fields, Irreducibility and factorization of polynomials.
4.Indoctrinate the coding theory with the linear and cyclic codes.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I:Lattices
Properties and Examples of Lattices – Distributive Lattices – Boolean Algebras – Boolean Polynomials - Minimal Forms of Boolean Polynomials.
Chapter 1: Sections 1–6</td></tr>
<tr><td colspan="7">UNIT- II :Applications of Lattices
Switching Circuits – Applications of Switching Circuits.
Chapter 2:Sections 7–8</td></tr>
<tr><td colspan="7">UNIT-III :Finite Fields
Finite Fields.
Chapter 3:Sections 13</td></tr>
<tr><td colspan="7">UNIT-IV :Polynomials
Irreducible Polynomials over Finite Fields - Factorization of Polynomials over Finite Fields.
Chapter 3:Sections 14–15</td></tr>
<tr><td colspan="7">UNIT -V:Coding Theory
Linear Codes – Cyclic Codes.
Chapter 4:Sections 17–18</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Indian Reprint, Springer Verlag,NewYork, 2006.</td></tr>
</table>

Reference Books	1.A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey. 2.J.L.Gersting, Mathematical Structures for Computer Science, 3rdEdn., ComputerScience Press, New York. 3.S.Wiitala,Discrete Mathematics - A Unified Approach, McGraw Hill Book Co.
Website and e-Learning Source	1.http://www.discrete-math-hub.com/resources-and-help.html 2.https://onlinecourses.nptel.ac.in/noc22_cs123/preview 3. https://onlinecourses.nptel.ac.in/noc22_cs85/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1:Know the algebraic structures of lattices and Boolean algebra, and sketch the minimizationof Boolean polynomials.

CLO2: Model the switching circuits with applications.

CLO3: Understand the finite fields and its mathematics properties.

CLO4: Acquire the notions of the polynomials over finite fields, Irreducibility and factorization of polynomials.

CLO5: Apply the coding theory with the linear and cyclic codes in cryptography.

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

Elective III to be chosen from Group C

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRAIC TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE XIII - Group C:(PM/AP/IC/ITC)</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>IV</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>VIII</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce the ideas of algebraic topology to other branches of Mathematics</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Calculus in the Plane
Path Integrals: Angles and Deformations - Differential forms and path Integrals - Independence of Path - Criterion for exactness. Angles and Deformations: Angle functions and Winding numbers - Reparametrizing and Deforming the Paths. Winding Numbers. Definition - Homotopy and Reparametrization - Varying the Point - Degrees and Local Degrees
Chapter 1: (a) to (c);Chapter 2: only (a) and(b)Chapter 3 : (a) to (d)</td></tr>
<tr><td colspan="2"></td><td colspan="7">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 Variations. Homology: Chains, Cycles, and H0U - 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)</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- III: Holes and Integrals
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 (d) Chapter 10: (a) to (d)</td></tr>
<tr><td colspan="2"></td><td colspan="7">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)</td></tr>
<tr><td colspan="2"></td><td colspan="7">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)</td></tr>
</table>

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	William Fulton, Algebraic Topology - A First Course, Springer-Verlag, New York, 1995
Reference Books	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 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)
Students will be able to

CLO1: To Know about the differentiation and integration in planes.

CLO2: To understand the homology group.

CLO3: To Understand the integrals over continuous paths in space.

CLO4: To know about fundamental groups and covering spaces.

CLO5: To understand G-Coverings and Patching Coverings.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE XIII - Group C:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Probability Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces collection, bar diagrams and to understand the measure of central tendencies, correlation and Regression lines.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Sample Moments and their Functions: Notion of a _ sample and a statistic – Distribution functions of X, S2 and _ (X , S2) - χ 2 distribution – Student t-distribution – Fisher’s Z-distribution – Snedecor’s Fdistribution – Distribution of sample mean from non-normal populations Chapter 9 : Sections 9.1 to 9.8</td></tr>
<tr><td colspan="6">UNIT-II: Significance Test: Concept of a statistical test – Parametric tests for small samples and large samples - χ 2 test – Kolmogorov Theorem – Smirnov Theorem – Tests of Kolmogorov and Smirnov type – The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests – Independence Tests by contingency tables. Chapter 10 : Sections 10.11 Chapter 11 : 12.1 to 12.7..</td></tr>
<tr><td colspan="6">UNIT-III: Estimation : Preliminary notion – Consistency estimation – Unbiased estimates – Sufficiency – Efficiency – Asymptotically most efficient estimates – methods of finding estimates – confidence Interval. Chapter 13 : Sections 13.1 to 13.8 (Omit Section 13.9)</td></tr>
<tr><td colspan="6">UNIT-IV: Analysis of Variance : One way classification and two-way classification. Hypotheses Testing: Poser functions – OC function- Most Powerful test – Uniformly most powerful test – unbiased test. Chapter 15 : Sections 15.1 and 15.2 (Omit Section 15.3) Chapter 16 : Sections 16.1 to 16.5 (Omit Section 16.6 and 16.7).</td></tr>
<tr><td colspan="6">UNIT-V : Sequential Analysis : SPRT – Auxiliary Theorem – Wald’s fundamental identity – OC function and SPRT – E(n) and Determination of A and B – Testing a hypothesis concerning p on 0-1 distribution and m in Normal distribution. Chapter 17 : Sections 17.1 to 17.9 (Omit Section 17.10)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">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)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963.
Reference Books	1. E.J.Dudewicz and S.N.Mishra , Modern Mathematical Statistics, John Wiley and Sons, New York, 1988. 2. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern New Delhi, 1988(3rd Edn) 3. G.G.Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973 4. B.L.Van der Waerden, Mathematical Statistics, G.Allen & Unwin Ltd., London, 1968..
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the Sampling moments and their functions

CLO2: Analysis and evaluate the significance of test.

CLO3: Analysis of Estimation.

CLO4: Understand the analysis of variance.

CLO5: To understand the sequential analysis

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">STATISTICAL DATA ANALYSIS USING R- PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE XIII - Group C:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basic knowledge in Computer and Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To master the use of R interactive environment with an understanding of the use of R documentation.
2. To use R for descriptive statistics andwrite multivariate models in R.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT- I: Introduction to R language
Starting and quitting in R, Basic features in R - Built-in functions and online help - Logical vectors - Rational operators - Changing Directories, redirecting R output, Lists Data frames.</td></tr>
<tr><td colspan="7">UNIT- II: Programming Statistical Graph
Plotting bar charts, dot charts - Plotting Pie charts - Plotting Histograms - Plotting Box plots -Plotting scatter plots- Plotting QQ plots.</td></tr>
<tr><td colspan="7">UNIT- III: Programming with R
For loop - If statement -- while loop - Newton’s method for finding root - Repeat loop, break and next statements - Problems and Exercises.</td></tr>
<tr><td colspan="7">UNIT- IV: Simulation in R
Monte Carlo simulation - Generation of pseudo-random numbers - Bernoulli random variables - Binomial random variables - Poisson random variables - Exponential random numbers.</td></tr>
<tr><td colspan="7">UNIT- V: Computational Linear Algebra in R
Vectors and matrices in R - Constructing matrix objects - Accessing matrix elements - Row and column names - Matrix properties,Matrix multiplication and inversion - Eigen values and Eigen vectors.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">W. John Braun, Duncan J. Murdoch, A first course in statistical programming with R, Cambridge University Press, 2007.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="7">1. Gardener, M.Beginning R: The statistical programming language, John Wiley & Sons 2012.
2. Martin, T. The Undergraduate Guide to R. A beginner’s introduction to R programming Language, 2009.
3. Chambers, J. Software for data analysis: programming with R. Springer Science & Business Media, 2008.</td></tr>
</table>

Website and e-Learning Source	1. http://assets.cambridge.org/97805218/72652/frontmatter/9780521872652_frontmatter.pdf 2. http://students.aiu.edu/submissions/profiles/resources/onlineBook/A7E7d8_Beginning%20R%20statistics.pdf 3. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf 4. https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf 5. https://nptel.ac.in/ 6. https://swayam.gov.in/nc_details/NPTEL 7. https://www.coursera.org/ 8. https://spoken-tutorial.org/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Familiarize with basics of R software and built in function of R.

CLO2: Identify the characteristics of datasets and plot the datasets in R using graphical methods.

CLO3: Demonstrate understanding and use of for loop, if statement and break.

CLO4: Implement the learning techniques and computing environment that are suitable for the applications under consideration.

CLO5: Compute vectors and matrices, matrix inverse, eigen values and eigen vectors.

	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

Elective – IV: Group D: (PM/AP/IC/ITC)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MODELING AND SIMULATION WITH EXCEL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XIV: Group D: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT–I : Presentation Of Quantitative Data
Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation.
Analysis of Quantitative Data : Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analysis of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data—Forecasting/Data Relationship Tools.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- II : Presentation Of Qualitative Data
Introduction-Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter.
Analysis of Qualitative Data
Introduction-Essentials of Qualitative Data Analysis-PivotChart or PivotTable Reports.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT–III : Inferential Statistical Analysis Of Data
Introduction-χ 2—Chi-Square Test of Independence for Categorical Data-z-Test and t-Test of Categorical and Interval Data-An Example-ANOVA-Experimental Design.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT–IV : Modeling And Simulation: Part 1 Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V : Modeling And Simulation: Part 2
Types of Simulation and Uncertainty-The Monte Carlo Sampling Methodology-A Financial Example—Income Statement-An Operations Example—Autohaus.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Excel data analysis modelling and simulation, Hector Guerrero, Springer-Verlag Berlin Heiddelberg 2010.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know to present and analyze quantitive data.

CLO 2: Know to present and analyze qualitative data.

CLO 3: Know inferential statistical analysis of data.

CLO 4: Know modeling and simulation for deterministic data.

CLO 5: Know modeling and simulation for non deterministic data.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MACHINE LEARNING AND ARTIFICAL INTELLIGENCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XIV: Group D: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1.To Learn about Machine Intelligence and Machine Learning applications
2.To implement and apply machine learning algorithms to real-world applications.
3.To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems. To understand how to perform evaluation of learning algorithms and model selection.
4.To understand about the basic theory of problem solving paradigmsand search strategies in artificial intelligence
5.To make the students familiar with knowledge representation, planning, learning, natural language processing and robotics</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">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.</td></tr>
<tr><td colspan="6">UNIT-II: Neural Networks and Genetic Algorithms
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms
– Advanced Topics – Genetic Algorithms– Hypothesis Space Search – Genetic programming –Models of Evaluation and Learning.</td></tr>
<tr><td colspan="6">UNIT-III: Bayesian and Computational Learning
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.</td></tr>
</table>

	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 Component	Questions related to the above topics, from various competitive examination 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.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 Taylor and Francis Group. 4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017. 5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002.
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)

Students will be able to

CLO1: To understand fundamental issues and challenges of machine learning.

CLO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches

CLO3: Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning

CLO4: Understand the computation intelligence

CLO5: Apply basic principles of AI in solutions that require problem solving, inference,perception, knowledge representation, and learning

	Pos						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 NETWORKS**					
Paper Number		**Elective – XIV: Group D: (PM/AP/IC/ITC)**					
Category	Elective	**Year**	IV	**Credits**	3	**Course Code**	
		Semester	VIII				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	1		--	4	
Pre-requisite		UG level					
Objectives of the Course		To know the main fundamental principles and techniques of neural network systems and investigate the principal neural network models and applications.					
Course Outline		**UNIT-I : Neuron Model and Network Architectures** Mathematical Neural Model-Network Architectures-Perceptron-Hamming Network-Hopfield Network-Learning Rules.					
		UNIT-II : Perceptron Architectures Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.					
		UNIT-III : Supervised Hebbian Learning The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation-Multilayer 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-Conjugate Gradient.					
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		Martin T. Hagan, Howard B/Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi, 2002.					
Reference Books		1. James A.Freeman, David M.Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003. 2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.					

Website and e-Learning Source	1.https://nptel.ac.in/courses/117/105/117105084/ 2. https://nptel.ac.in/courses/106/106/106106184/

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.

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALGEBRAIC NUMBER THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XV: Group E: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The course aims to provide a study on modules over rings, finite fields, algebraic extensions, number fields and cyclotomic fields, Noetherian rings and modules and Dedekind rings.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I: Algebraic Background
Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups.
Chapter 1: Sec. 1.1 to 1.6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II: Algebraic Numbers
Algebraic numbers - Conjugatesand Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers.
Chapters 2: Sec. 2.1 to 2.6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III:Quadratic and Cyclotomic Fields
Quadratics and cyclotomatic fields : Factorization into Irreducibles : Trivial factorization - Factroization into irreducibles - Examples of non-uniquefactorization into irreducibles.
Chapter 3: Sec. 3.1 and 3.2 ; Chapter 4: Sec. 4.2 to 4.4</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- IV:
Prime Factroization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan -Nagell Theorem.
Chapter 4: Sec. 4.5 to 4.9</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT- V :Ideals
Prime Factorization of Ideals - The norms of anIdeal - Non-unique Factorization in Cyclotomic Fields..
Chapter 5 : Sec. 5.2 to 5.4</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="6">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	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 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)

Students will be able to

CLO1: To know about rings, fields and factorization of polynomials .

CLO2: To know about norms and traces over ring of integers.

CLO3: To understand factorization to irreducible polynomials.

CLO4: To understand Euclidean Quadratic fields

CLO5: To know concepts of ideals .

	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		**FLUID DYNAMICS**					
Paper Number		**Elective XV: Group E: (PM/AP/IC/ITC)**					
Category	Elective	**Year**	V	**Credits**	3	**Course Code**	
		Semester	IX				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	1	--	3

Pre-requisite	Classical Dynamics
Objectives of the Course	The aim of the course is to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensionalflows and viscous flows.
Course Outline	**Unit I:** Kinematics of fluids in motion: Real fluids and ideal fluids - velocity of a fluid at a point stream lines and path lines - steadyand unsteady flows - the velocity potential - the vorticity vector - local and particle rates of change - the equation of continuity - worked examples.Chapter 2 : 2.1 – 2.8
	Unit II: Equation of motion of fluid: Pressure at a point in fluid at rest - Pressure at a point in a moving fluid - conditions at a boundary of two inviscid immiscible fluids - Euler‟s equation of motion - Bernoulli‟s equation –worked examples.Chapter 3 : 3.1 – 3.6
	Unit III: Some three dimensional flows: Introduction – sources – sinks and doublets – Axis symmetric flow – Stokes stream function.Chapter 4 : 4.1– 4.2 &
	Unit IV: Some two dimensional flows: Meaning of two dimensional flows – use of cylindrical polar coordinates – the stream function –the potential for two dimensional – irrotational – incompressible flows – complex velocity potential for standard two dimensional flows – the Milne-Thomson circle theorem with examples. Chapter 5 : 5.1 – 5.5 & 5.8
	Unit V : Viscous Flows : Stress components in real fluids – relation between Cartesian components of stress – translation motion of a fluid element – the rate of strain quadric and principle stresses – Some further properties of the rate of strain quadric stress analysis in fluid motion – relation between stress and rate of strain – the co-efficient of viscosity and laminar flow– the Navier –Stokes equations of motion of a viscous fluid. Chapter 8 : 8.1 –8.7 and 8.9

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. F. Chorlton, Text book of Fluid Dynamics, CBS Publication, New Delhi, 1985. 2. M.K.Venkataraman, Advanced Engineering & Sciences, The National Publishing Co.
Reference Books	1. G.K.Batchelor, An Introduction of Fluid Mechanics, Foundation Books, New Delhi,1993. 2. A.R.Paterson, A First Course in Fluid Dynamics, Cambridge University Press, New York,1987. 3. R.K.Rathy, An Introduction to Fluid Dynamics, IBH Publishing Company, New Delhi,1976. 4. R.Von Mises, O.Friedrichs, Fluid Dynamics, Springer International Student Edition,Narosa Publishing House, New Delhi. 5. S.W.Yuan, Foundation of Fluid Mechanics, Prentice Hall Private Ltd, New Delhi, 1976.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Students know what are Real fluids and ideal fluids, flows and solved problems regarding this.

CLO2: Solved some problems and derivations about equation of motion of fluid and learn some naming theorems.

CLO3: Students got some knowledge about some three dimensional and two dimensional flows.

CLO4: Students got some knowledge about some three dimensional and two dimensional flows.

CLO5: Analyze the Stress components and relation between Cartesian components of stress, translation motion of a fluid element – the rate ofstrain quadric. Navier –Stokes equations of motion

of a viscous fluid.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">Stochastic Processes</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE XV - Group E:(PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IX</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Basic knowledge on probability theory.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">The main objectives of this course are to: 1. suffice the students to have an overall exposure to the elements of stochastic processes so as to gain a complete knowledge of stochastic processes 2. Create analytical skills and practical thinking to apply the gained knowledge in real life situation 3. sharpen the knowledge of students towards generalizing the existing results for advanced technological applications</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I :
Continuous-Time Markov Models
Continuous Time Markov Chain, Examples, Transient Analysis, Occupancy Times, Limiting Behaviour.</td></tr>
<tr><td colspan="8">UNIT-II
Generalized Markov Models
Renewal Process, Cumulative Process, Semi-Markov Process, Examples and Long term Analysis</td></tr>
<tr><td colspan="8">UNIT-III :
Queueing Models
Queueing Systems, Single-Station Queues, Birth and Death queues with Finite and Infinite Capacity.</td></tr>
<tr><td colspan="8">UNIT-IV :
Queues and Networks
M/G/1 and G/M/1 Queues and Network of Queues.</td></tr>
<tr><td colspan="8">UNIT-V:
Brownian Motion
Standard Brownian Motion, Brownian Motion and First Passage Times.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">V.G. Kulkarni, Introduction to Modeling and Analysis of Stochastic Systems, Second Edition, Springer, New York, 2011.</td></tr>
</table>

Reference Books	1. S. M. Ross, Stochastic Processes , Second Edition, Wiley, New York, 1996. 2. J. Medhi, Stochastic Processes, Second Edition, New Age International, New Delhi, 2001.
Website and e-Learning Source	1. https://www.edx.org/course/introduction-to-probability 2. https://nptel.ac.in/courses/115/106/115106089/ 3. https://nptel.ac.in/courses/111/102/111102014/

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO1: know the basic knowledge about stochastic processes

CLO2: acquire more detailed knowledge about Markov process with discrete and continuous state space

CLO3: Understand the different aspects of queueing systems and their significance.

CLO4: Take into consideration the impact of Brownian motion in models involving random phenomena .

CLO5: master the generalized markov models and evaluate the pros and cons.

	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

Elective VI to be chosen from Group F

GroupF:(PM/AP/IC/ITC)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XVI: Group F: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>V</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>X</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">Per week</td><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are to:
1. To introduce students to some of the basic ideas of number theory, and to use this as a context in which to discuss the development of mathematics through examples, conjectures, theorems,
proofs and applications.
2. Illustrate different methods of proof in the context of elementary number theory, and will apply some basic techniques of number theory to cryptography.
3. To explore the working principles and utilities of various cryptographic algorithms including
secret key cryptography, hashes and message digests, and public key algorithms.
4. To introduce classical encryption techniques and concepts of modular arithmetic and number
theory. Expected Course Outcomes:</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I : Divisibility and the Euclidean algorithm – Congruences
Chapter 1 sections 1,2 and 3</td></tr>
<tr><td colspan="6">UNIT-II : Some applications to factoring – Quadratic residues and reciprocity.
Chapter 1 section 4 and chapter 2 section 2
.</td></tr>
<tr><td colspan="6">UNIT-III : Some simple cryptosystems – Enciphering matrices.
Chapter 3</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV The idea of public key cryptography – RSA – Discrete log – Knapsack.
Chapter 4 except section 5</td></tr>
</table>

	UNIT-V : Pseudo primes – The rho method – Fermat factorization and factor bases. Chapter 5
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
RecommendedText	J Neal Koblitz, "A Course in Number Theory and Cryptography"- Second Edition, Springer Publishers.
ReferenceBooks	7. A.Menezes, P. van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC press, 1996. 8. Douglas R. Stinson "Cryptography theory and practice" Second Edition, Chapman and Hall / CRC.
Websiteand 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)

On the successful completion of the course, student will be able to:
CLO1: Solve problems in elementary number theory.
CLO2: Apply elementary number theory to cryptography.
CLO3: Develop a deeper conceptual understanding of the theoretical basis of number theory and cryptography.
CLO4: Identify how number theory is related to and used in cryptography.
CLO5: practice of hiding information, converting some secret information to not readable texts in real-Life situations.

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FINANCIAL MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XVI: Group F: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>V</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>X</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">LabPractice</td><td>Total</td></tr>
<tr><td colspan="2">Per week</td><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG Level Finance Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study financial mathematics through various models and to study the various aspects of financial mathematics.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I:
Single Period Models: Definitions from Finance - Pricing a forward - One-stepBinary Model - a ternary Model - Characterization of no arbitrage - Risk-NeutralProbability Measure.
Chapter 1</td></tr>
<tr><td colspan="6">UNIT – II:
Binomial Trees and Discrete Parameter Martingales: Multi-period Binary model - American Options - Discrete parameter martingales and Markov processes - Martingale Theorems - Binomial Representation Theorem – Overtureto Continuous models.
Chapter 2</td></tr>
<tr><td colspan="6">UNIT – III:
Brownian Motion: Definition of the process - Levy's Construction of BrownianMotion - The Reflection Principle and Scaling - Martingales in Continuous time.
Chapter 3</td></tr>
<tr><td colspan="6">UNIT – IV:
Stochastic Calculus: Non-differentiability of Stock prices - Stochastic Integration- Ito's formula - Integration by parts and Stochastic Fubini Theorem –GirsanovTheorem - Brownian Martingale Representation Theorem – Geometric BrownianMotion - The Feynman - Kac Representation.
Chapter 4</td></tr>
<tr><td colspan="6">UNIT – V:
Block-Scholes Model: Basic Block-Scholes Model - Block-Scholes price andhedge for European Options - Foreign Exchange - Dividends - Bonds – Marketprice of risk.
Chapter 5</td></tr>
</table>

ExtendedProfessionalComponent	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, ProblemSolving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.
Reference Books	1.MartinBoxter and Andrew Rennie, Financial Calculus: An Introduction toDerivatives Pricing, Cambridge University Press, Cambridge, 1996. 2. Damien Lamberton and Bernard Lapeyre, (Translated by Nicolas Rabeau andFarancoisMantion), 3. Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall,1996. 4. MarekMusiela and MarekRutkowski, Martingale Methods in FinancialModeling, Springer Verlag, New York, 1988. 5. Robert J.Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets,SpringerVerlag, New York, 2001 (3rd Printing)
Website and e-Learning Source	https://archive.org/details/financialmathema032436mbp

CourseLearningOutcome (forMappingwith POsandPSOs)

Studentswillbeable to

CLO 1: Use discrete and continuous processes in financial modeling.

CLO 2 : Gain knowledge in the relationship between stochastic and deterministic models.

CLO 3: Understand the roles of Put and Call options in risk reduction also

CLO 4 : understand hedging strategies to reduce risk.

CLO 5: Understand the role of the Black-Scholes partial differential equation and its boundary and final conditions in option pricing.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Mathematical Python</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – XVI: Group F: (PM/AP/IC/ITC)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>V</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>X</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td>1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To introduce the fundamentals of Python Programming.
2. To teach about the concept of Functions in Python.
3. To impart the knowledge of Lists, Tuples, Files and Directories.
4. To learn about dictionaries in python.
5. To explores the object-oriented programming, Graphical programming aspects of python with help of built in modules.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I:BASICS: Python Variables – Executing Python from the Command Line – Editing Python Files – Python Reserved Words – Basic Syntax-Comments -Standard Data Types – Relational Operators – Logical Operators -– Bit Wise Operators – Simple Input and Output</td></tr>
<tr><td colspan="6">UNIT-II :CONTROL STATEMENTS: Control Flow and Syntax – Indenting – if Statement – statements and expressions- string operations- Boolean Expressions –while Loop – break and continue – for Loop. LISTS: List-list slices – list methods – list loop – mutability – aliasing – cloning lists - list parameters. TUPLES: Tuple assignment, tuple as return value –Sets – Dictionaries.</td></tr>
<tr><td colspan="6">UNIT-III:FUNCTIONS: Definition – Passing parameters to a Function – Built-in functions- Variable Number of Arguments – Scope – Type conversion-Type coercion-Passing Functions to a Function – Mapping Functions in a Dictionary – Lambda – Modules – Standard Modules – sys – math – time – dir – help Function.</td></tr>
<tr><td colspan="6">UNIT-IV :ERROR HANDLING: Run Time Errors – Exception Model – Exception Hierarchy – Handling Multiple Exceptions – Data Streams – Access Modes Writing – Data to a File Reading – Data From a File – Additional File Methods – Using Pipes as Data Streams – Handling IO Exceptions – Working with Directories.</td></tr>
<tr><td colspan="6">UNIT-V:OBJECT ORIENTED FEATURES: Classes Principles of Object Orientation – Creating Classes – Instance Methods – File Organization – Special Methods – Class Variables – Inheritance – Polymorphism – Type Identification – Simple Character Matches – Special Characters – Character Classes – Quantifiers – Dot Character – Greedy Matches – Grouping – Matching at Beginning or End – Match Objects – Substituting – Splitting a String – Compiling Regular Expressions.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Martin C. Brown, PYTHON: The CompleteReference‖, McGraw-Hill, 2001. 2. E. Balagurusamy (2017), "Problem Solving and Python Programming", McGraw-Hill, First Edition
Reference Books	1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011 1. Wesley J Chun, ―Core Python Applications Programming‖, Prentice Hall, 2012
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO1: Understanding the concepts of Input / Output operations in file.
CLO2: Remembering the concept of operators, data types, looping statements in Python programming.
CLO3: Applying the concept of functions and exception handling.
CLO4: Analyzing the structures of list, tuples and maintaining dictionaries.
CLO5: Demonstrate significant experience with python program development environment.

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

Skill Enhancement Courses

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICS FOR COMPETIVE EXAMINATIONS-I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE(SEC 1)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">--</td><td>--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">12th StandardMathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">After taking the course,
• The student will able to answer the questions related to the number system.
• The student will able to answer real life simple problems by using HCF and LCM.
• The student will able to apply the correct sequence of operations to find out the value of a given mathematical expressions.
• The student will able to solve the problem involving square roots, cube roots and average.
• The student will able to carry out the problems related to age and simple product.</td></tr>
<tr><td colspan="2">CourseOutline</td><td colspan="6">UnitI: Number System. Hours: 6</td></tr>
<tr><td colspan="2" rowspan="4"></td><td colspan="6">UnitII: H.C.F and L.C.M of numbers, Decimal Fractions. Hours:6</td></tr>
<tr><td colspan="6">Unit III: Simplification. Hours: 6</td></tr>
<tr><td colspan="6">UnitIV: Square root and Cube Roots, Averages. Hours:6</td></tr>
<tr><td colspan="6">UnitV: Problems on numbers, Problems on Age, Surds and Indices. Hours:6</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Nottobeincluded in the External Examinationquestionpaper)	Questions related to the above topics, from various competitive examinationsUPSC/TNPSC/otherstobesolved(Tobediscussedduringthe Tutorialhour)

Skills acquired fromthiscourse	Knowledge,problemsolving,analyticalability,professional competency,professionalcommunicationandtransferableskill.
Recommended Text	1.R.S. Aggarwal[2017],QuantitativeAptitudeforCompetitiveExaminations,S.ChandandCompany,NewDelhi. Chapters11-13,18,19,22,23
Reference Books	1.PraveenR.V,QuantitativeAptitudeandreasoning,PHILearningPvt,New Delhi.

CourseLearning Outcome(forMappingwithPOsandPSOs)

Studentswillbeableto

CLO1: SolveMathematicalProblemsusingMathematicalformulae.

CLO2: Understand the knowledge of application of Mathematics

CLO3: Understandtheconceptsofsimplification.

CLO4: Calculatethesquarerootandcuberoot.

CLO5: Solvetheproblemsonage.

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

Titleof theCourse		**MATHEMATICSFORCOMPETIVEEXAMINATIONS-II**					
PaperNumber		**ELECTIVE(SEC 2)**					
Category	SEC	**Year**	I	**Credits**	2	**Course Code**	
		Semester	II				
InstructionalHours Perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		2		--	--	2	
Pre-requisite		12th StandardMathematics					

Objectives of theCourse	Aftertakingthecourse, Topreparethestudentsforcompetitiveexaminations
CourseOutline	**Unit I:** Time and work – Time and distance – Problems on Trains.(Book1:Chapters15,17,18).
	UnitII: Simpleinterest,compoundInterest–Bargraphs–PieCharts–LineGraphs.(Book1:Chapters21,22,37,38,39).
	UnitIII: LogicalSequenceofWords–ArithmeticalReasoning–InsertingtheMissingCharacter.(Book2,Section:1,Chapters13–15)
	UnitIV: DataSufficiency–DecisionMaking–VerificationofTruthoftheStatement.(Book2,Section:1,Chapters16,17,20.)
	UnitV: Non-VerbalReasoning–AnalyticalReasoning–GroupingofIdenticalFigures.(Book2,Section:3,Chapter3,4,13)

Extended Professional Component (is a part of internal component only, Nottobeincluded in the External Examinationquestionpaper)	Questions related to the above topics, from various competitive examinationsUPSC/TNPSC/otherstobesolved(To ediscussedduringtheTutorialhour)
Skills acquired fromthiscourse	Knowledge,problemsolving,analyticalability,professional competency,professionalcommunicationandtransferableskill.
Recommended Text	1.R.S.Aggarwal,*QuantitativeAptitudeforCompetitiveExaminations*,RevisedEdition,S.ChandandCompanyLtd.,RamNagar,NewDelhi,Reprint2022. 2. R.S.Agarwal,*AModernApproachToVerbalAndNonverbalReasoning*,S.Chand,2018.
ReferenceBooks	V.V.K.Subbiraj,*TestofReasoning–Verbal/Non-Verbal&GeneralIntelligenceforCompetitiveExaminations*,SuraBooks,2007

CourseLearningOutcomes

Thiscoursewillenablethestudentsto:

CONumber	COStatement	Knowledge Level
CO1	makecritiqueofquantitativeinformationusing proportionalreasoning	K5
CO2	Interpretandcompareweightedaverages,indices, ranking.	K2
CO3	identifyusesandmisusesofpercentagesrelatedtoaproperun derstanding ofthebases.	K1
CO4	examiningandestimatingpercentagesasratesper100	K3,K4
CO5	solveforanunknownquantityinproportional situation	K6

E-learningsource:www.tcyonline.com/tests/mathematics-competitive-examhttp://www.indiabix.com/online-test/non-verbal-reasoning-test/http://books.tamilcube.com/career/aptitude-test/non-verbal-reasoning/non-verbal-reasoning-questions-001.aspx

https://www.kent.ac.uk/careers/tests/spatialtest.htmhttp://www.careerbless.com/aptitude/qa/home.phphttp://www.careerride.com/online-aptitude-test.aspx

SKILL ENHANCEMENT COURSE - IV
COMMERCE AND TALLY

Hours: 1 **Credits: 1**

Learning Objectives

1 To understand the fundamentals of SPSS
2 To compare the values obtained in t-test and ANOVA
3 To perform regression and non-parametric tests
4 To create company, groups and ledgers and obtain financial statements using Tally Prime
5 To understand inventory management and account for goods and services tax

UNIT I: INTRODUCTION TO COMPUTERS

History of Computers, Parts of Computers, Hardware: Specifications and Data Storage Management, Software: Concept of Systems Software applications NIT

UNITII: OFFICE PRODUCTIVITY TOOLS

Introduction to MS Word, MS Excel and MS PowerPoint, Use of various web browser.

UNIT III: INTRODUCTION TO TALLY

Creating Accounts, feeding opening balances, chart of accounts, capital, current accounts, Investment, loans, Sales and Purchase : Purchase/Sales Order, Receipt Note, Purchases/Sales Bill, Debit/Credit note journal, Value Added Tax(VAT) bills, Trial Balance and Final Accounts

UNIT 1V: ACCOUNTING SOFTWARES

Features of Accounting Software, Installation of Tally Package, Opening screen, Creating Company, Altering and Configuring Company. Menu related accounts, Ledgers: Creating, Display, Altering.

UNIT V: INVENTORY

Creation of group and stock. Vouchers in tally: Pre-define Vouchers, Configuring tally, Bank deposit, Depreciation and generating various reports.

Course outcomes:

1. Construct data file in SPSS
2. Examine Means of samples
3. Apply non-parametric tests
4. Construct a company, form groups and get automated financial statements
5. Plan for automation of inventory

Books for study: 1. Sundara Pandian.P, Muthulakshmi. S &Vijayakumar, T (2022), Research Methodology &Applications of SPSS in Social Science Research, Sultan Chand 63 &Sons, New Delhi

2. Morgan George. A, Barrett C Karen, Leech L Nancy and Gloeckner Gene W (2019),IBM SPSS for Introductory Statistics, Routledge, 6thEdition, U.K

3. Official Guide to Financial Accounting using TallyPrime (2021), BPB Publication,Delhi
4. Chheda Rajesh, U (2020), Learn Tally Prime, Ane Books, 4thEdition, New Delhi

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">GEOGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>1</td><td colspan="2"></td><td colspan="2">1</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Solid foundation in basic math, including algebra and geometry. Completion of one year of high school or college-level math is recommended. Familiarity with equations, functions, and basic geometry, plus computer proficiency, is essential.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">• To introduce thestudents to Geogebra.
• To enhance understanding of mathematical concepts.
• To make the students to progressively build skills and knowledge.
• To leverage geometry for advanced applications.
• To ensure prerequisite knowledge and skills.</td></tr>
</table>

Course Outline	**Unit - I: Introduction to Geogebra and Matrices (6 hours)** Introduction to Geogebra and its Applications- Exploring the Geogebra interface- Creating and manipulating matrices - Matrix operations (addition, multiplication) - Rank and Transpose of a matrix- Inverse of a matrix.
	Unit - II: Trigonometry and Geogebra (6 hours) Trigonometric functions and identities- Graphing trigonometric functions - Using Geogebra to solve trigonometric equations- Trigonometric applications and Geogebra tools.
	Unit - III: Roots of Polynomials (6 hours) Solving polynomial equations- Graphical representation of polynomial functions- Finding roots and factors of polynomials - Maxima and Minima of polynomial equations.
	Unit - IV: Limits and Continuity (6 hours) Introduction to limits and their graphical representation- Calculating limits- Exploring the concept of continuity - Continuity and limits in real-world scenarios.
	Unit - V: Advanced Topics and Practical Applications (6 hours) Further exploration of mathematical concepts- Real-world applications and case studies of the topics covered- Interactive problem-solving.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill

Text Book **Recommended Text**	**Textbook and Resources:** 1. **Online Geogebra Documentation:**Geogebra provides extensive online documentation and tutorials to support learning and exploration. 2. **Additional Reading:** Students are encouraged to explore additional resources related to specific topics covered in the course, such as calculus textbooks for more in-depth coverage of differentiation and integration. 3. **Course Materials:** Lecture notes, slides, and assignments provided by the instructor throughout the course will be essential references. **Geogebra Software:** Ensure you have access to the latest version of GeoGebra, which can be downloaded for free from the Geogebra website
Website and **e-Learning Source**	1. Search Tutorials | spoken-tutorial.org 2. Applications of GeoGebra - Course (swayam2.ac.in) 3. GeoGebra 5.04 - Course (swayam2.ac.in)

Course Learning Outcomes:

Course Outcome (CO)	**Description**
CO1: Proficiency	- Navigate the Geogebra interface effectively. - Construct and manipulate geometric objects, points, lines, and angles. - Perform symbolic computations using the algebra view. - Graph functions and equations using Geogebra. - Utilize Geogebra tools for geometry and algebraic tasks. - Employ Geogebra scripting for advanced mathematical tasks.
CO2: Matrix and Trigonometry Mastery	- Using matrices, including operations like addition, multiplication, and inversion. - Solve trigonometric equations and graph trigonometric functions using Geogebra. - Understand matrix transformations and trigonometric properties.
CO3: Understanding Limits and Continuity	- Analyze limits graphically and mathematically. - Comprehend the concept of mathematical continuity. - Represent limits and continuity visually using Geogebra.
CO4: Geogebra Scripting and Advanced Tasks	- Use Geogebra scripting for advanced mathematical tasks and explorations.
CO5: Critical Thinking and Mathematical Problem-Solving	- Develop critical thinking skills in approaching mathematical problems. - Apply mathematical concepts

	systematically to real-world scenarios. - Enhance overall problem-solving abilities.
CO6: Effective Communication of Mathematical Ideas	- Communicate mathematical ideas clearly, both verbally and in writing. - Present mathematical concepts and solutions in an organized manner - Demonstrate mathematical reasoning effectively.
CO7: Independent Learning and Exploration	- Gain confidence and skills for independent learning and exploration of mathematical concepts using Geogebra. - Apply mathematics in various academic and practical contexts.

SKILL ENHANCEMENT COURSES- VI
OFFICE AUTOMATION

SEMESTER IV
HOURS: 2
CREDITS: 2

UNIT I Basics of computer

Introduction to Computer-Components of Computer-Concept of Hardware and Software-Data Representation-Concept of Data Processing- Application of Information Electronics and Communication

UNIT II Introduction to GUI based OS

Introduction to various types of OS and its functions-User Interface-Various settings of GUI based OS.-File and Directory Management-Various types of file extension- Common Utilities.

UNIT III Elements of Word Processing

Objective of Word Processing-Word Processing Basics-Opening and Closing Documents-Text Creation and Manipulation-Formatting Text -Table Manipulation - Column and picture manipulation -Page Setup - Mail Merge

UNIT IV Spreadsheet

Objective of Spreadsheet-Elements of Electronics Spreadsheet-Manipulation of Cells and worksheet - Function and Charts

UNIT V Presentation

Introduction and Objective- Basics of Power Point -Creation of presentation-Preparation of Slides - Providing Aesthetics - Presentation of Slides - Slide Show

Titleof theCourse	**R Language for Statistics**						
PaperNumber	**ELECTIVE(SEC VII)**						
Category	SEC	**Year**	III	**Credits**	2	**Course Code**	
		Semester	VI				
InstructionalHours perweek	**Lecture**		**Tutorial**		**LabPractice**	**Total**	
	2		--		--	2	
Pre-requisite	12thStandardMathematics						

Objective: To introduce to the students then ovel applications of R language and to give them hands on experience of working with data.

Unit–I:**Basic ConceptsinR**

Assignmentofvalues,Character,Vectorarithmetic,UnderstandingDatatypes,importing/exportin g data - Computation of tables and graphical representation in R:plot,piechart,boxplot,generatinggraphsfromimporteddata

Unit– II:**ProbabilityDistributions**

Fittingandplottingofbinomial,Poissonand Normaldistributions

Unit–III:CorrelationandRegression

Correlation and linearregression: Representation of bivariate data through scatterdiagram,KarlPearson's,Spearman'sandKendall'scoefficientsofcorrelation,Coefficientofdetermination,linear regressionmodel,MultipleLinear Regression.

Unit–IV:**Tests ofHypothesis**

Student'st-test,OnesampleZ–test,Pairedatat–test

Unit–V:Chi-squaretestandDesignofExperiments

Chi-squaretest:Independenceofattributesandgoodnessoffit–DesignofExperiments: Completely randomized design (CRD), Randomized block design (RBD)andLatinsquaredesign(LSD).

BooksforReference

1. MarkGardener, *BeginningR the StatisticalProgramming Language*, JohnWiley&Sons,Inc.2012.
2. JosephAdler,*RinaNutshellADesktopQuickReference*, O'reilly,2010.
3. CornillonPierreAndreEtAl,RForStatistics,TandFIndia,2015.
4. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander, Addison-WesleyData &AnalyticsSeries,2018.
5. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, HadleyWickham,Garrett Grolemund, Shroffpublishers, 2017.
6. Learn R For Applied Statistics: With Data Visualizations Regressions And Statistics byHui,Apress, 2019

Course Learning Outcomes

Thiscoursewillenablethestudentsto:

CO Number	CO Statement	Knowledge Level
CO1	explain practical implications of expectation and variance and how they predict the shapes of distribution and density(mass) functions of a random variable	K5

CO2	demonstratecapabilitytowriteprogrammingcodesfor plottingdifferentdistributions.	K4
CO3	evaluatetheindependenceofattributesanddesignof experiments.	K6
CO4	describeandapplyprobabilitydistributionfunctionanddifferent typesof distributivefunctionsthrough R Language.	K1
CO5	knowandunderstandaboutTestsofHypothesis throughR.	K2

E– Learningsource:https://www.r-project.org/

https://www.r-statistics.com/

Group G (Skill Enhancement Courses) SEC

Title of the Course		**Mathematical Documentation using LATEX/other Packages**					
PaperNumber		**Skill Enhancement Course – VIII**					
Category	**Skill Enhancement Course – VIII**	**Year**	IV	**Credits**	2	**Course Code**	
		Semester	VIII				
Instructional Hours		**Lecture**		**Tutorial**		**LabPractice**	**Total**
Per week		2		-		2	4
Pre-requisite		Basic knowledge of programming & Mathematics Course					
Objectives of the Course		The main objectives of this course are to: • Introduce the Software knowledge in Latex					

	• Learn Mathematics structures using Latex • Understanding the basic concepts and their properties are important for the development of the present and further courses.
Course Outline	**UNIT-I :** Text formatting, TEX and its offspring
	UNIT-II: Unit:2 What's different in LATEX2ϵ , Distinguishing LATEX2 Basic of a LATEX file LATEX2 Basic of a LATEX file .
	UNIT-III : Commands and Environments-Command names and arguments, Declarations Lengths, special Characters.
	UNIT-IV : Document layout and Organization-Document class, Page style, Parts of the Document.
	UNIT-V : Table of Contents, Fine tuning text, Footnotes and marginal notes.
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
RecommendedText	: H. Kopka and P.W. Daly , "A guide to LATEX" - third Edition, Addison –Wesley , London 1999.
ReferenceBooks	Stefan Kottwitz"LaTeX Beginner's Guide: Create High-quality and Professionallooking Texts, Articles, and Books for Business and Science Using LaTeX" Packt Publishing, 2011.
Websiteand e-Learning Source	http://mathforum.org,http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,www.mathpages.com

Course Learning Outcomes:

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

- CLO1: Remember to Download and install open source software Latex
- CLO2: Understanding and formatting Latex
- CLO3: Illustrate to learn to create Latex file
- CLO4: Apply and Analyze the Latex commands to large files
- CLO5: Able to learn mathematics derivations and structures using LATEX

	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Office Automation and ICT Tools</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Skill Enhancement Course - VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement Course – VIII</td><td>Year</td><td>IV</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>2</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic knowledge of computers</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">➢ Describe the usage of computers and why computers are essential components in real world.
➢ Utilize the Internet Web resources to societal needs.
➢ Solve common real world problems using appropriate Information Technology applications and systems.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">Unit 1 Basic concepts of computer, functions and characteristics of computer, computer era with its generations and classifications about Windows platform, its features and versions. Introduction of Computer Networks</td></tr>
<tr><td colspan="6">Unit 2 MS-Word – Word processing application features, editing and modification of textual information features, object insertion and modification features, tabulation features, mailing merging and labeling features. Printing Documents.</td></tr>
<tr><td colspan="6">Unit 3 MS-Excel – spreadsheet application features, data representation into the cells of spreadsheet, applying basic arithmetic operations on to it, applying built-in functions and logical condition to the cell data. Filtering and Sorting features are also included. Working with sheets, Creating Charts, Printing.</td></tr>
</table>

	Unit 4 MS-PowerPoint – presentation application features, slide presentation features, animation and transition features to the slides, audio and video insertion features with slideshow features. Adding Effects to the Presentation, Printing Handouts.
	Unit 5 Basic of internet, working of search engine, ICT tools, video conferencing types, video conferencing platforms, online forms, Google sheets, docs, drive and visualization tools concepts**.** Google meet, Zoom meeting creation. Recording tool of online meeting,
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Using Web resources and modeling the on-line e-business system. Making Presentation for business and societal issues. (To be discussed during the Practical hour)
Skills acquired from this course	Possess the knowledge of basic hardware peripherals. Know and use Microsoft Office and ICT tools.
Recommended Text	3. Microsoft Office 2007: The Complete Reference, McGraw-Hill Inc 4. E Balagurusamy, Fundamentals of Computers, Tata McGraw Hill Education Private Limited.,2009.
Reference Books	7. MICROSOFT OFFICE 365 ALL-IN-ONE FOR BEGINNERS & POWER USERS: The Concise Microsoft Office 365 A-Z Mastery Guide for All Users (Word, Excel, PowerPoint, ... (OFFICE 365 MASTERY GUIDE 2022 Book 1) Kindle Edition. 8. T. C. Bartee , Computer Architecture and Logic Design, McGraw-Hill 9. Sukhwinder Singh; Gaurav Kumar and kanwal Preet , ICT Skill Development , Twenty first Century Publications, 2014
Website and e-Learning Source	https://www.rgycsm.org/ , https://ncert.nic.in/ , https://ocw.mit.edu/

Course Learning Outcome (for Mapping with POs and PSOs)

By learning the course, the students will be able ·

CLO1: to perform documentation ·

CLO2: to perform accounting operations ·

CLO3: to perform presentation skills

CLO4: Recognize when to use each of the Microsoft Office programs to create professional and academic documents.

CLO5: Use Microsoft Office programs to create personal, academic and business documents following current professional and/or industry standards.

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

Title of the Course	DIFFERENTIAL EQUATIONS USING SCILAB					
Paper Number	Skill Enhancement Course - VIII					
Category: Skill Enhancement Course - VIII	Year	IV	Credits	2	Course Code	
	Semester	VIII				
Instructional Hours per week	Lecture	Tutorial		Lab Practice	Total	
	2	-		2	4	
Pre-requisite	Basic understanding of commands and UG Level Differential Equations					
Objectives of theCourse	1.Understand the basic commands 2.Solve the system of equations 3.Evaluate the polynomials 4.Solve the Ordinary differential equations.					
Course Outline	**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 Scilab					
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)					
Skills acquired fromthis course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill					
Recommended Text	1. PROGRAMMING USING SCILAB, AKHILESH KUMAR					
Reference Books	1.Ordinary Differential Equations with Scilab by Gilberto E.Urroz					
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)

Students will be able to

CLO 1: Understand the Scilab.

CLO2: Learning the Scilab Programming.

CLO3: Plotting the function in Scilab.

CLO4: Solving Ordinary Differential Equations using Scilab.

CLO5: Programming Scilab for Polynomials.

	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		TERM PAPER & SEMINAR PRESENTATION					
Paper Number		Skill Enhancement Course IX					
Category	SEC	Year	V	Credits	2	Course Code	
		Semester	IX				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	-	-	3		
Course outline		Professional Communication Skill : Term paper & Seminar presentation Assignment of Problem by faculty Lecture - I (by the student) 25% Lecture - II (by the student) 25% Lecture - III (by the student) 25% Submission of a write-up (10 to 15 pages using LaTex) 25% Marks / Grade Points / Lecture Grade as per the Regulation)					

Title of the Course		INTERNSHIP / INDUSTRIAL ACTIVITY					
Category		Year	V	Credits	2	Course Code	
		Semester	IX				
Instructional Hours per week		Lecture	Tutorial	Lab Practice			

Title of the Course		TRAINING FOR COMPETITIVE EXAMINATIONS					
Paper Number		Professional Competency Skill Enhancement					
Category	SEC	Year	V	Credits	2	Course Code	
		Semester	X				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
					3		
Course Outline		1.Training for Competitive Examinations Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) 2.General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours) OR Mathematics for Advanced Research Studies (4 hours)					

Title of the Course		EXTENSION ACTIVITY					
Paper Number							
Category		Year	V	Credits	1	Course Code	

	Semester	X		
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
Course Outline	Performance based assessment			

Title of the Course	Foundation course **- Bridge Mathematics**						
Paper Number	**FOUNDATION 1**						
Category	Core	**Year**	I	**Credits**	2	**Course Code**	**FC**
		Semester	I				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	2	-	--	2			
Pre-requisite	12th Standard Mathematics						
Objectives of the Course	To bridge the gap and facilitate transition from higher secondary to tertiary education; To instil confidence among stakeholders and inculcate interest for Mathematics;						
Course Outline	**UNIT-I:** Algebra: Binomial theorem, General term, middle term, problems based on these concepts						
	Unit II: Sequences and series (Progressions). Fundamental principle of counting. Factorial n.						
	Unit III: Permutations and combinations, Derivation of formulae and their connections, simple applications, combinations with repetitions, arrangements within groups, formation of groups.						
	Unit IV: Trigonometry: Introduction to trigonometric ratios, proof of sin(A+B), cos(A+B), tan(A+B) formulae, multiple and sub multiple angles, sin(2A), cos(2A), tan(2A) etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule						
	Unit V: Calculus: Limits, standard formulae and problems, differentiation, first principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.						
Recommended Text	1. NCERT class XI and XII text books. 2. Any State Board Mathematics text books of class XI and XII						
Website and e-Learning Source	https://nptel.ac.in						

Course Learning Outcome

After completion of this course successfully, the students will be able to

CLO 1: Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also, solve the related problems

CLO 2: Find the various sequences and series and solve the problems related to them. Explain the principle of counting.

CLO 3: Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations

CLO 4: Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and submultiple angles, etc. Also, they can solve the problems using the transformations.

CLO 5: Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

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

Generic /Discipline Specific courses offered by Department of Mathematics to Other Department Papers

Generic Elective Courses (Allied Courses)

<table>
<tr><td>Title of the Course</td><td colspan="6">ALLIED MATHEMATICS–I</td></tr>
<tr><td>Paper Number</td><td colspan="6">ELECTIVE COURSE I</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>-</td><td>--</td><td colspan="3">4</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course- WRONG</td><td colspan="6">• Necessary skills to analyze and make decision on Assignment and Transportation problems Simple Harmonic Motion
• To solve real world problems on Sequencing and Network and its applications</td></tr>
<tr><td>Course Outline</td><td colspan="6">UNIT-I: Summation of series: Binomial series- Exponential series-Logarithmic series-Simple Problems.
Chapter2: Sections: 2.1.3,2.2,2.2.1,2.3,2.3.3. Hours:12

UNIT-II: Matrices: Symmetric–Skew-Symmetric– Hermitian –Skew –Hermitian– Orthogonal and Unitary matrices– Cayley -Hamilton theorem(withoutproof)–Verification-ComputationofinverseofmatrixusingCayley-Hamiltontheorem.
Chapter4: Sections:4.1.1–4.1.6,4.5.2and4.5.3. Hours:12

Numerical Methods: Newton's method to find a root approximately. Finite Differences: Interpolation: Operators,Δ, ∇,E, E^{-1}differencetables. Interpolation formulae: Newton's forward and backward interpolation formulae for equal intervals, Lagrange's interpolation formula.
Chapter3:Sections3.4.1.Chapter5:Sections:5.1and5.2.Hours:12

UNIT–IV:Trigonometry:Expansions of $\sin^n\theta$, $\cos^n\theta$, in a series of powers of sinθ and cosθ-Expansions of sin(nθ) and cos(nθ) in a series sine cosines of multiples of "θ"-Expansions of sinθ, cosθ and tanθ in a series of powers of "θ"–Hyperbolic and inverse hyperbolic functions .
Chapter6:Section6.1–6.3 Hours:12

UNITV: Differential Calculus: Successive differentiation, nth derivatives, Leibnitz theorem (without proof) and applications, Jacobians, maxima and minima of functions of two variables-Simple problems
Chapter1,Section1.1to1.3.1. Hours:12</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired From this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Text	AlliedMathematics,VolumeIandVolumeIIbyP.DuraipandianandS.Udayabaskaran,S. ChandPublications VolumeI:UnitI–IV,VolumeII–UnitV
Reference Books	1. AncillaryMathematicsbyS.NarayananandT.K.ManickavachagomPillay,S.ViswanathanPinters,1986,Chennai 2. AlliedMathematicsbyA.Singaravelu 3. AlliedMathematicsbyP.R.Vittal

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the concepts of Summation of Series.

CLO2: Understand the concepts of Cayley Hamilton Theorem and inverse matrices.

CLO3: Understand the concepts of finite differences.

CLO4: Understand the knowledge about expansions, hyperbolic and inverse hyperbolic functions.

CLO5: Understand the concept of Leibnitz theorem and functions of two variables

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

Title of the Course		**ALLIEDMATHEMATICS–II**					
Paper Number		ELECTIVECOURSE II					
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		Semester	II				
Instructional		**Lecture**		**Tutorial**		**Lab Practice**	**Total**

Hours Per week	6	-	--	6
Pre-requisite	12^{th}StandardMathematics			
Objectives of the Course	• To discuss and analyze the concept of gradient, divergence and curl and its properties. • To be familiar with Green's, Gauss and Stoke's theorem in vector integrals. • To find the solution of first order linear partial differential equations. • To solve the ordinary differential equations by using Laplace and Inverse Laplace Transform.			
CourseOutline	**Unit – I: Differentiation of Vectors** Differentiation of vectors – Differential operators – Solenoidal – Irrotational – Directional derivative – Gradient –Divergence and curl – Formula involving operator ∇. (Chapter 8: Pages: 329 - 363)			
	Unit – II: Integration of Vectors Line integrals – Surface integrals – Volume integrals – Statements of Gauss divergence, Green's, Stoke's theorems and its applications – verifications. (Chapter 8: Pages: 364 - 390, 395 - 418 excluding Green's theorem in space- problems)			
	Unit – III: Partial Differential Equations Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions – Solutions of standard types of first order equations: $f(p,q)=0, f(x,p)=g(y,q), f(x,p,q)=0, f(y,p,q)=0, f(z,p,q)=0$: $z=px+qy+f(p,q)$ (Chapter 6: Pages: 252 - 269)			
	Unit – IV: Laplace Transforms Definition – Laplace transforms of e^{at}, cos at, sin at, cosh at, sinh at, t^n, $e^{at}f(t)$, $t^n f(t)$, $f'(t)$, $f''(t)$. (Chapter 7: Pages: 289 - 298)			
	UNIT-V: Inverse Laplace transform – Solving differential equations of second order with constant coefficients using Laplace transform. (Chapter 7: Pages: 299 - 317excluding simultaneous equations - problems)			

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	S. Narayanan, P. Kandhasamy, R. HanumanthaRao and T.K. ManickavasagamPillai, Ancillary Mathematics, Volume II, S. Viswanathan Printers, Chennai 2010.
Reference Books	1. P. Balasubramaniyam, K. G. Subramanian, Ancillary Mathematics, Volume – I, Tata McGraw – Hill publishing company limited, New Delhi, 1996. 2. P. DuraiPandian, S. UdayaBaskaran, Allied Mathematics, Volume – I, Muhil publishers, 1st Edition, Chennai, 1997. 3. P. Kandsamy and K. Thilagavathy, Allied Mathematics volume – I, Volume – II, S. Chand & Company, New Delhi, 2004. 4. Shanti Narayan, P.K. Mittal, Differential Calculus, S. Chand & Co, New Delhi, 2005. 5. A. Singaravelu, Allied Mathematics, Meenakshi Agency, Chennai, 2001. 6. P.R. Vittal, Allied Mathematics, Margham Publications, Chennai, 1999.

Discrete Mathematics-I

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	DISCRETE MATHEMATICS-I	Core	4	-	-	-	3	4	25	75	100
Learning Objective											
LO1	To make the students understand the Mathematical Logic and truth table.										
LO2	To know about how and when to use set theory.										
LO3	To understand the discrete structure, storage structure.										

LO4	To understand the methods of Relations and ordering.	
LO5	To understand the functions, classifications, and types.	
UNIT	**Contents**	**No. of Hours**
I	**Mathematical logic-:** Connectives, well formed formulas, Tautology, Equivalence of formulas, Tautological implications, Duality law, Normal forms.	12
II	**Set Theor**y: Basic Concept of Set Theory – Operations on Sets – Venn Diagram	12
III	Representation of Discrete Structure : Data Structure – Storage Structure - Sequential Allocation – Pointers and Linked Allocation – An Application of Bit Represented Sets.	12
IV	**Relations and Ordering:** Relations – Properties of Binary Relations in a set – Relation Matrix and the Graph of a Relation – Partition and Covering of a set – Equivalence Relations – Compatibility Relations – Composition of Binary Relations –Partial Ordering – Partially Ordered set.	12

V	**Functions** Definitions of functions and its Classification – Types – Examples – Composition of functions – Inverse functions – Binary and n-ary operations – Characteristic function of a set – Hashing functions – Recursive functions	12
	Total	60

Course Outcomes		**Programme Outcome**
CO	Solve problems in Mathematical logic and truth table.	
1	Know and understand about set theory.	PO1, PO6
2	Know and understand about discrete structure, storage structure.	PO2
3	Know and understand about Relations and Ordering	PO4, PO5
4	Understand the functions, classification and types.	PO6

Text Book

Discrete Mathematical Structures with applications to computer Science J.P Tremblay and R.P Manohar (Mc.Graw Hill, 1997.)

Reference Books

P.R. Vittal,Mathematical Foundations– Margham Publication,Chennai.

Discrete Mathematics-Oscar Levin(3rd Edition)

Web Resources

https://nptel.ac.in/courses/106106094 https://nptel.ac.in/courses/111107058

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	2	3	3	2	3
CO 3	3	3	3	3	3	3
CO 4	3	2	2	3	3	3
CO 5	3	2	3	3	3	2
Weight age of course contributed to each PSO	15	12	14	15	14	14

S-Strong-3 M-Medium-2 L-Low-1

Title of the Course	**DISCRETEMATHEMATICS II**						
Paper Number	**ELECTIVECOURSE**						
Category		**Year**		**Credits**		**Course Code**	
		Semester					
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**		**Total**
	4		-		--		4
Pre-requisite	12th Standard Mathematics						
Objectives of the Course	This course aims to develop mathematical maturity and ability to deal with abstraction and to develop construction and verification of formallogical manipulation.						
Course Outline	UNIT I: RECURRENCE RELATIONS AND GENERATING FUNCTIONS Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations. (Chap V . Sections:1 to 5)						

	UNIT II: MATHEMATICAL LOGIC TF Statements - Connectives - Atomic and Compound Statements - Well-formed [StatementFormulae]- Truth Table of a Formula-Tautology -Tautological Implications and Equivalence of Formulae. (Chap IX . Sections:1 to 8)
	UNIT III: MATHEMATICAL LOGIC [CONTD..] Replacement process - Functionally complete sets of connectives and Duality law – NormalForms-PrincipalNormalForms.(Chap IX . Sections: 9 to 12)
	UNIT IV: LATTICES Lattices [omit example 15 PpNo.10.6]- Some properties of Lattices - New Lattices (omit remark Pp 10.14)-Modular and Distributive Lattices (omit theorem 10 and 17,Example 4-Pp10.23, Example 11-Pp10.24) (Chap X . Sections:1 to 4)
	UNIT-V BOOLEAN ALGEBRA Boolean Algebra (omit theorem 25) - Boolean Polynomials- Karnaugh Maps (omit K- map for 5 and 6 variables) (Chap X . Sections:5 to 7)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M.K.Venkataraman, N.Sridharan and N.Chandrasekaran, [2003] Discrete Mathematics, The National Publishing company, chennai.
Reference Books	7. Oscar Levin, Discrete Mathematics, 3rd Edition,2016. 8. B. A. Davey & H. A. Priestley (2002). *Introduction to Lattices and Order* (2nd edition). Cambridge University Press. 9. Edgar G. Goodaire& Michael M. Parmenter (2018). *Discrete Mathematics withGraph Theory* (3rd edition). Pearson Education. 10. Rudolf Lidl& Günter Pilz (1998). *Applied Abstract Algebra* (2nd edition). Springer. 11. Kenneth H. Rosen (2012). *Discrete Mathematics and its Applications*: *WithCombinatorics and Graph Theory* (7th edition). McGraw-Hill. 12. C. L. Liu (1985). *Elements of Discrete Mathematics* (2nd edition). McGraw-Hill.
Website and e-Learning Source	https://nptel.ac.in

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	Analyse and perceive various graph theoretic concepts and familiarize with their applications.	K4, K5
CO2	Describe about partially ordered sets, Boolean algebra, lattices and their types.	K1
CO3	Apply Karnaugh map for simplifying the Boolean expression	K3
CO4	Demonstrate the skill to construct simple mathematical proofs and to validate.	K2, K6
CO5	Achieve greater accuracy, clarity of thought and language.	K6

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	2	2	2	3	3	3	2	2	2	2	3	2.42
3	2	2	2	2	3	3	3	3	3	3	2	3	2.58
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.57
	Result												High

Title of the Course		**MATHEMATICAL STATISTICS - I**					
Paper Number		**Elective**					
Category	Core	**Year**		**Credits**		**Course Code**	
		Semester					
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
				--			
Pre-requisite		12^{th} Standard Mathematics					

Objectives of the Course	• To make the students to gain wide knowledge in the fundamental concepts of Statistics • To understand the idea of random variables and its types • To derive certain values in corporated with random variables • To relate the statistical distributions with the real life situations • To apply statistical techniques to get the solutions to real life problems
Course Outline	**Unit I:** Random variables: Distribution function-Discrete random variable-Continuous random variable.
	Unit II: Mathematical expectation-Expectedvalueoffunctionofarandomvariable-Propertiesof expectation - Properties of variance – Covariance.
	Unit III: Moment generating function–Properties of cumulants-Chebychev'sinequality-Binomial distribution.
	Unit IV: Poissondistribution: Properties, Moments of Poisson distribution–Geometric distribution: Moment generating function of Geometric distribution.
	Unit V: Norma ldistribution: Momentgeneratingfunction of Normal distribution, Mean deviation about mean – Gamma distribution - Exponential distribution.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / 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 transferable skill.

Text Book	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019.
Recommended Text	3. Vittal,P.R.(2004).*Mathematicalstatistics*.MarghamPublications. 4. Kapur, J. N &Saxena, H. C. (2010). *Mathematical statistics* (20thed.). S. Chand & Company Ltd.
Website and e-Learning Source	https://nptel.ac.in

CourseOutcomes		
CO No.	**CO-Statements** Onsuccessfulcompletionofthiscourse,studentswillbe able to	**Cognitive Levels (K- Level)**
CO1	acquiretheknowledgeofbasicconceptsinstatistics	**K1**
CO2	beabletounderstandvarioustypesofrandomvariablesand the distributions	**K2**
CO3	calculatemoments,cumulants,momentgeneratingfunction andvariousconstantsofprobabilitydistributions	**K3**
CO4	illustratethetheoryofrandomvariables,distribution functionsandprobabilitydistributionswithsuitable	**K4**
CO5	beabletoevaluatesolutionofreal-lifeproblemsunderthe concept of probability and probability distributions.	**K5**

Relationship Matrix											
Course Outcomes	**ProgrammeOutcomes (POs)**					**ProgrammeSpecificOutcomes(PSOs)**					**Mean Scoreof COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2.2**
CO2	**3**	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2.2**
CO3	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2.1**
CO4	**3**	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2.2**
CO5	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**2**	**2.3**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MATHEMATICAL STATISTICS - II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td></td><td rowspan="2">Credits</td><td rowspan="2"></td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2">--</td><td></td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To test the significance of sampling
• Finding the Goodness of Fit
• To derive the various measures of t and Fdistributions
• To Analyze the correlation coefficient and Regression lines</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">Unit I: Introduction-TypesofSampling-ParameterandStatistic-Testsofsignificance-Procedure for testing of hypothesis - Test of significance for large samples - Sampling ofattributes-Sampling of variables.</td></tr>
<tr><td colspan="8">Unit II:Introduction - Student’s t - distribution - Applications of t-distribution</td></tr>
<tr><td colspan="8">Unit III:-F-distribution -Applicationsof F-distribution.</td></tr>
<tr><td colspan="8">Unit IV: Meaning of Correlation –Scatter Diagram – Karl Pearsons’sCoeficient of Correlation – Rank Correlation</td></tr>
<tr><td colspan="8">Unit V:Introduction - Linear regression</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Text Book	S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co, New Delhi, Reprint 2019. **UnitI**: *Ch 14 (Full)* **UnitII**: *Ch 16 (Sec16.1-16.3.3)* **UnitIII** : *Ch 16 (Sec16.5-16.6.5)* **UnitIV**: *Ch10(Sec10.1-10.4, 10.7.1)* **UnitV**: *Ch.11 (Sec11.1-11.2.5)*
Recommended Text	1. Vittal,P.R.(2004).*Mathematicalstatistics*.MarghamPublications. 2. Kapur, J. N &Saxena, H. C. (2010). *Mathematical statistics* (20thed.). S. Chand & Company Ltd.
Website and e-Learning Source	https://nptel.ac.in

CONo.	**CO-Statements** Onsuccessfulcompletionofthiscourse,studentswillbeableto	**CognitiveLevels (K-levels)**
CO-1	Recognizetheparametersandstatisticstotestthesignificanceofsampling	**K1**
CO-2	Finding the Goodness of Fit	**K2**

CO-3	Derivethevarious measuresofChi-square, tandFdistributions	**K3**
CO-4	Correlation coefficients between Observed and Estimated values	**K4**
CO-5	AnalysetheRegression lines	**K4**

<table>
<tr><td>Title of the Course</td><td colspan="7">Linear Algebra</td></tr>
<tr><td>Paper Number</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td></td><td rowspan="2">Credits</td><td rowspan="2"></td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td></td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2">--</td><td></td></tr>
<tr><td>Pre-requisite</td><td colspan="7">12th Standard Mathematics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">The objective of this course is to develop a strong foundation in linear algebra that provide a basic for advanced studies not only in mathematics but also in other branches like engineering, physics and computers, etc. Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Linear transformations Linear transformations
Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals.</td></tr>
<tr><td colspan="7">UNIT-II: Algebra of polynomials The algebra of polynomials –Polynomial ideals - The prime factorization of a polynomial - Determinant functions.</td></tr>
<tr><td colspan="7">UNIT-III: Determinants Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials.</td></tr>
<tr><td colspan="7">UNIT-IV: Diagonalization Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem.</td></tr>
</table>

	UNIT-V: The Rational and Jordan forms Cyclic subspaces – Cyclic decompositions theorem (Statement only) – Generalized Cayley – Hamilton theorem - Rational forms – Jordan forms.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill
Text Book	I.N. Herstein, "Topics in Algebra", 2nd Edition, Wiley Eastern Ltd, New Delhi, 2013.
Recommended Text	REFERENCES: 1. Kenneth M Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 2013. 2. M. Artin, "Algebra", Prentice Hall of India Pvt. Ltd., 2005. 3. S.H. Friedberg, A.J. Insel and L.E Spence, "Linear Algebra", 4th Edition, Pritice-Hall of India Pvt. Ltd., 2009. 4. J.J. Rotman, "Advanced Modern Algebra", 2nd Edition, Graduate Studies in Mathematics, Vol. 114, AMS, Providence, Rhode Island, 2010. 5. G. Strang, "Introduction to Linear Algebra", 2ndEdition, Prentice Hall of India Pvt. Ltd, 2013.
Website and e-Learning Source	https://nptel.ac.in

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	M	M	M
CO2	M	M	M	S	S	S	M	S	S	M
CO3	S	S	S	S	M	M	S	S	M	S
CO4	M	S	S	S	S	M	M	M	M	M
CO5	S	S	S	M	M	M	M	M	M	M

PO – Programme Outcome CO – Course outcome

S – Strong M-Medium L – Low (may be avoided)

TitleoftheCourse	**C. GRAPH THEORY AND APPLICATIONS**						
PaperNumber	**ELECTIVECOURSE**						
Category Elective	**Year**		**Credits**	3	**Course Code**		
	Semester						
Instructional Hours PerWeek	**Lecture**		**Tutorial**		**LabPractice**		**Total**
			-		-		
Pre-requisite	12th StandardMathematics						
Objectives of the Course	To study and develop the concepts of Graphs, sub graphs,Trees, Connectivity, Eulerian, Hamiltonian graphs, Matchings and Planar graphs.						
Course Outline	**UnitI**: Graphs, Degrees, Subgraphs, Isomorphism of graphs, Ramsey Numbers, Independent sets and Coverings. (Sec 2.1, 2.2, 2.3, 2.4, 2.5, 2.6)						
	UNIT-II : Intersection graphs and line graphs, Matrices, Operations on graphs, Degree Sequence, Graphic Sequence. (Sec 2.7, 2.8, 2.9, 3.1, 3.2)						
	UNIT-III: Walks, Trails, Paths, Connectedness and Components, Cut point, Bridge, Block, Connectivity. (4.1, 4.2, 4.3, 4.4)						

	UNIT-IV: Eulerian graphs, Hamiltonian graphs, Characterization of Trees, Centre of a Tree (5.1, 5.2, 6.1, 6.2)
	UNIT-V: Matchings, Matchings in Bipartite Graphs, Definition and properties of a planar graphs, characterization of planar graphs. (7.1, 7.2, 8.1, 8.2)
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC /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 transferable skill.
Recommended Text	S.ArumugamandS.Ramachandran,"InvitationtoGraphTheory", SCITECHPublications India Pvt. Ltd., 7/3C, Madley Road, T.Nagar, Chennai - 17
ReferenceBooks	5. Douglas B.West 'Introduction to Graph Theory',PearsonEducation,Inc.Pearson Prentice Hall,London. 6. S.A.Choudham,AFirstCourseinGraphTheory,MacmillanIndiaLtd. 7. RobinJ.Wilson,IntroductiontoGraphTheory,LongmanGroup Ltd. 8. J.A.BondyandU.S.R.Murthy,GraphTheorywithApplications,Macmillon,London.
Websiteand e-Learningsource	https://nptel.ac.in https:www.mathhelp.com/

Course Learning Objectives:

The students will be able to

1 Understand the basics of graph theory and their various properties.

2 Model problems using graphs and to solve these problems algorithmically.

3 Apply graph theory concepts to solve real world applications like routing,

TSP/traffic control, etc.

MappingwithProgramme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	3	3	2	3	2
CO2	3	2	3	3	2	3	3	3	2	3
CO3	2	2	3	3	3	3	2	3	3	2
CO4	3	3	2	3	3	2	3	2	3	3
CO5	2	3	3	2	3	3	3	3	2	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MATHEMATICS FOUNDATION</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE COURSE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">12th Standard Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To train the students to solve the problems in theory of equations
• To provide knowledge about the matrix, Trigonometric expansions, differentiation and various numerical methods for evaluation.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="8">UNIT-I: Summation of series: Binomial series- Exponential series-Logarithmic series-Simple Problems.
Chapter2: Sections: 2.1.3,2.2,2.2.1,2.3,2.3.3. Hours:12</td></tr>
<tr><td colspan="8">UNIT-II: Matrices: Symmetric–Skew-Symmetric– Hermitian –Skew –Hermitian– Orthogonal and Unitary matrices– Cayley -Hamilton theorem(withoutproof)–Verification-ComputationofinverseofmatrixusingCayley-Hamiltontheorem.
Chapter4: Sections:4.1.1–4.1.6,4.5.2and4.5.3. Hours:12</td></tr>
</table>

	Numerical Methods: Newton's method to find a root approximately. **Finite Differences**: Interpolation: Operators,Δ, ∇,E, E^{-1}differencetables. Interpolation formulae: Newton's forward and backward interpolation formulae for equal intervals, Lagrange's interpolation formula. Chapter3:Sections3.4.1.Chapter5:Sections:5.1and5.2.Hours:12
	UNIT–IV:**Trigonometry**:Expansions of $\sin^n\theta$, $\cos^n\theta$, in a series of powers of sinθ and cosθ-Expansions of sin(nθ) and cos(nθ) in a series sine cosines of multiples of "θ"-Expansions of sinθ, cosθ and tanθ in a series of powers of "θ"–Hyperbolic and inverse hyperbolic functions . Chapter6:Section6.1–6.3 Hours:12
	UNITV: **Differential Calculus:** Successive differentiation, nth derivatives, Leibnitz theorem (without proof) and applications, Jacobians, maxima and minima of functions of two variables-Simple problems Chapter1,Section1.1to1.3.1. Hours:12
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired From this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Text	AlliedMathematics,VolumeIandVolumeIIbyP.DuraipandianandS.Udayabaskaran,S. ChandPublications VolumeI:UnitI–IV,VolumeII–UnitV
Reference Books	4. AncillaryMathematicsbyS.NarayananandT.K.ManickavachagomPillay,S.ViswanathanPinters,1986,Chennai 5. AlliedMathematicsbyA.Singaravelu 6. AlliedMathematicsbyP.R.Vittal

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the concepts of Summation of Series.

CLO2: Understand the concepts of Cayley Hamilton Theorem and inverse matrices.

CLO3: Understand the concepts of finite differences.

CLO4: Understand the knowledge about expansions, hyperbolic and inverse hyperbolic functions.

CLO5: Understand the concept of Leibnitz theorem and functions of two variables

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

Title of the Course		**Probability and Statistics**							
Paper Number		ELECTIVE COURSE							
Category	Core	**Year**		**Credits**		**Course Code**			
		Semester							
Instructional Hours Per week		**Lecture**		**Tutorial**		**Lab Practice**		**Total**	
				-		--			
Pre-requisite		UG level Probability and Statistics Knowledge							
Objectives of the Course		1. To enable the students to acquire the knowledge of statistics 2. To make the students understand various characteristics of discrete and continuous statistical distributions with mathematical techniques							
Course Outline		**Unit I: RANDOM VARIABLES** Random variables - the concept of a random variable - distribution and density functions - random variables of the discrete and continuous type - joint distribution and joint density functions - marginal distribution - conditional distribution - co-variance – correlation - mathematical expectation - Moment generating function - characteristic function. **Chapter 1&2 (1.1 – 1.7, 2.1 – 2.9):**M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.							

	Unit II: SOME PROBABILITY DISTRIBUTIONS Binomial and Poisson distributions - Normal distribution - Gamma and Exponential distribution -Weibull distribution - Regression and Correlation - Partial and Multiple Correlation - Multiple regression. **Chapter – 4 (4.1 - 4.7):**M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.
	Unit III: TESTING OF HYPOTHESIS. Estimation and procedure of testing of hypothesis - Large sample tests - Small sample tests -student's t-test - F-test - Chi-square test - Testing of mean, variance and proportions -independence of attributes and goodness of fit. **Chapter 4 & Chapter 5** of M. Fisz, Probability theory and Mathematical Statistic, John Willey and sons, Newyork,1963.
	Unit IV: DESIGN OF EXPERIMENTS Analysis of variance - One way and two way classifications - completely Random Design (CRD) - Randomized Block Design (RBD) - Latin Square Design (LSD). **Chapter 10:**Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).
	Unit V: RELIABILITY **(** Basic concept-Reliabilities of series and parallel systems-System Reliability-Hazard function-Reliability and Availability-Maintainability. **Chapter 15 & 16 (15.1 - 15.2, 16.1 - 16.5)**Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired From this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Text	➢ R.E.Walpole, R.H.Mayers, S.L.Mayers and K.Ye, Probability and Statistics for engineers and scientists, 7th Edition, Pearson Education (2003). ➢ Kishore S. Trivedi, Probability & Statistics with Reliability, queuing and computer Science applications, Prentice Hall of India, Pvt. Ltd., New Delhi (2009).
Reference Books	7. J.L.Devore, Probability and Statistics, 5th Edition, Thomson (2000). 8. R.A.Johnson, Miller & Freund's Probability and Statistics for Engineers, Seventh edition, Pearson Education, New Delhi (2008). 9. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th Edition, 2003 10.

Course Learning Outcome :

At the end of the Course, the Students will able to

CO1 Describe the concepts of Random variables and Distribution Function with examples.
CO2 Evaluate Binomial, Poisson distributions, Regression and Correlation distributions.
CO3 Analyze student's t-test, F-test and Chi-square test.
CO4 **Analyze** Randomized Block Design (RBD) and Latin Square Design (LSD).
CO5 Basic concept-Reliabilities of series.

Mapping with Programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	M	M	M
CO2	M	M	M	S	S	S	M	S	S	M
CO3	S	S	S	S	M	M	S	S	M	S
CO4	M	S	S	S	S	M	M	M	M	M
CO5	S	S	S	M	M	M	M	M	M	M

1. PO – Programme Outcome CO – Course outcome
2. S – Strong M-Medium L – Low (may be avoided)

Title of the Course		**Mathematics for Cyber security**					
Paper Number							
Category	SEC	**Year**	II	**Credits**	2	**Course Code**	
		Semester	III				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		1		1	2		
Pre-requisite		12th standard basic knowledge					

Objectives of the Course	The main objectives of this course are to: 1. To introduce students to some of the basic ideas of number theory, and to use this as a context inwhich to discuss the development of mathematics through examples, conjectures, theorems, proofs and applications. 2. Illustrate different methods of proof in the context of elementary number theory, and will apply some basic techniques of number theory to cryptography. 3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms. 4. To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
Course Outline	**Unit 1:** Divisibility and the Euclidean algorithm – Congruences .
	Unit 2: Some applications to factoring – Quadratic residues and reciprocity
	Unit 3: Some simple cryptosystems – Enciphering matrices.
	Unit 4: The idea of public key cryptography – RSA – Discrete log – Knapsack
	Unit 5: Pseudo primes – The rho method – Fermat factorization and factor bases.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,ProfessionalCommunicationandTransferrableSkill

Text Book **Recommended Text**	**Text Book:** Neal Koblitz, "A Course in Number Theory and Cryptography"- Second Edition, Springer Publishers. Unit 1: Chapter 1 sections 1,2 and 3, Unit 2: Chapter 1 section 4 and chapter 2 section 2 Unit 3: Chapter 3, Unit 4: Chapter 4 except section 5, Unit 5: Chapter 5
	Reference Books 9. A.Menezes, P. van Oorschot and S. Vanstone, "Handbook of Applied Cryptography", CRC press, 1996. 10. Douglas R. Stinson "Cryptography theory and practice" Second Edition, Chapman and Hall / CRC.
Website and **e-Learning Source**	**4.** Search Tutorials | spoken-tutorial.org **5.** Applications of GeoGebra - Course (swayam2.ac.in)

Course Outcomes:
On the successful completion of the course, student will be able to:
CO1-- Identify and apply various properties of and relating to the integers including the Well Ordering Principle, primes, unique factorization, the division algorithm, and greatest common divisors.-- K1 & K2
CO2 -- Understand the concept of congruence and use various results related to congruencies including the Chinese Remainder Theorem. --K2 & K3
CO3 -- Identify and Understand how number theory is related to and used in Cryptography - K2 & K4
CO4 -- Acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.-- K4
CO5 -- Understand how to deploy encryption techniques to secure data in transit across data networks --K5 & K6

Unit	i. Remembering	ii. Understanding	iii. Applying	iv. Analyzing	v. Evaluating	vi. Creating
1	Yes	NO	NO	YES	YES	NO
2	Yes	No	Yes	Yes	Yes	NO
3	NO	YES	YES	NO	YES	NO
4	YES	NO	NO	YES	YES	YES
5	NO	NO	YES	NO	YES	YES