M.SC.

APPLIED MATHEMATICS

Course of Study, Schemes of Examinations & Syllabi

(Choice Based Credit System)

PG & Research Department of Mathematics

H.H. The Rajahs' College (Autonomous)

Re-Accredited with B^+ by NAAC

Pudukkottai- 622 001.

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024

CONTENTS

1. Preamble

In pursuit of the Higher Education Department Policy Note 2022-23 Demand 20, Section 1.4, Tamil Nādu State Council for Higher Education took initiative to revamp the curriculum. On 27 July 2022, a meeting was convened by the Member-Secretary Dr. S. Krishnasamy enlightening the need of the hour to restructure the curriculum of both Under-graduate and Post-graduate programmes based on the speeches at the Tamil Nādu Legislative Assembly Budget meeting by the Honourable Higher Education Minister Dr K. Ponmudy and Honourable Finance Minister Dr. P. Thiagarajan. At present there are three different modes of imparting education in most of the educational institutions throughout the globe. Outcome Based Education, Problem Based Education, and Project Based Education.

Now our Honourable Higher Education Minister announced Industry Aligned Education. During discussion, Member Secretary announced the importance of question papers and evaluation as envisaged by the Honourable Chief Secretary to Government Dr, V. IraiAnbu. This is very well imbedded in Revised Bloom's Taxonomy.

Taxonomy forms three learning domains: the cognitive (knowledge), affective(attitude), and psychomotor (skill). This classification enables to estimate the learning capabilities of students.

Briefly, it is aimed to restructure the curriculum as student-oriented, skill-based, and institution-industry-interaction curriculum with the various courses under

"Outcome Based Education with Problem Based Courses, Project Based Courses, and Industry Aligned Programmes" having revised Bloom's Taxonomy for evaluating students skills.

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 Dom

2a) Post Graduate Programme

Programme Outcomes:

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

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

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

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

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

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

M.Sc Mathematics

Programme Specific Outcomes:

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

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

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

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

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

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

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

Template for P.G., Programmes

Semester–I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
1.1Core-I	5	7	2.1Core-IV	5	6	3.1 Core-VII	5	6	4.1Core-XI	5	6
1.2 Core-II	5	7	2.2 Core-V	5	6	3.2 Core-VIII	5	6	4.2 Core-XII	5	6
1.3 Core – III	4	6	2.3 Core – VI	4	6	3.3 Core – IX	5	6	4.3 Project with viva voce	7	10
1.4 Elective -I Discipline Centric	3	5	2.4 Elective – III Discipline Centric	3	4	3.4 Core – X	4	6	4.4 Elective - VI (Industry / Entrepreneurship) 20% Theory 80% Practical	3	4
1.5 Elective-II Generic:	3	5	2.5 Elective - IV Generic:	3	4	3.5 Elective - V Discipline Centric	3	3	4.5 Skill Enhancement III	2	4
			2.6 Skill Enhancement I	2	4	3.6 Skill Enhancement course - II/ Professional Competency Skill **(Online objective)**	2	3	4.6 Extension Activity	1	
						3.7 Internship/ Industrial Activity **(30Hrs)**	2	-			
	20	**30**		**22**	**30**		**26**	**30**		**23**	**30**
Total Credit Points -91											

MSc APPLIED MATHEMATICS SYLLABUS:

First Year – Semester – I

Part	SEM	List of Courses		Sub Code	Credits	No. of Hours
PART A	1.1	Core – I - Algebraic Structures		**23PMT1**	5	7
	1.2	Core – II – Real analysis-I		**23PMT2**	5	7
	1.3	Core – III – Ordinary Differential Equations		**23PMT3**	4	6
	1.4	Elective ½	Graph Theory and Applications	**23PMTE1A**	3	5
			Number Theory and Cryptography	**23PMTE1B**		
	1.5	Elective ¾	Fuzzy Sets and Their Applications	**23PMTE2A**	3	5
			Statistical Data Analysis Using R-Programming	**23PMTE2B**		
					20	**30**

Semester-II

Part	SEM	List of Courses		Sub Code	Credits	No. of Hours
PART A	2.1	Core – IV – Advanced Algebra		**23PMT4**	5	6
	2.2	Core – V – Real Analysis-II		**23PMT5**	5	6
	2.3	Core – VI – Partial Differential Equations		**23PMT6**	4	6
	2.4	Elective 5/6	Mathematical Statistics	**23PMTE3A**	3	4
			Modeling and Simulation With Excel	**23PMTE3B**		
	2.5	Elective 7/8	Mathematical Programming	**23PMTE4A**	3	4
			Machine Learning and Artificial Intelligence	**23PMTE4B**		
PART B	2.6	Skill Enhancement Course [SEC] – I Mathematical documentation using LATEX		**23PMTSE1**	2	4
					22	**30**

Second Year – Semester – III

Part	SEM	List of Courses		Sub Code	Credits	No. of Hours
PART A	3.1	Core – VII – Complex Analysis		**23PMT7**	5	6
	3.2	Core – VIII – Stochastic Processes		**23PMT8**	5	6
	3.3	Core – IX – Topology		**23PMT9**	5	6
	3.4	Core – X –Fluid Dynamics		**23PMT10**	4	6
	3.5	Elective 9/10	MATLAB	**23PMTE5A**	3	3
			Lie Groups and Lie Algebras	**23PMTE5B**		
PART B	3.6	Skill Enhancement Course II- Professional Competency Skill Enhancement Course – 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) – ONLINE EXAM OR Mathematics for Advanced Research Studies (4 hours) **(Online Objective)**		**23PMTSE2**	2	3
	3.7	Internship / Industrial Activity [Credits] (30 Hrs)		**23PIT**	2	-
					26	**30**

Semester-IV

Part	SEM	List of Courses		Sub Code	Credits	No. of Hours
PART A	4.1	Core – XI – Functional Analysis		**23PMT11**	5	6
	4.2	Core – XII –Calculus of Variations and Integral Equations		**23PMT12**	5	6
	4.3	Project with VIVA VOCE		**23PMTP**	7	10
	4.4	Elective – VI	Sampling Techniques	**23PMTE6A**	3	4
			Mathematical Python	**23PMTE6B**		
PART B	4.5	Skill Enhancement Course – III - Office Automation and ICT Tools		**23PMTSE3**	2	4
PART C	4.6	Extension Activity		**23PEA**	1	-
					23	**30**

Total 91 Credits for PG Courses

Institution-Industry-Interaction (Industry aligned Courses)

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

Syllabus for M.Sc Mathematics

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE I</td></tr>
<tr><td rowspan="2">Categor y</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">23PMT1</td></tr>
<tr><td>Semester</td><td>I</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>5</td><td colspan="2">2</td><td>--</td><td colspan="2">7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">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)</td></tr>
<tr><td colspan="6">UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules
Chapter5: Section5.7(Lemma5.7.1, Lemma5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5</td></tr>
<tr><td colspan="6">UNIT-III : Linear Transformations: Canonical forms —Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5</td></tr>
<tr><td colspan="6">UNIT-IV : Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7</td></tr>
<tr><td colspan="6">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)</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	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">REAL ANALYSIS I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE 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">23PMT2</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">2</td><td colspan="2">--</td><td>7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level realanalysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">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.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">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</td></tr>
<tr><td colspan="2"></td><td colspan="8">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</td></tr>
<tr><td colspan="2"></td><td colspan="8">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</td></tr>
</table>

	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 III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2" rowspan="2">23PMT3</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></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">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 differentialequations</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	1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967. 2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi2001 6. 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 colspan="2">Title of the Course</td><td colspan="6">ADVANCED ALGEBRA</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE 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 rowspan="2">Course Code</td><td rowspan="2">23PMT4</td></tr>
<tr><td>Semester</td><td>II</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">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Algebraic Structures</td></tr>
<tr><td colspan="2">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 colspan="2" 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 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>
<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">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>Title of the Course</td><td colspan="6">REAL ANALYSIS II</td></tr>
<tr><td>Paper Number</td><td colspan="6">CORE V</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td rowspan="2">23PMT5</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td 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">1</td><td>--</td><td>6</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td>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>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></td><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></td><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 particularpoint
—Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
<tr><td></td><td colspan="6">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)</td></tr>
</table>

	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="6">PARTIAL DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td rowspan="2">23PMT6</td></tr>
<tr><td>Semester</td><td>II</td><td></td><td></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>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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="6">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="6">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="6">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="6">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 boundaryconditions

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">the Course</td><td colspan="8">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE 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">23PMT7</td></tr>
<tr><td>Semester</td><td>III</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 colspan="2">Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">6</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">Course Outline</td><td colspan="8">UNIT-I Elementary Point Set Topology
Sets and Elements – Metric Spaces – Connectedness -Compactness
Chapter 3: Section 1.1 to 1.4
Conformality
Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area
Chapter 3 : Section 2.1 to 2.4

UNIT-II Linear Transformations
The Linear Group – The Cross Ratio – Symmetry .- Oriented Circles – Families of Circles
Chapter 3 : Section 3.1 to 3.5

Elementary Conformal Mappings
The Use of Level Curves – A survey of Elementary Mappings – Elementary Riemann Surfaces.
Chapter 3 : Section 4.1 - 4.3

UNIT-III Fundamental theorems in complex integration: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk; Cauchy's Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.
Chapter 4 : Section 1.1 - 1.5 & 2.1 - 2.3

UNIT-IV Local Properties of Analytic Functions - Removable Singularities - Zeros and Poles – The Local Mapping – The Maximum Principle.
Chapter 4 : Section 3.1 – 3.4

UNIT-V: Power series expansions: Definition and Basic Properties - Weierstrass's Theorem – The Taylor Series – The Laurent Series;
Chapter 5 : Section 1.1 – 1.3</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	[1] Serge Lang, Complex Analysis, Addisn Wesley, 1977. [2] S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1997. [3] V. Karunakaran, Complex Analysis.
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: Be able to comprehend the local and global properties of analytic functions.
CLO2: Know and understand harmonic functions and their basic properties.
CLO3: Be able to understand properties of entire functions.
CLO4*: Develop Taylor and Laurent series .*

CLO5 *Explain the Weierstrass'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="8">STOCHASTIC PROCESSES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE VIII</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">23PMT8</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">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Probability and Statistics</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="4">Course Outline</td><td colspan="8">UNIT-I : Stochastic Processes: some notions – Specification of Stochastic processes – Stationary processes – Markov Chains – Definitions and examples – Higher transition probabilities – Generalization of independent Bernoulli trails – sequence of chain – Dependent trains. Chapter II section: 2.1 to 2.3, Chapter III section : 3.1 to 3.3</td></tr>
<tr><td colspan="8">UNIT-II : Markov chains : Classification of states and chains – Determination of Higher transition probabilities – Stability of a Markov system – Reducible chains – Markov chains with continuous state space Chapter III section 3.4 to 3.6, 3.8,3.9 and 3.11</td></tr>
<tr><td colspan="8">UNIT-III: Markov processes with Discrete state space: Poisson processes and their extensions –Poisson process and related distribution – Generalization of Poisson process – Birth and Death process – Markov processes with discrete state space (continuous time Markov Chains). Chapter : IV section: 4.1 to 4.5</td></tr>
<tr><td colspan="8">UNIT-IV : Markov processes with continuous state space : Introduction – Brownion motion – Wiener process – Differential equations for a Wiener process – Kolmogorov equation – First passage time distribution for Wiener process.
Chapter : V section : 5.1 to 5.5</td></tr>
</table>

	UNIT-V: Renewal processes and theory : Renewal process - Renewal process in continuous time - Renewal equation – stopping time – Wald's equation - Renewal Theorem. Chapter : VI section : 6.1 to 6.5.
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	J. Medhi, Stochastic Processes, Wiley Eastern. 1982
Reference Books	1. Samuel Karlin, Howard M. Taylor, A first course in stochastic processes, 2nd edition. 2. Narayan Bhat, Elements of Applied Stochastic processes, 2nd edn, John Wiley, 1984. 3. S.K.Srinivasan and K.Mehata, Stochastic processes, Tata Mc Graw Hill, 1976. 4. N.U.Prabhu, Stochastic processes, Macmillan, 1965.
Website and e-Learning Source	https://nptel.ac.in/courses/111/102/111102014/#
	https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2145&context=gradreports

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: *Describe Stochastic processes, Markov processes, Poisson processes and generalization*

CLO2: *Gather the knowledge about Wiener process and its Applications*

CLO3: *To acquire the knowledge about Brownion motion, differential equations, Wiener process and Kolmogorov equation*

CLO4: To acquire the Knoeledge about Renewal processes, Wald's equation, renewaltheorem and its Applications.

CLO5: *To understand the content of Renewal processes and its Applications*

	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">TOPOLOGY</td></tr>
<tr><td>Paper Number</td><td colspan="6">CORE IX</td></tr>
<tr><td rowspan="2">Category Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>23PMT9</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">Real Analysis</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td>Course Outline</td><td colspan="6">Unit - I: Topological spaces and continuous functions: (15 Hours)
Topological Spaces – Basis for a Topology – The Order Topology – The Product Topology on XxY – The Sub-space topology – Closed sets and limit points – Continuous functions
Chapter 2, Sec 12 to 18

Unit-II:Metric topology and Connectedness: (15 Hours)
The Product topology – The Metric Topology - Connected spaces – Connected Subspaces of the Real line - Components and Local connectedness.
Chapter 2, Sec 19 to 21

Unit-III:Compactness: (14 Hours)
Compact Spaces - Compact subspaces of the real line – Limit point compactness
Chapter 3, Sec 26 to 28

Unit -IV: Countability and Separation axioms: (14 Hours)
The countability axioms - The separation axioms – Normal space.
Chapter 3, Sec 30 to 32

Unit-V:Complete Metric Spaces (14 Hours)
The Urysohn’s Lemma – The Urysohn’sMetrization theorem (statement only) - Tietz Extension theorem
Chapter 4, Sec 33 to 35</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>
</table>

Recommended Text	**Text Book:** James R. Munkres,"**Topology**"– second edition, Prentice Hall, New Delhi (2003). (2009)
Reference Books	1. J. Dugundgi, "**Toplogy",** Allyn and Bacon, Boston, (1966) 2. Sze-Tsen Hu, Elements of General Topology, Holden-Day Series in Mathematics, 1964.
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: Understanding metric spaces as a motivation to topology
CLO2: Continuous functions and their properties in topological spaces
CLO3: *Understanding Basis as a collection of basic open sets*
CLO4: *Understand compactness and connectedness in topological spaces*
CLO5: *Understand separation axioms*

	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">FLUID DYNAMICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE 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">23PMT10</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>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Dynamics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To give the students an introduction to the behaviour of fluids in motion.
• To give the students a feel of the applications of Complex Analysis in the analysis of the flow of liquids.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Real Fluids and Ideal Fluids - Velocity of a Fluid at a point - Streamlines and Path lines; Steady and Unsteady Flows - The Velocity potential – The Vorticity vector - Local and Particle Rates of Change – The Equation of continuity - Worked examples - Acceleration of a Fluid – Conditions at a rigid boundary - General analysis of fluid motion - Pressure at a point in a Fluid at Rest - Pressure at a point in Moving Fluid - Conditions at a Boundary of Two Inviscid Immiscible Fluids -Euler’s equations of motion - Bernoulli's equation - worked examples.
Chapter 2 and Chapter 3: Sections 3.1 to 3.6</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II: Discussion of a case of steady motion under conservative body forces – Some potential theorems-Some Flows Involving Axial Symmetry - Some special two- Dimensional Flows - Impulsive Motion. Some three-dimensional Flows: Introduction - Sources, Sinks and Doublets - Images in a Rigid Infinite Plane - Axi-Symmetric Flows; Stokes stream function
Chapter 3: Sections 3.7 to 3.11 and Chapter 4: Sections 4.1, 4.2, 4.3, 4.5</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III: Some Two-Dimensional Flows: Meaning of a Two-Dimensional Flow - Use of cylindrical Polar coordinates – The stream function – The Complex Potential for Two- Dimensional, Irrotational, Incompressible Flow - complex velocity potentials for Standard Two-Dimensional Flows - Some worked examples – The Milne-Thomson circle theorem and applications – The Theorem of Blasius
Chapter5 : Sections: 5.1 to 5.9 except 5.7</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit IV: The use of conformal Transformation and Hydrodynamical Aspects - Vortex rows. Viscous flow: Stress components in a Real fluid - relations between Cartesian components of stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses -
Chapter 5: Section 5.10 , 5.12 and Chapter 8: Sections 8.1 to 8.4</td></tr>
</table>

	Unit V: Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion - Relations Between stress and rate of strain - The coefficient of viscosity and Laminar Flow - The Navier - Stokes equations of Motion of a Viscous Fluid . **Chapter 8: Sections 8.5 to 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	Content and Treatment as in Text Book of Fluid Dynamics by F. Chorlton (CBS publishers& Distributors, New Delhi-110 002) 1985.
Reference Books	. J.F. Wendt, J.D. Anderson, G.Degrez and E. Dick, Computational Fluid Dynamics : An Introduction, Springer-Verlag, 1996. 2. J.D. Anderson, Computational Fluid Dynamics, The Basics with Applications, McGraw Hill, 1995. 3. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1984. 4. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer-Verlag, New York, 1993. 5. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Pvt Limited, New Delhi, 1976. 6. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
Website and e-Learning Source	https://nptel.ac.in/courses/112/106/112106200/

Course Outcomes:	
On the successful completion of the course, student will be able to:	
CO1	Recall the basic concepts of Real Fluids and Ideal Fluids, the Equation of continuity and Euler's equations of motion.
CO2	Discussion of a case of steady motion under conservative body forces and Axi-Symmetric Flows; Stokes stream function
CO3	Analyze and understand the concepts of some two-dimensional flows.
CO4	Analyze the viscous flow.
CO5	Analyze and apply the properties of the Rate of Strain Quadric and The 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="6">Functional Analysis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>23PMT11</td></tr>
<tr><td>Semester</td><td>IV</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">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</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="5">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>
<tr><td colspan="6">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</td></tr>
<tr><td colspan="6">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</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	*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	***CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS***						
Paper Number	***CORE XII***						
Category	*Core*	***Year***	*II*	***Credits***	*5*	***Course Code***	**23PMT12**
		Semester	*III*				
Instructional Hours per week	***Lecture***		***Tutorial***		***Lab Practice***	***Total***	
	5		*1*		*--*	*6*	
Pre-requisite	*Calculus*						
Objectives of the Course	*To study combined the concepts of calculus and Integral equations* *To learn about Linear Equation and Hilbert-Schmidt Theory*						
Course Outline	***UNIT-I : Calculus of Variations and Applications :*** *Maxima and Minima – The Simplest Case – Illustrative Exambles – Natural boundary conditions and Transition conditions – The variational notation – The more general case.* ***Chapter 2 : Sections 2.1 - 2.6***						
	UNIT-II :*Constraints and Lagrange Multiplier – Variable end points – Sturm-Liouville Problems – Hamilton's Principle – Lagrange's Equations.* ***Chapter 2 : Sections 2.7 – 2.11***						
	UNIT-III : Integral Equations: *Introduction – Relations between differential and integral equations – The Green's function – Alternative definition of the Green's function.* ***Chapter 3 : Sections 3.1 - 3.4.***						
	UNIT-IV : Linear equation in cause and effect : *The influence function – Fredholm equations with separable kernels - Illustrative Exambles.* ***Chapter 3 : Sections 3.5 – 3.7.***						
	UNIT-V: *Hilbert – Schmidt theory – Iterative Methods for solving equations of the second kind – The Neumann series – Fredholm theory.* ***Chapter 3 : Sections 3.8 – 3.11.***						
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	*Francis B. Hilderbrand, Method of Applied Mathematics, Second edition, Prentice-Hall, Inc.*						

Reference Books	1. M.Krasnov, A.Kiselev, G.Mekarenko, "Problems and Exercises in Integral Equations"(1971) Visalaandhra Publishing House. 2. L.Elsgolts, "Differential Equations and Calculus of Variations", Mir Publishers. 3. Peter J.Collins," Differential & Integral Equations", Oxford University Press. 4. Ram.P.Kanwal, "Linear Integral Equations Theory & Techniques", Academic Press.
Website and e-Learning Source	*http://youtu.be/GiPOQC5nYMs, http://youtu.be/WPlBrzjI1KI*

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: *Conceptual Understanding of* Maxima and minima , Natural boundary conditions and Transition conditions.

CLO2: *Apply* Constraints and Lagrange Multiplier, Variable end points, Sturm-Liouville Problems.

CLO3: *Introduce* Integral Equations *and study* Green's function

CLO4: *Discuss* influence function and Fredholm equations with separable kernels.

CLO5: *Construct and analyze* Iterative Methods for solving equations of the second kind , Neumann series and Fredholm theory.

	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">PROJECT WITH VIVA VOCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE 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">7</td><td rowspan="2">Course Code</td><td rowspan="2">23PMTP</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">10</td><td colspan="2">-</td><td>--</td><td>10</td></tr>
</table>

ELECTIVE COURSES

Title of the Course		**GRAPH THEORY AND APPLICATIONS**					
Paper Number		**Elective 1**					
Category	**Elective**	**Year**	I	**Credits**	3	**Course Code**	**23PMTE1A**
		Semester	I				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	1	--	5

Pre-requisite	UG level Graph Theory concepts
Objectives of the Course	• To give a rigorous introduction to the basic concepts of Graph Theory. • To give applications of Graph Theory in other disciplines
Course Outline	**UNIT-I: Connectivity and edge connectivity**: Vertex cuts and edge cuts - Whitney's inequality (relating K,K and d) - Blocks and blocks of graphs - Characterization of 2 - connected graphs and blocks - Menger's theorem (without proof). **Chapter 3 in which Section 3.3 is omitted**
	UNIT-II : Independent sets:Independent sets and their characterization - Matchings - Vertex as well as edge independence numbers, Covering numbers - Perfect matching – Konig's Theorem (without proof) - Galli's theorem - Ramsey numbers - Theorems on the upper bounds and lower bounds for Ramsey numbers - Ramsey graphs - Erdos theorem. **Chapter 7 – Sections7.1 and 7.2.**
	UNIT-III : Vertex colourings and chromatic numbers of graphs - Critical graphs and their properties - Brook's theorem - Hajo's conjecture and Dirac's theorem. **Chapter 8 - Sections 8.1, 8.2 and 8.3**
	UNIT-IV : Chromatic polynomials - The five colour theorem - The four colour theorem with proof - Edge chromatic number - Vizing's theorem with proof **Chapter 8 - Section 8.4; Chapter 9 - Section 9.6; Chapter 6 - Sections 6.1 and 6.2.**
	UNIT-V: Directed graphs- Directed paths (Roy-Gallai Theorem) - Tournaments - Directed Hamilton paths and cycles (Moon's theorem, Ghouila - Houri theorem). **Chapter 10 - Sections 10.2 and 10.3**

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	J.A. Bondy and U.S.R. Murthy, "**Graph Theory with Applications**", 1976
Reference Books	1. F. Harary, Graph Theory, Addison –Wesley, 1969 2. G NarasingaDeo, Graph Theory with Applications to Engineering and Computer
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Solve problems using basic graph theory

CLO2: Identify induced subgraphs, cliques, matchings, covers in graphs.

CLO3: Determine whether graphs are Hamiltonian and/or Eulerian

CLO4: Solve problems involving vertex and edge connectivity, planarity and crossing numbers

CLO5*: Solve problems involving vertex and edge coloring*

	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">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE-2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMTE1B</td></tr>
<tr><td>Semester</td><td>I</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 Number Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• To understand fundamental number-theoretic algorithms such as the Euclidean algorithm, the Chinese Remainder algorithm, binary powering, and algorithms for integer arithmetic.
• To understand fundamental algorithms for symmetric key and public-key cryptography.
• To understand the number-theoretic foundations of modern cryptography and the principles behind their security.
• To implement and analyze cryptographic and number-theoretic algorithms.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I: Elementary Number Theory: Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring.

Chapter 1</td></tr>
<tr><td colspan="6">UNIT II : Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES
Chapter 3</td></tr>
<tr><td colspan="6">UNIT III : Finite Fields, Quadratic Residues and Reciprocity (Chapter 2)</td></tr>
<tr><td colspan="6">UNIT IV: Public Key Cryptography
Chapter 4</td></tr>
<tr><td colspan="6">UNIT V: Primality, Factoring, Elliptic curves and Elliptic curve crypto systems
(Chapter 5, sections 1,2,3 &5 (omit section 4), Chapter 6, sections 1& 2 only)</td></tr>
<tr><td colspan="2">Extended Professional Component</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 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	1. Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987
Reference Books	1. I.Niven and H.S.Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi,1976 2. David M.Burton, Elementary Number Theory, Brown Publishers, Iowa,1989 3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972 4. N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.
Website and e-Learning Source	1. https://nptel.ac.in/courses/111101137 2. https://archive.nptel.ac.in/courses/106/103/106103015/ 3. https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO 2: Distinguish the DES and the AES.

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

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

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

	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="8">FUZZY SETS AND THEIR APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective 3</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">23PMTE2A</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">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">To know the algebraic structures and analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To provide the knowledge of operations on fuzzy sets
• .To introduce the mathematical field on the concept of a fuzzy numbers
• To enable the students to develop fuzzy relations.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I Basic types – Basic concepts – α-cuts – Additional properties of α-cuts – Extension principle for Fuzzy sets.</td></tr>
<tr><td colspan="8">UNIT-II: Operations on Fuzzy sets:
Types of operations – Fuzzy complements – t-Norms – Fuzzy Unions - Combinations of operations.</td></tr>
<tr><td colspan="8">UNIT-III: Fuzzy Arithmetic and Fuzzy Relations
Fuzzy numbers - Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers - Binary fuzzy relations – Fuzzy equivalence relations – Fuzzy compatibility relations - Fuzzy ordering relations</td></tr>
<tr><td colspan="8">UNIT-IV : Introduction to Fuzzy graph – Operations on fuzzy graphs – Complement of a fuzzy graph – Cartesian product and composition – Union and join</td></tr>
<tr><td colspan="8">UNIT-V : Definition of the concept of Intuitionistic Fuzzy sets: An example – Properties of Intuitionistic Fuzzy sets – Operations and relations over Intuitionistic Fuzzy sets.</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>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004. 2. A.Nagoor Gani and V.T.Chandrasekaran, A first look at fuzzy Graph Theory, Allied Publishers Pvt.Ltd. Chennai, First Edition (2010). 3. Krassimir T. Atanasov, Intuitionistic fuzzy sets: theory and applications, Springer-Verlag Berlin Heidelberg 1999.
Reference Books	1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991. 2. G.J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995. 3. J.N.Moderson & P.S. Nair Fuzzy graphs and fuzzy hypergraphs. Livro da série: Studies in Fuzziness and Soft Computing, Physica-Verlag, (2000).
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Discuss the types of operations on fuzzy sets,
CLO2: t- norms and fuzzy arithmetic.
CLO3: Study knowledge of fuzzy equivalnce relations.
CLO4: Identify fuzzy relations, binary fuzzy relations and fuzzy equivalence relations.
CLO5: Discuss the Operations and relations over Intuitionistic Fuzzy sets and Study knowledge on Fuzzy graphs

	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">STATISTICAL DATA ANALYSIS USING R- PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE 4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMTE2B</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></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">Pre-requisite</td><td colspan="6">Basic knowledge in Computer and Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. The course aims to provide a study on statistical data analysis using R-Programming.
2. How to use the R software in data visualization.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I Introduction to R programming: What is R? - Installing R and R Studio – R Studio Overview - Working in the Console - Arithmetic Operators – Logical Operations - Using Functions - Getting Help in R and Quitting R Studio- Installing and loading packages. Data structures, variables, and data types in R: Creating Variables - Numeric, Character and Logical Data - Vectors - Data Frames - Factors -Sorting Numeric, Character, and Factor Vectors - Special Values.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II Data Visualization using R: Scatter Plots - Box Plots - Scatter Plots and Box- and-Whisker Plots Together -Customize plot axes, labels add legends and add colours.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT III Descriptive statistics in R: Measures of central tendency - Measures of variability - Skewness and kurtosis - Summary functions, describe functions, and descriptive statistics by group.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT IV Testing of Hypothesis using R: T-test, Paired Test, correlation, Chi Square test, Analysis of Variance and Correlation</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT V Predictive Analytics: linear Regression model, Non-Linear Least Square, multiple regression analysis, Logistic Regression, Panel Regression Analysis, ARCH Model, GARCH models, VIF model.</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">Recommended Text</td><td colspan="6">1. Crawley, M. J. (2006), ―Statistics - An introduction using R‖, John Wiley, London 32.
2. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015), ―Statistics using R‖, second edition. Narosa Publishing House, New Delhi.
3. Shahababa B. (2011) , ―Biostatistics with R‖, Springer, New York.
4. Braun & Murdoch (2007), ―A first course in statistical programming with R‖, Cambridge University Press, New Delhi.</td></tr>
</table>

Website and e-Learning Source	1. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf 2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R- Manual2.html 3. https://smac-group.github.io/ds/ 4. https://www.geeksforgeeks.org/predictive-analysis-in-r

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Describe Installing R and R Studio
CLO2: Explain Scatter Plots, Box Plots and Scatter Plots and Box
CLO3: Understand the .Measures of central tendency Measures of variability
CLO4: Demonstrate the ability to apply T-test, Paired Test, correlation.
CLO5: Use linear Regression model, Non-Linear Least Square

	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="8">MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective 5</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">23PMTE3A</td></tr>
<tr><td>Semester</td><td>II</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">3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG Level Probability and Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">• To understand the concepts of various discrete and continuous probability distributions
• To apply these techniques to real life problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Two Random variables - Joint density - Marginal probability density – Conditional distribution - Expectation and variance - Independence of two random variables - Mutual independence and pairwise independence.</td></tr>
<tr><td colspan="8">UNIT-II : Some special distributions: The Binomial and related distributions – The Poisson distribution – The Gamma and Chi-Square Distributions – The Normal distribution- The Bivariate normal distribution.</td></tr>
<tr><td colspan="8">UNIT-III : Distributions of functions of random variables - Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type – The β, t and F distributions- Distributions of order statistics- The moment generating function technique.</td></tr>
<tr><td colspan="8">UNIT-IV : The distributions of $\bar{X}$ and nS^2/σ^2 - Expectations of functions of random variables – Limiting distributions: Limiting moment generating functions – The Central limit theorem.</td></tr>
<tr><td colspan="8">UNIT-V : Introduction to statistical inference: Point Estimation – Confidence intervals for means – Confidence intervals for differences of means - χ^2 – test – More about estimation - Bayesian Estimation- Measures of quality of estimators.</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>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	**1.** Robert V. Hogg and Allen T. Craig, "**Introduction to Mathematical Statistics**" (Fifth Edition). Chapter 2 (Sections 2.1 to 2.4) Chapters 3, 4 (except 4.5 and 4.10), 5(Sections 5.3 and 5.4 only) 6(except 6.4 and 6.5), 7 (Section 7.1 only) 8 (Section 8.1 only) and 9(Sections 9.1 to 9.3).
Reference Books	1. P.Kandasamy,K.Thilagavathi,K.Gunavathi, Probability Statistics and Queueing Theory S.CHAND & Company Ltd Ramnagar, New Delhi. 2. S.P.GUPTA,Statistical methods, Sultan Chand &Sons Educational Publishers, New Delhi. 3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 11th Edition, 2003.
Website and e-Learning Source	

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: The moments of discrete and random variables as well as be familiar with common named continuous random variables

CLO2: To derive the probability density functions of transformations of random variables and use these techniques to generate data from various distributions.

CLO3: To calculate probabilities, and derive the marginal an distributions of bivariate random variables.

CLO4: *To calculate confidence intervals for means, differences of mean.*

CLO5*: Theory of estimation and measures of quality estimators*

	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">MODELING AND SIMULATION WITH EXCEL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE 6</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMTE3B</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
3</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT I Introduction- How Do We Classify Models? - An Example of Deterministic Modeling -Understanding the Important Elements of a Model</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT II Model Building with Excel – Basic Model - Sensitivity Analysis - Controls from the Forms Control Tools- Scroll Bars .</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT III Modeling and Simulation: Types of Simulation and Uncertainty -Incorporating Uncertain Processes in Models -The Monte Carlo Sampling Methodology-Implementing Monte Carlo Simulation Methods-A Word About Probability Distributions - Modeling Arrivals with the Poisson Distribution-VLOOKUP and HLOOKUP Functions.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-IV A Financial Example—Income Statement -An Operations Example—Autohaus -Status of Autohaus Model - Building the Brain Worksheet - Building the Calculation Worksheet-Variation in Approaches to Poisson Arrivals—Consideration of Modeling Accuracy.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT V Sufficient Sample Size - Building the Data Collection Worksheet -Solver—Constrained Optimization -Example—York River Archaeology Budgeting –Scenarios</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">1. Hector Guerrero , Excel Data Analysis Modeling and Simulation,Springer Heidelberg Dordrecht London New York.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="7">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: Understanding the important elements of a model

CLO 2: Describe Model Building with Excel
CLO 3: Explain the types of simulation and uncertainty

CLO 4: To know about building the calculation worksheet

CLO 5: Explain the sufficient sample size

	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">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE 7</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMAE4A</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></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>Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces advanced topics in Linear and non-linear Programming</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I Introduction: Concept as optimization – statement of the problem – classical optimization – classical treatment as inequality constraints.
Chapter 1 Sections: 1.1 to 1.4</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II Nonlinear Programming: Kuhn Tucker necessary condition – Quadratic Programming and Duality.
Chapter 2 Sections: 2.1, 2.2 2.5 to 2.7</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III Search method for unconstrained optimization: Gride Search- Hooke and Jeeves Method – Fibbonacci series.
Chapter 3Sections: 3.1 to 3.3, 3.6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV Gradient method for unconstrained optimization: The Newton-Raphson method – The Davident – Fletcher power method – The complementary DFF formula
Chapter 4 Sections: 4.1 to 4.5</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V Dynamic Programming: The Allocation Problem – Oriented and Non-Network – The Farmer's problem – Scheduling problem.
Chapter 6 Sections: 6.1 to 6.6.</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">G.R. Walsh, "Method of Optimization",John Wiley and Sons, New York 1975.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">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</td></tr>
</table>

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

CO1	Explain the concept as optimization and classical treatment as inequality constraints.
CO2	Solving Nonlinear Programming problems.
CO3	Apply the Gride Search- Hooke and Jeeves Method.
CO4	Understanding the Newton-Raphson method and the complementary DFF formula.
CO5	Solving the Allocation Problem and Oriented and Non-Network problem.

	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="8">MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective 8</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">23PMTE4B</td></tr>
<tr><td>Semester</td><td>II</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>3</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Linear Algebra and Calculus, Probability Basics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. Understanding Human learning aspects.
2. Acquaintance with primitives in the learning process by computer.
3. Understanding the nature of problems solved with Machine Learning.
4. Familiar with basic principles of AI
5. Capable of using heuristic searches</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">UNIT-I: Introduction: What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation.</td></tr>
<tr><td colspan="8">UNIT-II : Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.</td></tr>
<tr><td colspan="8">UNIT-III : Concept Learning: Concept Learning, General-to-Specific Ordering: Task, search, Find S algorithm, Version space and the candidate elimination algorithm, List-then-eliminate algorithm, inductive bias.</td></tr>
<tr><td colspan="8">UNIT-IV : Fundamentals of Artificial Intelligence
Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem. Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation</td></tr>
<tr><td colspan="8">UNIT – V: Uninformed Search Strategies
Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.</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 Tu
torial hour)</td></tr>
</table>

Skills acquired from this course	**Knowledge, Analyze research based problems using Machine learning techniques, Understand the basics of the theory and practice of Artificial Intelligence as a discipline.**
Recommended Text	**1. 1.T. Mitchell, " Machine Learning", McGraw-Hill, 1997.** **2. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.** **3. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill** **4. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.**
Reference Books	**1. Ethem Alpaydin, "Introduction to Machine Learning", MIT press, 2004.** **2. Jacek M. Zurada, "Introduction to Artificial neural System", JAICO publishing house,2002,.** **3. Ivan Bratko : "Prolog Programming For Artificial Intelligence" , 2nd Edition Addison Wesley, 1440.** **4. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley**
Website and e-Learning Source	**1. www.nptelvideos.in** **2. http://www.eecs.qmul.ac.uk/~mmh/AINotes/AINotes4.pdf** **3. https://www.slideshare.net/JismyKJose/conceptual-dependency-70129647**

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Demonstrate knowledge of learning algorithms and concept learning through Implementation for sustainable solutions of applications.

CLO2: Evaluate decision tree learning algorithms

CLO3: Analyze research based problems using Machine learning techniques

CLO4: Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents capable of problem formulation.

CLO5: Evaluation of different uninformed search algorithms on well formulates problems along with stating valid conclusions that the evaluation supports.

	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">MATLAB</td></tr>
<tr><td>Paper Number</td><td colspan="6">Elective 9</td></tr>
<tr><td rowspan="2">Category Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMTE5A</td></tr>
<tr><td>Semester</td><td>III</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>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2"></td><td>--</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="6"></td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">• Understand the Matlab Desktop, Command window and the Graph Window.
• Be able to carry out numerical computations and analyses.
• Understand the mathematical concepts upon which numerical methods rely</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="6">UNIT-I:
Introduction: Basics of MATLAB -MATLAB windows – on line help - Input – Output, File types – Platform dependence – General commands.
Chapter 1 Section: 1.6.</td></tr>
<tr><td colspan="6">UNIT-II : Interactive Computation: Matrices and Vectors – Matrix and Array operations – Character Strings – A special note on array operators – command line functions - Using Built-in Functions and On-line Help – Saving and loading data – Plotting simple graphs.
Chapter 3 Section: 3.1 to 3.8.</td></tr>
</table>

	UNIT-III : Programming in MATLAB: Scripts and Functions – Script files - Functions files- Language specific features – Advanced Data objects. ***Chapter 4 Section: 4.1 to 4.4.***
	UNIT-IV: Applications: Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations. **Chapter 5 Section: 5.1 to 5.6**
	UNIT-V: Graphics: Basic 2-D Plots – Using subplot to Layout multiple graphs - 3 – D Plots – Handle Graphics – Saving and printing Graphs. **Chapter 6 Section: 6.1 to 6.6.**
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*

ecommended Text	*RUDRA PRATAP, **Getting Started with MATLAB** – A Quick Introduction for Scientistsand Engineers, Oxford University Press, 2003.*
Reference Books	**REFERENCE BOOKS:** 1.William John Palm, Introduction to Matlab 7 for Engineers, McGraw- Hill,Professional, 2005. 2.Dolores M. Etter, David C. Kuncicky , Introduction to MATLAB 7, Prentice Hall,2004.
Website and e-Learning Source	**Web Link:** 1. http://nptel.ac.in/courses/103106074/ 2. http://nptel.ac.in/courses/122106033/ 3. https://www.youtube.com/watch?v=SpAp7QACF34 4. https://www.youtube.com/watch?v=1PSFLKiEV7U 5. https://www.youtube.com/watch?v=OHxR8iMHDWw 6. https://www.youtube.com/watch?v=ZIjRXpqVtp0

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understanding the Important Elements of a Model

CLO2: Basic Model, Sensitivity Analysis and Controls

from the Forms Control Tools

CLO3: Know about Types of Simulation and Uncertainty.

CLO4:.Understand A Financial Example, Income

Statement and an Operations.

CLO5: Explain Sufficient Sample Size and building the Data Collection Worksheet

	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">LIE GROUPS and LIE ALGEBRAS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE 10</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23PMTE5B</td></tr>
<tr><td>Semester</td><td>III</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">-</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level linear algebra and matrix groups.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. In physics, Lie groups appear as symmetry groups of physical systems, and their Lie algebras (tangent vectors near the identity) may be thought of as infinitesimal symmetry motions.
2. Lie algebras and their representations are used extensively in physics, notably in quantum mechanics and particle physics.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I: Matrix Lie Groups
Chapter 1</td></tr>
<tr><td colspan="6">UNIT II: The Matrix Exponential
Chapter 2</td></tr>
<tr><td colspan="6">UNIT III: Lie Algebras
Chapter 3</td></tr>
<tr><td colspan="6">UNIT IV: Basic Representation Theory
Chapter 4</td></tr>
<tr><td colspan="6">UNIT V: Semisimple Lie Algebras
Chapter 7</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">1. Brain Hall, Lie Groups, Lie Algebras and Representations: An Elementary Introduction (Second Edition), Springer, USA, 2015.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. V. S. Varadarajan, Lie groups, Lie algebras and their representations, Sringer 1984.
2. Brian Hall, Lie groups, Lie algebras and representations, Springer 2003.
3. Barry Simon, Representations of finite and compact groups, AMS 1996.
4. A. W. Knapp, Representation theory of semismiple Lie groups. An overview based on examples, Princeton university press 2002.
5. S. Kumaresan S, A course in differential geometry and Lie groups, Texts and Readings in Mathematics, 22. Hindustan Book Agency, New Delhi, 2002.</td></tr>
</table>

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO 2: Determine the exponential of a matrix.

CLO 3: Differentiate Lie groups and Lie Algebras

CLO 4: Find the representation of $s_l(2\ ;\ C)$.

CLO 5: Explain reductive Lie algebra

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SAMPLING TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective 11</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">23PMTE6A</td></tr>
<tr><td>Semester</td><td>IV</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>3</td><td>1</td><td>--</td><td colspan="3">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">• To understand the Statistical Methods for many real life probabilistic situations.
• To learn the well known about Statistical Inference, Chi – square Test, F- Test, Analysis of variance, Experimental Design and Business Forecasting models to reorient their knowledge of sampling Techniques</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I : Statistical Inference – Test of Hypothesis: Introduction – procedure of Testing Hypothesis – Two types of errors in Testing of Hypothesis – Two tailed and one tailed Tests of Hypothesis – Measuring the power of a Hypothesis Test – Standard error and sampling Distribution – Universe Distribution – Estimation – Tests of significance for large samples – Test of significance of small samples – Applications of the t-Distribution.
Chapter: 3
.</td></tr>
<tr><td colspan="6">UNIT-II : CHI – Square Test and Goodness of fit : Introduction – Conditions for applying chi – square test – Yate’s corrections – Uses of Chi – square test – Additive property – Chi- square test for specified value of Population Varience – Limitations on the use of Chi –square test
Chapter :4</td></tr>
<tr><td colspan="6">UNIT-III : F- Test and Analysis of variance : The F- test or the Variance Ratio test – Applications of F-Test – Analysis of Variance – Assumptions in Analysis of Variance – Technique of Analysis of Variance – Analysis of variance in Two-way classification Model
Chapter :5</td></tr>
<tr><td colspan="6">UNIT-IV : Experimental Designs : Introduction – Randomized Block Design – Advantages of a completely Randomized Experimental Design – Latin squares – Steps in constructing Latin square - Randomized Blocks Vs Latin Square – Latin Cubes – Factorial Experiment
Chapter : 6
.</td></tr>
</table>

	UNIT-V : Business Forecasting : Introduction – Role of Forecasting in Business – Steps in Forecasting – Methods of Forecasting – Choice of a method of Forecasting – Theories of Business Forecasting – Forecasting Agencies. **Chapter: 8**
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	Dr.S.P.Gupta, Statistical Methods, Sultan Chand and Sons Educational Publishers New Delhi
RefereEce Books	1. Bensal A (2017). Survey Sampling, Narosa Publishing House Pvt. Ltd. 2. Cochran, W. G. (1977). Sampling Techniques, Third edition, Wiley Eastern Ltd. 3. Gupta A K and Kabe D G (2011), Theory of Sample Surveys, World Scientific. 4. Mukhopadhyay, M. (2009). Theory and Methods of Survey Sampling, Second Edition, PHI Learning Pvt. Ltd. 5. Murthy, M. N. (1967). Sampling Theory and Methods, Statistical Publishing Society, Calcutta. 6. Sampath, S. (2001). Sampling Theory and Methods, Second edition, Narosa Publishing Company, New Delhi. 7. Singh, D. and Chaudhary, F.S. (1986). Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd. 8. Sukhatme, P.V. and Sukhatme, B.V. (1970). Sampling Theory of Surveys with Applications, second edn, Asia Publishing House, Bombay.
Website and e-Learning Source	https://towardsdatascience.com> website-for-statistics https://www.copypress.com> resources> 12 places-you- https://guide.emich.edu.data>free-data

Course Outcome

At the end of the course the students will be able to

1. frame a Hypothesis according to the problem settted by them
2. Gather the knowledge about Statisticl Inference, Chi-square test and its Applications.
3. To acquire the knowledge about F- Test , Experimental Design, Latin square, Randomized Block and Latin Cubes.
4. To understand the methods of Business Forecasting, its techniques and the methods of Forecasting.

	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 PYTHON</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">ELECTIVE 12</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">23PMTE6B</td></tr>
<tr><td>Semester</td><td>IV</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>Total</td></tr>
<tr><td colspan="2"></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"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course aims
➢ To introduce to students Python programming.
➢ To learn python coding to implement algorithms for Mathematical problems.</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">Unit-I Introduction to Python Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements. Some simple programs to understand the relational, conditional and logical operators. Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using while loop; Finding the factors of a number using for loop; To check the given number is prime or not (use if... else statement); Find the factorial of a number (use if...if...else).; Simple programs to illustrate logical operators (and, or, not).</td></tr>
<tr><td colspan="6">Unit II Matrices, Differential Calculus & Analytical Geometry of Three Dimensions Python commands to reduce given matrix to echelon form and normal form with examples. Python program/command to establish the consistency or otherwise and solving system of linear equations. Python command to find the nth derivatives. Python program to find nth derivative with and without Leibnitz rule. Obtaining partial derivative of some standard functions Verification of Euler‘s theorem, its extension and Jacobean. Python program for reduction formula with or without limits. Python program to find equation and plot sphere, cone, cylinder.</td></tr>
</table>

	Unit III Roots of High-Degree Equations- Systems of Linear Equations Introduction, Simple Iterations Method - Finite Differences Method, Gauss Elimination Method: Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method.
	Unit IV Numerical differentiation, Integration and Ordinary Differential Equations Introduction & Euler's Method, Second Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method, Fourth Order Runge-Kutta's Method: Plot Numerical and Exact Solutions.
	Unit V Two-Point Boundary Value Problems Introduction to two- point boundary value Problems: second order differential equations - Higher order differential equations - solution of second order differential equation using Finite Difference 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 /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. Kiusalaas, Numerical methods in engineering with Python 3.** **Cambridge University Press, 2013.**
Reference Book	**H. P. Langtangen, Solving PDEs in Python: the FEniCS tutorial I. Springer Open, 2016**
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 learn how to use Python.
CLO2: Explain Python commands to find nth derivatives.
CLO3: Understand the .Simple Iterations in Python.
CLO4:.Numerical differentiation, Integration using Python.
CLO5: Two-Point Boundary Value Problems in Python.

	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

SKILL ENHANCEMENT COURSES

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICAL DOCUMENTATION USING LATEX</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Skill Enhancement Course-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">23PMTSE1</td></tr>
<tr><td>Semester</td><td>II</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>3</td><td>1</td><td>--</td><td colspan="3">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Mathematics and Programming Knowledge</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Prepare students to impart the knowledge of mathematical software and made them to prepare mathematical documents / their projects using this software.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I: Introduction:
Just What is LATEX? – Markup Languages - TEX and its offspring, Basics of a LATEX file – TEX Processing Procedure.
Chapter 1: Sections: 1.1-1.3, 1.5 - 1.6.

Unit II: Text, Symbols, Commands:
Command names and arguments – Environments – declarations – Lengths - Special Characters - Exercises.
Chapter 2: Sections: 2.1 – 2.6.

Unit III: Document Layout and Organization:
Document class - Page style - Parts of the document - Table of contents.
Chapter 3: Sections: 3.1 – 3.4.

Unit IV: Displayed Text:
Changing font - Centering and indenting – lists - generalized lists - Theorem-like declarations - Tabulator stops – Boxes – Tables - Printing literal text, Footnotes and marginal notes – Comments within text.
Chapter 4: Sections: 4.1 – 4.11.

Unit V: Mathematical Formulas
Mathematical environments - Main elements of math mode - Mathematical symbols- Additional elements - Fine-tuning mathematics - Beyond standard Latex.
Chapter 5: Sections: 5.1 – 5.6.</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	**A guide to LATEX and Electronic Publishing by H. Kopka and P.W. Daly**, Fourth Edition, Addison – Wesley, London, 2003. (https://www2.mps.mpg.de/homes/daly/GTL/gtl_20030512.pdf
Reference Books	H. Kopka and P.W. Daly, *A Guide to LaTeX2ε; Document Preparation for Beginners and Advanced Users*, 2nd edition, 1995, ISBN 0-201-42777-X published by Addison-Wesley. The standard reference for what goes on inside TeX is *The TeXbook* by Donald E. Knuth, 1986, ISBN 0-201-13448-9, published jointly by the American Mathematical Society and Addison-Wesley. M. Goossens, F. Mittelbach, and A. Samarin, *The LaTeX Companion*, published by Addison-Wesley, ISBN 0-201-54199-8 (essential for the serious LaTeX hackers).
Website and e-Learning Source	https://www.overleaf.com/home-2 https://papeeria.com/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the basic concepts of starting windows and

solve the LATEX applications

CLO2: Create Command names and arguments in LATEX..

CLO3: Solve problems using M files and apply the same for advanced data objects in LATEX..

CLO4: Know about the Document class, Page style and Parts of the document in LATEX

CLO5:.Understand how to use Mathematical Formulas

	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">Office Automation and ICT Tools</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Skill Enhancement Courses II</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">23PMTSE3</td></tr>
<tr><td>Semester</td><td>IV</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>4</td><td colspan="2">-</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Computer Knowledge</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• To work comfortably with file mangers, word processors, spreadsheets, presentation software's.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT-I:Word Processing
Ms - Word, Word processing, Manual and Electronic word processing, Screen layouts, Menus, Shortcut, Toolbars, Title bar, Status bar, Scroll bars, Rulers, Create, Open, Save, Rename and close document. Cut, Copy, Paste, undo and Re do options, Find and Replace Commands, Text, paragraph and Page formatting, Header and Footer, date and Time, Bullets and Numbering, Insert a table, Add and Delete rows, columns and cells.</td></tr>
<tr><td colspan="6">UNIT-II: Spread Sheet:
MS Excel Concept: Creating, Saving, closing, Editing a Workbook, Inserting, Deleting Work Sheets, entering data in a cell, Copying and Moving from selected cells, entering formula, handling operators in Formula, Functions: Mathematical, Logical, statistical, text, financial, Date and Time functions, Using Function Wizard. Formatting a Worksheet: Formatting Cells – changing data alignment, changing date, number, character or currency format, changing font, adding borders and colors, Printing worksheets, Charts and Graphs – Creating, Previewing, Modifying Charts.</td></tr>
<tr><td colspan="6">UNIT-III : Presentation
MS Power Point Concept : Creating, Opening and Saving Presentations, Working in Different Views, Working with Slides, Adding and Formatting Text, Formatting Paragraphs, Checking Spelling and Correcting Typing Mistakes, Making Notes Pages and Handouts, Drawing and Working with Objects, Adding Clip Art and other pictures, Designing Slide Shows using templates, Rehearse timing, Narration, Multimedia effects- Apply Transitions between Slides, Animate Slide Content, Set Timing for Transitions and Animations, Insert and Format Media, Encrypting presentations with a password, Running and Controlling a Slide Show, Printing Presentations</td></tr>
<tr><td colspan="6">UNIT – IV : INTERNET & ADVANCED COMMUNICATION:
Internet and Web Browsers: Definition & History of Internet - Uses of Internet - Definition of WebAddressing-URL-Different types of Internet Connections; Dial up connection, Broad band (ISDN, DSL, Cable), Wireless (Wi-Fi, WiMax, Satellite, Mobile) naming convention, browsers and its types, internet browsing, searching - Search Engines - Creating an email-ID, e-mail reading, saving, printing, forwarding and</td></tr>
</table>

	deleting the mails, checking the mails, viewing and running file attachments, addressing with cc and bcc.
	UNIT-V:Google Office Tools: Creating , saving , downloading , sharing files/folders from Google drive , creating and sharing Google docs, import and export docs, creating and sharing Google sheet, import and export Google sheet, Google forms and form responses ,creating Google slides to present your ideas
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination questionpaper)	**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. **Microsoft Office 2010 For Dummies By Wallace Wang** 2. **2007 Microsoft Office System Plain & Simple by Jerry Joyce Microsoft Press** 3. **Office XP : The Complete Reference- Stephen L. Selson – Tata McGraw Hill Education.** 4. **Working in Microsoft Office – Richard Mansfield – Tata McGraw Hill Education.** 5. **Dinesh Maidasani, Learning Computer fundamentals, MS-Office and Internet and Web Technology, Laxmi Publications PVT Limited, 2016.**
Reference Books	1. **Microsoft Office 2007 Bible - John** 2. **Walkenbach,HerbTyson,FaitheWempen,caryN.Prague,MichaelR.groh, PeterG.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd.** 3. **Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013.** 4. **A Conceptual Guide to OpenOffice** 5. **Computer & Internet Basics Step-by-Step - Etc-end the Clutter - Infinity Publishing** 6. **Open Office Basic: An Introduction**
website and e-Learning Source	• **http://office.microsoft.com/en-us/training/CR010047968.aspx** • **https://gsuite.google.com/leaming-center** • **http://windows.microsoft.com/en-in/windows/msoffice-basics-all-** • **http://spoken-tutorial.org**

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO1: Describe the features and functions of the categories of application software.
CLO2: Explain conclusions effectively, orally and in writing.
CLO3: Understand the dynamics of an office environment.
CLO4: Demonstrate the ability to apply application software in an office environment.
CLO5: Use Email and Google Suite for office data management tasks.

	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*

<table>
<tr><td>Title of the Course</td><td colspan="6">Mathematical Aptitude</td></tr>
<tr><td>Paper Number</td><td colspan="6">Skill Enhancement Courses II</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">23PMTSE2</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">3</td><td colspan="2">-</td><td>--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Training for Competitive Examination</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Mathematics for NET/UGC-CSIR/SET/TRB Competitive Examination</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT-I:Typical Problems
Calendar Problems - Clock Problems – Moving Locomotive Problems - Series Formation.
Chapter: 1 - 4</td></tr>
<tr><td colspan="6">UNIT-II: Numerical Ability
Numbers - Probability and Arrangements - Distances and Directions.
Chapter: 5 – 7</td></tr>
<tr><td colspan="6">UNIT-III : Daily Life Problems
Finding the x - Average - Monetary Problems.
Chapter: 8 – 9</td></tr>
<tr><td colspan="6">UNIT – IV : Geometrical Type Problems
Geometry - Mensuration and Quantitative Comparison.
Chapter: 11 & 12</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V:Logical Reasoning
Data Interpretation - Observational Ability – Logical Puzzles.
Chapter: 13 – 15</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination questionpaper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations NET / UGC – CSIR / SET / TRB / 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">1. CSIR –NET, GENERAL APTITUDE – a new outlook, Christy Varghese, III Edition, Lily publishing house, Kerala.</td></tr>
</table>

Reference Books	**1.General Aptitude Comprehensive Theory & Practice, Kailash Choudhary, 6TH Edition.** **2.CSIR-UGC-NET General Aptitude Theory and Practice, Ram Mohan Pandey, 2nd Edition, Path Finder Publication.**
website and e-Learning Source	**https://www.youtube.com/live/wgvQLG_8gEl?si=jlxPOYzPiDOvq6C** **https://youtu.be/OWq7bDBrZ5g?si=jwytq5jjkPYztbJw**

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO1: Guess and check the Problems quickly
CLO2: Demonstrate the ability to apply application.
CLO3: Analyze Real Life Problems.
CLO4: Know the Application of Mensuration.
CLO5: Understand the Logical Reasoning.

	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*