ALAGAPPA UNIVERSITY

M.Sc., MATHEMATICS

Syllabus
(Affiliated Colleges)

AUGUST 2023

NEW INITIATIVE IN MODERNISING POST-GRADUATE PROGRAMME IN MATHEMATICS
AUGUST 2023

Programme Outcomes:

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of anPost 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 researchperspective; 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.

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										

Credit Distribution for PG Programme
M.Sc Mathematics- Programme Structure

Sem	Part	Course Code	Courses	List of Courses	T/ P	Credit	Hours/ week	Max. Marks		
								Int.	Ext.	Total
Semester - I										
I	Part A	23MMA1C1	CC – 1	Algebraic Structures	T	4	5	25	75	100
		23MMA1C2	CC – 2	Real Analysis - I	T	4	5	25	75	100
		23MMA1C3	CC – 3	Ordinary Differential Equations	T	4	5	25	75	100
		23MMA1E1/ 23MMA1E2/ 23MMA1E3/	DSE- I	Number Theory and Cryptography / Graph Theory and Applications / Formal Languages and Automata theory	T	3	5	25	75	100
		23MMA1E4/ 23MMA1E5/ 23MMA1E6/	DSE- II	Mathematical Programming / Fuzzy sets and their Applications / Discrete Mathematics	T	3	5	25	75	100
	Part B	23MMA1SP	SEC-I	Office Automation (Internal Paper)	P	2	3	25	75	100
		23MMA1AP	AECC-I	Mathematics for Competitive Examinations - I (Internal Paper)	P	2	2	25	75	100
				Total	-	**22**	**30**	**175**	**525**	**700**
Semester - II										
II	Part A	23MMA2C1	CC – 4	Advanced Algebra	T	4	5	25	75	100
		23MMA2C2	CC-5	Real Analysis - II	T	4	5	25	75	100
		23MMA2C3	CC-6	Partial Differential Equations	T	4	5	25	75	100
		23MMA2E1/ 23MMA2E2/ 23MMA2E3	DSE-III	Algebraic Geometry / Mathematical Statistics / Tensor Analysis and Relativity	T	3	5	25	75	100
		23MMA2E4/ 23MMA2E5/ 23MMA2E6	DSE-IV	Calculus of Variations and Integral Equations / Wavelets /Machine Learning and Artificial Intelligence	T	3	5	25	75	100
	Part B	23MMA2SP	SEC-II	Mathematical Documentation using LATEX	P	2	3	25	75	100
		23MMA2AP	AECC-II	Mathematics for Competitive Examinations - II	P	2	2	25	75	100
				Total	-	**22**	**30**	**175**	**525**	**700**

Semester - III										
III	**Part A**	23MMA3C1	CC-7	Complex Analysis	T	4	5	25	75	100
		23MMA3C2	CC-8	Probability Theory	T	4	5	25	75	100
		23MMA3C3	CC-9	Topology	T	4	5	25	75	100
		23MMA3C4	CC-10	Industrial Statistics	T	3	5	25	75	100
		23MMA3E1/ 23MMA3E2/ 23MMA3E3	DSE- V	Algebraic Number Theory / Fluid Dynamics / Stochastic Processes	T	3	5	25	75	100
	Part B	23MMA3SP	SEC-III	MATLAB an Introduction	P	2	3	25	75	100
		23MMA3AP	AECC-III	Subjective Skills in Mathematics - I	P	2	2	25	75	100
		23MMA3I/ 23MMA3IA		**Internship / Industrial Activity** (Carried out in Summer Vacation at the end of I year – 30 hours	PR	2	-	25	75	100
				Total	-	**24**	**30**	**200**	**600**	**800**
Semester - IV										
IV	**Part A**	23MMA4C1	CC-11	Functional Analysis	T	4	5	25	75	100
		23MMA4C2	CC-12	Differential Geometry	T	4	5	25	75	100
		23MMA4C3	CC-13	Mechanics	T	4	5	25	75	100
		23MMA4PR	CC-14	Core Project with viva voce	PR	3	4	25	75	100
		23MMA4E1/ 23MMA4E2/ 23MMA4E3	Elective VI	Advanced Numerical Analysis / Algebraic Topology / Financial Mathematics	T	3	5	25	75	100
	Part B	23MMA4SP	SEC-IV	Mathematical Economics	P	2	4	25	75	100
		23MMA4AP	AECC-IV	Subjective Skills in Mathematics - II	P	2	2	25	75	100
		23MEA4		Extension Activity	P	1	-	25	75	100
IV				**Total**	**-**	**23**	**30**	**200**	**600**	**800**

TOTAL CREDITS: 91

Chairperson Details: Dr.KE.Sathappan, Associate Professor, Department of Mathematics, Alagappa Govt. Arts College, Karaikudi. Mobile No:9444173696.

<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">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA1C1</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 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">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">UNIT-I</td><td colspan="6">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="2">UNIT-II</td><td colspan="6">Solvable groups - Direct products - Finite abelian groups- Modules
Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="6">Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="6">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>
<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 Eastern Limited, 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 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="6">REAL ANALYSIS - I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA1C2</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>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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="8">Course Outline</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">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">UNIT-II</td><td colspan="6">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">UNIT-III</td><td colspan="6">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="6">ORDINARY DIFFERENTIAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA1C3</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>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td>--</td><td colspan="3">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential Equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations</td></tr>
<tr><td colspan="8">Course Outline</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">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="2">UNIT-II</td><td colspan="6">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="2">UNIT-III</td><td colspan="6">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="2">UNIT-IV</td><td colspan="6">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="2">UNIT-V</td><td colspan="6">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 Delhi 2001 6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.
Website and 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="8">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE- I A</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">23MMA1E1</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 colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Number Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop working knowledge on Greatest Common Divisor, factorization, linear Diophantine equations, quadratic residues Legendre symbols and The idea of Public key Cryptography.</td></tr>
<tr><td colspan="10">Course Outline</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="8">Introduction – Well Ordering – Induction- Binomial Coefficients- Greatest integer functions- Divisibility- Greatest Common Divisor (GCD) – Euclid‘s algorithm – GCD via Euclid ‘s algorithm- Least Common Multiple (LCM)- representation of integers.
(Chapter 1&2: Sections 1.1 to 1.6, 2.2 to 2.4 of Text book 1)</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="8">Introduction –primes counting function - prime number theorem- test of primality - canonical factorization _ fundamental theorem of arithmetic _ Seive of Eratosthenes _ Determining factorization- fundamental theorem of arithmetic- Seive of Eratosthenes determining canonical factorization of a natural number.
(Chapter 3 :Sections 3.1 to 3.3of Text book 1)</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="8">Congruence- equivalence relations-linear congruences -linear Diophantine equations-Chinese remainder theorem- polynomial congruences – modular arithmeticFermat’s theorem –Wilson’s theorem- Fermat number.
(Chapter 4 :Sections 4.2-4.7 of Text book 1)</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="8">Arithmetic functions- tau functions- Dirichlet product – quadratic residuesLegendre symbols- Gauss lemma- Law of reciprocity.
(Chapter 5 &7:Sections 5.1-5.2, 7.2-7.3 of Text book1)</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="8">Cryptography: Introduction- Some simple crypto systems-Enciphering MatricesThe idea of Public key Cryptography – RSA - Discrete log- Knapsack
(Chapter 3 &4 :Sections3.1- 3.2, 4.1-4.4 of Text book -2)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Neville Robbins, *Beginning Number Theory*, second Edition, Narosa, 2006. **2.** Neal Koblitz, *A Course in Number Theory and Cryptography,*Second edition, Springer-Verlag Newyork-1994.
Reference Books	1. Tom. M. Apostol, *Introduction to analytic Number theory*, Narosa Publishing House,1998. 2. Ivan Nivan, H.S.Zuckerman and H.L.Montgomery, *An introduction to the theory of Number,* 5th Ed paperback- International Edition, 1991.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Learn the Well Ordering, Greatest integer functions, Divisibility, Greatest Common Divisor, Euclid's algorithm and Least Common Multiple.

CLO 2: Define the primes counting function, prime number theorem, canonical factorization fundamental theorem of arithmetic, Seive of Eratosthenes Determining factorization fundamental theorem of arithmetic and Seive of Eratosthenes determining canonical factorization of a natural number.

CLO 3: Form the equivalence relations, linear congruences, linear Diophantine equations, Chinese remainder theorem, polynomial congruences and understand about modular arithmetic Fermat's theorem and Wilson's theorem, Fermat number.

CLO 4: Definearithmetic functions and tau functions, Legendre symbols to understand the Gauss lemma- Law.

CLO 5: Understand the simple crypto systems, Enciphering Matrices, the idea of Public key Cryptography and RSA.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-I B</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">23MMA1E2</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">UG level Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop working knowledge on Cut edges and cut vertices, Euler Tours, Perfect Matchings, Edge chromatic number, Independent sets, Chromatic number, Planar Graph and Eular formula.</td></tr>
<tr><td colspan="10">Course Outline</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="8">Graphs, Subgraphs : Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection Cycles. Trees- Cut Edges and Bonds– Cut Vertices– Cayley’s Formula. (Chapter 1&2: Sections 1.1 to 1.7, 2.1 to 2.4)</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="8">Connectivity, Euler Tours And Hamilton Cycles: Connectivity – Blocks- Euler tours – Hamilton cycles.
(Chapter 3&4: Sections 3.1 to 3.2, 4.1 to 4.2)</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="8">Matchings – Matchings Coverings in Bipartite Graphs – Perfect Matching. Edge colourings: Edge Chromatic Number – Vizing’s Theorem.
(Chapter 5&6: Sections 5.1 to 5.3,6.1 to 6.2)</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="8">Independent Sets, Cliques: Independent Sets- Ramsey’s Theorem VertexColourings: Chromatic Number – Brook’s Theorem – Hajos Conjecture – Chromatic Polynomials – Girth and Chromatic Number.
(Chapter 7&8: Sections 7.1 to 7.3, 8.1 to 8.5)</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="8">Plane and Planar Graphs – Dual Graphs – Euler’s Formula- Bridges – Kuratowski’s Theorem (Proof Omitted) – The Five Colour Theorem and The Four Colour Conjecture – Nonhamiltonian Planar Graphs – Directed Graphs: Directed Graphs – Directed Paths – Directed Cycle
(Chapter 9&10: Sections 9.1 to 9.7 , 10.1 to 10.3)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">J.A.Bondy and V.S.R.Murty, Graph Theory and applications, Macmillan, London, 1976.</td></tr>
</table>

Reference Books	1. S.A.Choudum, *A First Course in Graph Theo*ry, Macmillan, India Ltd., 1987. 2. R.Balakrishnan and K.Renganathan, *A Text Book of Graph Theory*, Springer Verlag, New York, 1999.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Define Graph and Subgraph, explainthe adjacency and incidence matrix. Define tree and develop the respective theorems.

CLO 2: Define Connectivity Euler Tours And Hamilton Cycles.

CLO 3: Matchings Coverings in Bipartite Graphs, Perfect Matching are defined. Define Edge Chromatic Number and Vizing's Theorem.

CLO 4: Define Independent Sets and Cliques, Ramsey's Theorem, Brook's Theorem, Hajos Conjecture, Chromatic Polynomials ,Girth.

CLO 5: Define Plane, Planar Graphs, Dual Graphs, Euler's Formula- Bridges, The Five Colour Theorem, The Four Colour Conjecture, Nonhamiltonian Planar Graphs are defined. Define directed Graphs, directed Paths, directed Cycle.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FORMAL LANGUAGES AND AUTOMATA THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-I C</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">23MM A1E3</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="5"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level set theory and Logic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce the concepts and to develop working knowledge on Finite automata, regular sets, free grammars, normal forms and Turing machines.</td></tr>
<tr><td colspan="9">Course Outline</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="7">Finite automata and Regular expressions - Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε moves – Regular expressions – Regular grammars.
(Chapter 2. Sections 2.1 to 2.5 Chapter 9 Section 9.1)</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="7">Properties of regular sets. The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.
(Chapter 3 : Sections 3.1 to 3.4)</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="7">Context-free grammars -Motivation and introduction – Context-free grammars – Derivation treesSimplification of context-free grammars – Chomsky normal form – Greibach normal form.
(Chapter 4 : Section 4.1 to 4.6)</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="7">Pushdown automata- Informal description- Definitions-Pushdown automata and context-free languages – Normal forms for deterministic pushdown automata.
(Chapter 5 : Sections 5.1 to 5.3)</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="7">Properties of context-free languages The pumping lemma for CFL’s – Closure properties for CFL’s – Decision algorithms for CFL’s. Introduction to Turing Machines The Turing machine – Programming techniques for Turing machines.
(Chapter 6 & 8: Sections 6.1 to 6.3, 8.2, 8.3)</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="7">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="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	John E.Hopcraft and Jeffrey D.Ullman, *Introduction to Automata Theory, Languages and Computation*, Narosa Publishing House, New Delhi, 1987.
Reference Books	1. A. Salomaa, *Formal Languages*, Academic Press, New York, 1973. 2. John C. Martin, *Introduction to Languages and theory of Computations* (2nd Edition) Tata- McGraw Hill Company Ltd., New Delhi, 1997
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Define Finite automata, regular expressions, Basic definitions of Nondeterministic finite automata, Finite automata with ε moves and Regular expressions.

CLO 2: Examine the properties of regular sets, Pumping lemma for regular sets, Closure properties of regular sets, to explain the decision algorithms for regular sets.

CLO 3: AnalyzetheContext-free grammars and Derivation trees, simplification of context-free grammars. To derive the Chomsky normal form and Greibach normal form.

CLO 4: Define the Pushdown automata and context-free languages. To learn the Normal forms for deterministic pushdown automata.

CLO 5: Understand aboutthe pumping lemma for CFL's, closure properties for CFL's, Decision algorithms for CFL's. To learn the Turing machine concepts.

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

Title of the Course		MATHEMATICAL PROGRAMMING					
Paper Number							
Category	DSE- II A	Year	I	Credits	3	Course Code	23MMA1E4
		Semester	I				

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

Pre-requisite	UG Level Linear Programming
Objectives of the Course	To work the Integer linear programming, Dynamic programming, Goal programming, Non-linear programming and Simulations.

Course Outline

UNIT-I	**Integer Linear Programming :** Types of Integer Linear Programming Problems – Concept of Cutting Plane – Gomory's All Integer Cutting Plane Method – Gomory's Mixed Integer Cutting Plane Method- Branch and Bound Method **(Chapter 7: Sections 7.1 to 7.6)**
UNIT-II	**Dynamic Programming:** Introduction – Dynamic programming Terminology – Developing optimal decision policy – Dynamic programming under certainty – Dynamic programming approaches for solving Linear programming problem. **(Chapter 22: Section 22.1 to 22.5)**
UNIT-III	**Goal Programming:** Difference between LP and GP approach – Concept of Goal Programming – Goal Programming Model formulation – Graphical solution method of Goal Programming. **(Chapter 8 : Section 8.1 to 8.5)**
UNIT-IV	**Non-linear Programming Methods** : Introduction – The general Non – linear programming problem – Graphical solution method - Quadratic programming – Applications of Quadratic programming. **(Chapter 24: Section 24.1 to 24.5)**
UNIT-V	**Simulation:** Introduction – Definition Simulation – Types of Simulation – Steps of simulation process – Advantages and Disadvantages of Simulation – Stochastic Simulation and Random Numbers – Simulation inventory problems – Simulation of Queuing problems – Simulation of PERT problems. **(Chapter 19: Section 19.1 to 19.8 and 19.11)**

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	J.K.Sharma, Operations Research,(Fifth edition) Macmillan, New Delhi, 2013.
Reference Books	1. Hamdy A. Taha, Operations Research – An Introduction, Eighth Edition, Prentice-Hall, New Delhi, 2012. 2. Kanti Swarup, Manmohan and P. K. Gupta, Operations Research, Sultan Chand &Co., 2006 3. Kambo, Mathematical Programming Techniques, East –West Publications, Delhi, 1991. 4. J. C. Pant, Introduction to Operations Research, Jain Brothers, 2008.
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: Learn and solve the Integer Linear Programming Problems, Gomory's Mixed Integer Cutting Plane Method, Branch and Bound Method.

CLO2: Solve and create the Dynamic programming Terminology, Dynamic programming under certainty and Dynamic programming approaches for solving Linear programming problem.

CLO3: Understand and learn about the Goal Programming, Graphical solution method of Goal Programming.

CLO4: get knowledge in Non – linear programming problem, Graphical solution method, Quadratic programming and Applications of Quadratic programming.

CLO5: get idea in Simulation, Steps of simulation process, Advantages and Disadvantages of Simulation, Stochastic Simulation and Random Numbers and Simulation of PERT problems.

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

<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"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-II B</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">23MMA1E5</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">UG level Fuzzy set theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop the Fuzzy sets, Fuzzy relations , Fuzzy measure, Types of uncertainty and Fuzzy system.</td></tr>
<tr><td colspan="10">Course Outline</td></tr>
<tr><td colspan="2">UNIT – I</td><td colspan="8">Fuzzy Relations:
Basic concepts of fuzzy sets – Crisp verses fuzzy relations – Binary fuzzy relations – Binary relations on single set – Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations.
(Chapter : 1 & 5 : Sections 1.3, 1.4, 5.1, 5.3 to 5.7 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="8">Fuzzy Measure:
General Discussion – Belief and Plausibility measures – Probability measures – Possibility and Necessity measures – Relationship among Classes of fuzzy measures.
(Chapter 4: Sections 4.1 to 4.5 of Text Book 2)</td></tr>
<tr><td colspan="2">UNIT – III</td><td colspan="8">Uncertainty and Information:
Type of Uncertainty – Measures of fuzziness – Classical measures of uncertainty – Measures of dissonance - Measures of confusion.
(Chapter 5 : Sections 5.1 to 5.5 of Text Book 2)</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="8">Fuzzy Systems:
General discussion – Fuzzy controllers – Fuzzy systems and Neural Network – Fuzzy Neural Networks - Fuzzy Automata – Fuzzy dynamic systems.
(Chapter 12: Sections 12.1 to 12.7 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="8">Fuzzy Decision Making:
General Discussion – Individual decision making – Multiperson decision making – Multicriteria decision making – Multistage decision making – Fuzzy ranking method.
(Chapter 15: Sections 15.1 to 15.7 of Text Book 1)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1.George J. Klir and Bo Yuan, *Fuzzy sets and Fuzzy logic(Theory and applications)*, PHI Publications, 2010. 2.George J. Klir and Tina A. Floger, *Fuzzy sets, Uncertainty and Information*, PHI Publications, 2007.
Reference Books	1. A.Kaufman, Introduction to the Theory of Fuzzy Subsets, Academic Press, 1975. 2.H.J.Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf https://www.mdpi.com/books/pdfdownload/book/4344

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know theconcepts of fuzzy sets, fuzzy relation, Fuzzy equivalence relations, Fuzzy compatibility relations and Fuzzy ordering relations.

CLO 2: understand about the belief and Plausibility measures, Probability measures, Possibility and Necessity measures.

CLO 3: get the knowledge inMeasures of fuzziness, Classical measures of uncertainty, Measures of dissonance and Measures of confusion.

CLO 4: learn theFuzzy controllers, Fuzzy systems and Neural Network and Fuzzy Automata with dynamic systems.

CLO 5: increase their competencies in individual decision making, Multiperson decision making and Fuzzy ranking method.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DISCRETE MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-II C</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">23MMA1E6</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 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">UG level sets and logic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Aim of the paper is to develop the knowledge in discrete mathematics for logic, recurrence relation, lattice theory, coding theory and permutation and combination.</td></tr>
<tr><td colspan="8">Course Outline</td></tr>
<tr><td colspan="2">UNIT I</td><td colspan="6">Logic – Normal forms – Principal normal forms – Theory of inference – Open statements – Quantifiers – Valid formula and equivalence – Predicate Calculus – More than one quantifier.
(Chapter IX: Sections 11 to 18 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT II</td><td colspan="6">Recurrence Relations and Generating Functions – Recurrence – an introduction – Polynomials and their Evaluations Recurrence Relations – Solution of Finite order Homogeneous (Linear) Relations. Solution of Non-homogeneous Relations – Generations Functions – Some Common Recurrence Relations – Primitive Recursive Functions – Recursive and Partial Recursive Functions.
(Chapter V: Sections 1 to 9 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT III</td><td colspan="6">Lattices – Lattices – Some Properties of Lattices – New Lattices – Modular and Distributive Lattices. Boolean Algebra – Boolean Algebras – Boolean Polynomials – Karnaugh Map – Switching Circuits
(Chapter X: Sections 1 to 8 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT IV</td><td colspan="6">Coding theory – Introduction – Hamming distance – Encoding message – Group codes – Procedure for generating group codes – Decoding error correction.
(Chapter VIII: Sections 1 to 6 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT V</td><td colspan="6">The Basic counting principle – The pigeonhole principle – Permutation and Combination – Binomial coefficients and Identities – Generalised Permutation and Combinations – Generating Permutation and Combinations.
(Chapter 6 : Sections 6.1 to 6.6 of Text Book 2)</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>
</table>

Recommended Text	1. Dr.M.K.Venkataraman, Dr.N.Sridharan and Dr.N.Chandra Sekaran, *Discrete Mathematics* The National Publishing Company, Chennai, 2001. 2. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, Fourth edition, McGraw Hill Publications.
Reference Books	1.Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Indian Reprint 2006, Springer Verlag, New York. 2. P Trembly and R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw – Hill Publishing Company Ltd, New Delhi 1997. 3.T. Veerarajan, *Discrete Mathematics*, Tata McGraw-Hill Publishing company, 2007.
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

CLO 1: learn Logic, Theory of inference and Predicate Calculus.

CLO2: solve the rrecurrence relations, Generating Functions and Solution of Non-homogeneous Relations.

CLO 3: teach the Latticetheory, Boolean Algebras,Karnaugh Map and Switching Circuits.

CLO 4:write a Coding and decoding theory that is useful to write a coding in computer.

CLO 5:solve the problems in Permutation and Combination problem.

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

=

SKILL ENHANCEMENT COUIRSE:(Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">OFFICE AUTOMATION</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC-I</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>23MMA1SP</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>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td>3</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic knowledge in Computer</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The aim of this course is to develop the concepts of MS Windows, Ms Word, MS Excel, MS Power Point and MS Access.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">MS Windows: Concepts – Features – Windows Structure – Desktop – Taskbar – Start Menu– My Computer My Pictures – My music – Working with Recycle Bin – Managing files and folders: exploring hard disk – creating new folder, searching files and folders – disk –navigating between folders – coping and moving files and folder from one drive to another – Windows Accessories – calculator – Notepad – Paint – Word pad – Character Map: Windows Explorer: exploring hard disk, coping and moving files and folder from one drive to another Entertainment, Installation of Hardware and Software, Using scanner, system tools, communication, sharing information between computers.</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="6">MS Word: Introduction to MS Office – Features & area of use – Starting Word – Parts of Word Window – Mouse operations – Keyboard operations – Menus & Commands – Toolbars and their icons – Shortcut Menus – Wizards and Templates – Creating a New Document – Different Page Views and layouts – Applying various Text Enhancements; Working with – Styles, Text Attributes; Paragraph and Page Formatting; Text Editing using various features; Bullets, Numbering, Autoformatting, Printing & various print options Advanced Features: Spell Check, Thesaurus, Find & Replace; Headers & Footers; Inserting– Page Numbers, Pictures, Files, Autotexts, Symbols etc.; Working with Columns, Tabs & Indents; Creation & Working with Tables including conversion to and from text; Margins & Space management in Document; Mail Merge, Envelops & Mailing Labels.</td></tr>
<tr><td colspan="2">UNIT – III</td><td colspan="6">MS Excel: Introduction – area of use – Concepts of Workbook & Worksheets: Using Wizards; Various Data Types – Using different features with Data, Cell and Texts: Selecting cells – Selecting cells with mouse – Entering and Editing text – Entering numbers, formulas and dates – Text alignment – Inserting, Removing & Resizing of Columns & Rows; Working with Data & Ranges; Different Views of Worksheets; Column Freezing, Labels, Hiding, Splitting etc.; Use of Formulas, Calculations & Functions; Cell Formatting including Borders & Shading; Working with Different Chart Types; Printing of Workbook & Worksheets with various options.</td></tr>
</table>

UNIT-IV	**MS PowerPoint:** Introduction & area of use – Creating a New Presentation; Opening – Saving – Closing – Working with Presentation Using Wizards; Slides & its different views: Creating, Inserting, Deleting and Copying of Slides; Menus: File – Edit – View – Insert – Format – Tools – Slide Show – Window – Help – Working with Notes, Handouts, Columns & Lists; Adding Graphics, Sounds and Movies to a Slide; Printing Presentations, Notes, Handouts with print options.
UNIT-V	**MS Access:** Introduction – Parts of an Access Window – Starting MS Access – Database Creation – Table Creation using Table Wizard – Table Creation using Design view – Saving Database – Query – Form – Reports
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Reference Books

1. Windows XP Complete Reference. BPB Publications
2. MS Office XP complete BPB publication
3. MS Office 2000 by Sanjay Saxena, Vikas publishing house pvt Ltd.
4. MS Windows XP Home edition complete, BPB Publications
5. I.T. Tools and Applications, A. Mansoor, Pragya Publications

Website and e-Learning Source	https://wiki.openoffice.org/w/images/7/7e/Installation_Guide_OOo3.pdf https://wiki.openoffice.org/w/images/b/b1/AOO41GS.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: get knowledge in MS Windows.
CLO 2: write any letter using MS - Word.
CLO 3: learn the concepts of MS-Excel.
CLO 4: give an idea in MS-Power point.
CLO 5: learn the concepts of MS-Access.

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

Note: Internal Examination only

ABILITY ENHANCEMENT COURSE: (Internal Paper)

Title of the Course		**MATHEMATICS FOR COMPETITIVE EXAMINATION - I**							
Category	**AECC-I**	**Year**	I	**Credits**	2	**Course Code**	**23MMA1AP**		
		Semester	I						
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**		**Total**	
		-		--		2		2	
Pre-requisite		Basic Mathematics							
Objectives of the Course		To update the skills in numerical and quantitative techniques. Able to critically evaluate various real life situations by resorting to Analysis of key issues and factors. Able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions							
UNIT-I		Numbers – HCF – LCM – Square Roots & Cube Roots- Problems on numbers. **(Chapters 1, 2,57)**							
UNIT-II :		Decimal Fractions, Simplification, Time & Distance. **(Chapter 3,4,18)**							
UNIT-III :		Surds and Indices – Percentage – Profit and Loss- Simple Interest- Compund Interest. **(Chapters 9, 11, 22, 23)**							
UNIT-IV :		Ratio and Proportion – Partnership – Alligation or Mixture- Probability. **(Chapters 13, 14, 21, 31)**							
UNIT-V:		Average – Problems on Age- Calendar. **(Chapters 6,8,27)**							
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill							
Recommended Text		Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examinations" , S.Chand& Company Ltd, New Delhi -2007							
Reference Books		1.Arun Sharma, *Quantitative Aptitude,* Mc-Grawhill publications. 2. Rajesh Varma, *Fast Track Objective Arithmetic*, Arihant publications.							
Website and e-Learning Source		https://books.shunyafoundation.com/book-quantitative-aptitude-by-r-s-aggarwal-publishedby-s-chand-english/dp/ODTRGH2							

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: solve theproblems of Numbers, HCF, LCM, Square Roots & Cube Roots.

CLO 2: evaluate the problems of decimal Fractions, Simplification, Time & Distance.

CLO 3: find the solution of Surds and Indices, Percentage, Profit and Loss, Simple Interest and Compound Interest.

CLO 4: solve the problems of ratio and Proportion, partnership and Alligation or Mixture.

CLO 5: analyse theconcepts ofaverage, Problems on Age and Calendar.

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

Note: Internal Examination only

SEMESTER - II

<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"></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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA2C1</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>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">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">UNIT-I :</td><td colspan="6">Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Elements of Galois theory.
Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">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="2">UNIT-V :</td><td colspan="6">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 colspan="2">Title of the Course</td><td colspan="6">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA2C2</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>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2">UNIT-I :</td><td colspan="6">Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Integration of Functions of a Real variable - Integration of Non-negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">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>
<tr><td colspan="2">UNIT-V :</td><td colspan="6">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)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. 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 rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA2C3</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">4</td><td colspan="2">1</td><td>--</td><td>5</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">UNIT-I :</td><td colspan="6">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="2">UNIT-II :</td><td colspan="6">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="2">UNIT-III :</td><td colspan="6">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="2">UNIT-IV :</td><td colspan="6">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>
<tr><td colspan="2">UNIT-V :</td><td colspan="6">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</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	TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.
Reference Books	1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964. 2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983. 3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968. 4. M.D.Raisinghania, *Advanced Differential Equations,* S.Chand& Company Ltd., New Delhi, 2001. 5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

.

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

Title of the Course		ALGEBRAIC GEOMETRY					
Category	**DSE-III A**	**Year**	I	**Credits**	3	**Course Code**	**23MMA2E1**
		Semester	II				

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

Pre-requisite	UG level Algebra concepts
Objectives of the Course	The aim of this course is to develop basic algebraic tools to explore the geometry of these varieties. We will build up a dictionary between geometric properties of varieties and numerical invariants of equations.
UNIT-I	Commutative Algebra Nakayama lemma – Hilbert basis theorem – localization – Noetherian graded rings – Euler and Taylor identities – homogeneous localization – Krull and Chevally dimensions – Hilbert-Samuel polynomial – dimension theorem – Krull's principal ideal theorem – dimension of polynomial rings. **Chapter 1. Sections 10 to 14**
UNIT-II	Commutative Algebra (Contd….) Generalities – going up theorem – Noether's normalization lemma – Hilbert's Nullstellensatz – regular ring and UFDs – criteria for normality – relative normalizations – towards Zariski's main theorem – Schmidt and Lüroth's theorems – elimination theory. **Chapter 1 : Sections 15 to 18**
UNIT-III	Affine Varieties - Affine algebraic sets – regular functions – irreducible algebraic sets – affine varieties – complete intersections – finite sets and curves – surfaces and solids. **Chapter 2: Sections 21 to 26.2**
UNIT-IV	Affine Varieties (Contd...) Linear varieties – determinantal varieties – group varieties – morphisms – rational morphisms – birational equivalence – products. **Chapter 2: Sections 26.3 to 28**
UNIT-V	Projective Varieties Terminology – projective Algebraic sets – homogenisation / dehomogenisation – projective closures – morphisms – products – complete varieties **Chapter 3: Sections 31 to 37**
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	Musli, "*Algebraic Geometry for Beginners*", Text and Readings in Mathematics Vol.20, Hindustan Book Agency (India), New Delhi, 2001.
Reference Books	1. N. Bourbaki, "*Commutative Algebra"*, Chapters 1-7, Springer, 1985. 2. D. Bump, "*Algebraic Geometry"*, World Scientific, Singapore, 1998. 3. D. Eisenbud, "*Commutative Algebra with a view towards Algebraic Geometry"*, GTM Vol. 150, Springer, 1995.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: learn Commutative Algebraic structures and some familiar theorems.

CLO 2: learn about the normalization, relative normalizations, Zariski's main theorem, Schmidt and Lüroth's theorems.

CLO 3: defineaAffine algebraic sets, regular functions, affine varieties, curves and surfaces.

CLO 4:Know the different types of varieties and morphisms.

CLO 5 : Understand the Projective Varieties Terminology, projective closures and products.

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

<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"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-III B</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">23MMA2E2</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">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Probability & statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">The main objectives of this course are to: Enables to learn different aspects of statistics. Acquire knowledge about moments and properties of theoretical distributions. Study unbiasedness and consistency of limiting distributions</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="8">Probability and Distributions - Introduction - Set Theory - The Probability Set Function - Conditional Probability and Independence –Random Variables - Discrete Random Variables- Continuous Random Variables
Chapter 1:Sections 1.1 to 1.7</td></tr>
<tr><td colspan="2">UNIT-II</td><td colspan="8">Probability and Distributions (continued) and Multivariate Distributions Probability and Distributions: Expectation of a Random Variables - Some Special Expectations - Important Inequalities. Multivariate Distributions: Distributions of Two Random Variables - Transformations: Bivariate Random Variables - Conditional Distributions and Expectations - Independent Random Variables.
Chapter 1 &2 : Sections 1.8 –to 1.10, 2.1 to 2.3, 2.5</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="8">Some Special Distributions - The Binomial and Related Distributions - The Poisson Distribution - The Γ, $\chi 2$, and β Distributions - The Normal Distribution.
Chapter 3 : Sections 3.1 to 3.4</td></tr>
<tr><td colspan="2">UNIT-IV</td><td colspan="8">Some Special Distributions (continued), Unbiasedness, Consistency and Limiting Distributions - Some Special Distributions (continued): t and F-Distributions. Unbiasedness, Consistency and Limiting Distributions: Expectations of Functions - Convergence in Probability - Convergence in Distribution - Central Limit Theorem.
Chapter 3& 4: Sections 3.6, 4.1 to 4.4</td></tr>
<tr><td colspan="2">UNIT-V</td><td colspan="8">Some Elementary Statistical Inferences- Sampling and Statistics – More on Confidence Intervals - Introduction to Hypothesis Testing - Additional Comments About Statistical Tests - Chi-Square Tests – The Method of Monte Carlo.
Chapter 5: Sections 5.1, 5.4 to 5.8</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	Robert V. Hogg, Allen T. Craig and Joseph W. McKean, Introduction to Mathematical Statistics, Sixth Edition, Pearson Education, 2005.
Reference Books	1. K. L. Chung, A course in Probability, Academic Press, New York, 1974. 2. R. Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996. 3. Y. S. Chow and H. Teicher, Probability Theory, 2nd Edition, Springer Verlag, Berlin, 1988
Website and e-Learning Source	https://nptel.ac.in/courses/111/104/111104032/ https://nptel.ac.in/courses/111/105/111105090 https://nptel.ac.in/courses/111/101/111101004

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Remembering the understanding the basic concepts such as statistics, probability and random variables.

CLO 2: Applying the concepts and methods to find the moments of the distributions.

CLO 3: Study multivariate distributions and the independence of random variables. Further evaluating the marginal distributions from bivariate distributions.

CLO 4 :Analyze and study the properties of some discrete as well as continuous distributions

CLO 5 : Understand the convergence of distributions and central limit theorem.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">TENSOR ANALYSIS AND RELATIVITY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-III C</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>23MMA2E3</td></tr>
<tr><td>Semester</td><td>II</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>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Analysis and Mechanics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The aim of this course is to develop basic invariance tools to explore the tensors of varieties. We will build up a special theory and relativity.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">Invariance - Transformations of coordinates and its properties - Transformation by invariance - Transformation by covariance and contra variance - Covariance and contra variance - Tensor and Tensor character of their laws - Algebras of tensors - Quotient tensors - Symmetric and skew symmetric tensors – Relative tensors.
Chapter 2: Sections 18 to 28 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Metric Tensor - The fundamental and associated tensors - Christoffel's symbols - Transformations of Chrisffel's symbols- Covariant Differentiation of Tensors - Formulas for covariant Differentiation- Ricci Theorem - Riemann -Christoffel Tensor and their properties.
Chapter 2: Sections 29 to 37 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Einstein Tensor- Riemannian and Euclidean Spaces (Existence Theorem) – The esystems and the generalized Kronecker deltas - Application of the e-systems.
Chapter 2: Section 38 to 41 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Special Theory of Relativity: Galilean Transformation - Maxwell's equations - The ether Theory – The Principle of Relativity Relativistic Kinamatics : Lorentz Transformation equations - Events and simultaneity - Example Einstein Train - Time dilation - Longitudinal Contraction - Invariant Interval - Proper time and Proper distance – World line - Example - twin paradox - addition of velocities - Relativistic Doppler effect.
Chapter 7: Sections 7.1 and 7.2 of Text Book 2</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Relativistic Dynamics : Momentum – energy – Momentum-energy four vector – Force – Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations. Accelerated Systems: Rocket with constant acceleration – example – Rocket with constant thrust.
Chapter 7: Sections 7.3 and 7.4 of Text Book 2</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	1. I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York, 1964. 2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.
Reference Books	1. J.L. Synge and A.Schild, Tensor Calculus, Toronto, 1949. 2. A.S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1930. 3. P.G. Bergman, An Introduction to Theory of Relativity, New york, 1942. 4. C.E. Weatherburn, Riemannian Geometry and Tensor Calculus, Cambridge, 1938.
Website and e-Learning Source	https://www.f.waseda.jp/sidoli/Einstein_Relativity.pdf https://web.math.princeton.edu/~nelson/books/ta.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Understand tensor algebra and its applications in applied sciences and engineering.

CLO 2: Know the fundamental mathematics of tensor that are important for higher learning

CLO 3: Work with some tools in branches of applied mathematics, physics and geophysics

CLO 4: Demonstrate knowledge and broad understanding of Special Relativity. Explain the meaning and significance of the postulate of Special Relativity.

CLO 5: Explain true nature of Lorentz transformation and Doppler Effect. Explain relativistic momentum and Einstein field equations.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-IV A</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">23MMA2E4</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>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">UG level calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The aim of this course is to obtain thorough analysis of various aspects of calculus of variations. To acquire the knowledge of solving problems in the fields of mechanics and mathematical physics.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">(CALCULUS OF VARIATIONS)
The method of variations in problems with fixed boundaries.
(hapter 6 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Vibrational problems with moving boundaries and certain other problems – Sufficient condition for an extremum.
Chapter 7&8 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Variational Problems Involving a Conditional Extremum - Direct Methods in Variational Problems.
(Chapter 9&10 of Text Book 1)</td></tr>
<tr><td colspan="2">UNIT-IV :(</td><td colspan="6">INTEGRAL EQUATIONS)
Linear Integral Equations - Definition, Regularity conditions - special kind of kernels - eigen values and eigen functions - convolution Integral - the inner and scalar product of two functions - Notation - reduction to a system of Algebraic equations - examples – Fredholm alternative - examples - an approximate method.
Chapter 1&2 of Text Book 2</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Method of successive approximations: Iterative scheme - examples - Volterra Integral equation - examples - some results about the resolvent kernel. Classical Fredholm Theory: the method of solution of Fredholm - Fredholm’s first theorem - second theorem - third theorem.
Chapter 3&4 of Text Book 2</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">1.L. Elsgolts, Differential equations and the calculus of variations, University Press of the Pacific, 2003.
2.Ram. P. Kanwal - Linear Integral Equations Theory and Practice, Birkhauser Boston, 2012.</td></tr>
</table>

Reference Books	1. S.G.Mikhlin, Linear Integral Equations, Hindustan Publishing Corp. Delhi,1960. 2 L.A.Pars, An Introduction to the Calculus of Variations, Heinemann, London, 1965. 3 R.Weinstock, Calculus of Variations with Applications to Physics and Engineering, McGraw-Hill Book Company Inc. New York, 1952.
Website and e-Learning Source	https://www.researchgate.net/file.PostFileLoader.html?id=56c4564d5cd9e3c https://www.researchgate.net/profile/AndreiPolyanin/publication/275518932

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO 1: Understand the concepts of calculus of variation and its properties

CLO 2: Use Euler's equation to solve various types of variational problems with fixed boundaries.

CLO 3: Modify the Euler's formula for a class of curves with moving boundary points. Also Derive sufficient conditions based on second variation

CLO 4 : solvethe problems related with reflection and refraction, diffraction of light rays. Classify Fredholm, Volterra and singular type integral equations

CLO 5:solve integral equations using Fredholm theorem, Fredholm Alternative theorem and method of successive approximations. Understand the classical Fredholm theory

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

Title of the Course		**WAVELETS**					
Paper Number							
Category	**DSE-IV B**	**Year**	I	**Credits**	3	**Course Code**	**23MMA2E5**
		Semester	II				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		4	1	--	5		
Pre-requisite		UG level Transform Techniques					
Objectives of the Course		The aim of this course is to develop the Fourier transform techniques and Z transforms techniques.					
UNIT-I		**The Discrete Fourier Transforms:** Basic properties of the Discrete Fourier Transform – Translation – invariant Linear Transformations. **Chapter 2 : Sections 2.1 to 2.3**					
UNIT-II :		**Wavelets on Z_N:** Construction of Wavelets on Z_N :The first stage – Construction on Wavelets on Z_N :The iteration setp. **Chapter 3 : Sections 3.1 and 3.2**					
UNIT-III		**Wavelets on Z :** $\ell^2(Z)$ – complete orthonormal sets in Hilbert spaces - $L^2[-\pi, \pi]$ and Fourier Series. **Chapter 4 : Sections 4.1 to 4.3**					
UNIT-IV :		**Wavelets on Z (Continued):** The Fourier Transform and Convolution on $\ell^2(Z)$ - First-Stage Wavelets on Z -The Iteration Step for Wavelets on Z. **Chapter 4 : Sections 4.4 to 4.6**					
UNIT-V:		**Wavelets on R:** L^2 (R) and Approximate Identities -The Fourier Transform on R - Multiresolution Analysis and Wavelets - Construction of Multiresolution Analyses -Wavelets with Compact Support and Their Computation. **Chapter 5 : Sections 5.1 to 5.5**					
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		Michael W Fraier, An Introduction to Wavelets through Linear Algebra, Springer verlag, Berlin, 1999					

Reference Books	1. C.K. Chui, An Introduction to Wavelets, Academic Press, 1992 2. E. Hernande and G.Weiss, A First Course in Wavelets, CRC Press, NY 1996. 3. D.F. Walnut, Introduction to Wavelet Analysis, Birkhauser, 2004
Website and e-Learning Source	https://inst.eecs.berkeley.edu/~ee225b/sp14/lectures/shorterm.pdf http://math.bu.edu/people/mkon/Wavelets.pdf http://disp.ee.ntu.edu.tw/tutorial/WaveletTutorial.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: know the Discrete Fourier Transforms.
CLO 2: solve the problems in Wavelets on Z_N.
CLO 3: solve the Wavelets on Z.
CLO 4:create a new one Wavelets on Z
CLO 5: solve and create the Wavelets on R.

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

<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"></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">23MMA2E6</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>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">The aim of this course is to develop about Machine Intelligence and Machine Learning applications. To implement and apply machine learning algorithms to real-world applicationsand apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.</td></tr>
<tr><td colspan="2">UNIT-I :</td><td colspan="8">Introduction:Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="8">Neural Networks and Genetic Algorithms:
Neural Network Representation – Problems – Perceptron’s – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms– Hypothesis Space Search – Genetic programming –Models of Evaluation and Learning</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="8">Bayesian and Computational Learning:
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="8">Introduction- Intelligent Agents : Problem Solving - by Searching - Informed Search Strategies-Optimization Problems - Adversarial Search-Knowledge and Reasoning - Logical Agents - First-Order Logic - Inference in First-Order Logic - Knowledge Representation.</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="8">Planning – Planning and Acting in the Real World - Uncertain knowledge and reasoning - Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Tom M. Mitchell,Machine Learning, McGraw-Hill Education (India) Private Limited, 2013. 2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Third Edition, Prentice Hall of India, New Delhi, 2010.
Reference Books	1. Ethem Alpaydin,—Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004. 2. Stephen Marsland,—Machine Learning: An Algorithmic Perspective, CRC Press,2009. 3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, Andreas Beham, —Genetic Algorithms and Genetic Programming‖,CRC Press Taylor and Francis Group. 4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017. 5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002.
Website and e-Learning Source	https://inst.eecs.berkeley.edu/~ee225b/sp14/lectures/shorterm.pdf http://math.bu.edu/people/mkon/Wavelets.pdf http://disp.ee.ntu.edu.tw/tutorial/WaveletTutorial.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc

CLO 2: appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.

CLO 3: Be able to design and implement various machine learning algorithms in a range of real-world applications.

CLO 4:understand the computation intelligence.

CLO 5: apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

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

SKILL ENHANCEMENT COURSE : (Internal Paper)

<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"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC-II</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">23MMA2SP</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>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The aim of this course is to make the students learn the art of typing mathematics text on their own. To inculcate professional training required to become a scholar in mathematics.</td></tr>
<tr><td colspan="2">UNIT- I</td><td colspan="6">Introduction - Text formatting, TEX and its offspring, What's different in LATEX 2ϵ, Distinguishing LaTex 2ϵ, Basics of a LaTex file.</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Commands and Environments - Command names and arguments, Environments, Declarations, Lengths, Special Characters – Spaces and carriage returns, Quotation marks, Hyphens and dashes, Printing command characters.</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Document Layout and Organization, Displayed Text - Document class, Page style, Parts of the document, Table of contents – Automatic entries, Printing the table of contents, Fine-Tuning text – Line breaking, Page breaking. Displayed Text – Changing font – Emphasis, Choice of font size, Font attributes, Centering and indenting, Lists.</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Displayed Text (Continued) - Tables, Printing literal text, Footnotes and marginal notes.</td></tr>
<tr><td colspan="2">UNIT – V</td><td colspan="6">Mathematical Formulae - Mathematical environments, Main elements of math mode, Mathematical symbols – Greek letters, function names, Additional elements, Fine–tuning mathematics – Horizontal spacing, Selecting font size in formulas.</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">Reference Books</td><td colspan="6">1. Leslie Lamport. LATEX: A Document Preparation System, Addison-Wesley, Reading, Massachusetts, second edition, 1994.
2. Helmut Kopka and Patrick W. Daly, A Guide to LATEX, Third Edition, Addison – Wesley, London,1999.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mirrors.ctan.org/info/lshort/english/lshort.pdf
https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
https://docs.kde.org/trunk4/en/extragear_office/kile/quick-using.html
https://www.ctan.org/tex-archive/info/simplified-latex/</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO 1: Understand basic concepts of Text formatting and LaTex file

CLO 2: Demonstrating command names and arguments, Special characters.

CLO 3: Apply the commands to create document layout and displayed output

CLO 4: Create Table, Printing Text, Foot notes and marginal notes
CLO 5 : Apply LaTex commands to mathematical formulae

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

Note: Internal Examination only

ABILITY ENHANCEMENT COURSE: (Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICS FOR COMPETITIVE EXAMINATION - II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">AECC-II</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">23MMA2AP</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>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To update the skills in numerical and quantitative techniques. Able to critically evaluate various real life situations by resorting to Analysis of key issues and factors. Able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">Chain Rule – Pipes and Cisterns – Time and work.
Chapters 15, 16, 17 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Boats and Streams –Area and Surface area - Volume
Chapters 19, 20, 24, 25 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Clocks – Stock and Shares – Permutation and Combination.
Chapters 28, 29, 30 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">True Discount – Banker’s Discount – Height and Distance –Odd Man Out and series.
Chapters 32, 33, 34, 35 of Text Book 1</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">NON - VERBAL REASONING
Series – Analogy – Analytical Reasoning.
Chapters 1, 2 & 4 of Text Book 2</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. Dr.R.S.Aggarwal, Quantitative Aptitude for Competitive Examinations ,S.Chand& Company Ltd, New Delhi -2021.
2. Dr.R.S.Aggarwal, A modern Approach to Verbal & Non – verbal Reasoning, S.Chand& Company Ltd, New Delhi -2013.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1.Arun Sharma ,Quantitative Aptitude, Mc-Grawhill publications.
2. Rajesh Varma, “Fast Track Objective Arithmetic”, Arihant publications.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">https://books.shunyafoundation.com/book-quantitative-aptitude-by-r-s-aggarwal-publishedby-s-chand-english/dp/ODTRGH2</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: solve the problems in Chain Rule, Pipes and Cisterns, and Time and work.

CLO 2: find the solution ofBoats and Streams, Area and Surface area and Volume**.**

CLO 3: evaluate the problems ofClocks, Stock and Shares, Permutation and Combination.

CLO 4: get the knowledge inTrue Discount, Banker’s Discount, Height and Distance and Odd Man Out and series.

CLO 5: analyse about the Series , Analogy and Analytical Reasoning.

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

Note: Internal Examination only

SEMESTER-III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">COMPLEX ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA3C1</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Complex Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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">UNIT-I :</td><td colspan="6">Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:
Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3& Section 3 : 3.1 to 3.4</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">The general form of Cauchy's Theorem :Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7 & Section 5: 5.1 and 5.2</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Evaluation of Definite Integrals and Harmonic Functions:Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3&Sections 6 : 6.1 to 6.3</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Harmonic Functions and Power Series Expansions:
Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .
Chapter 4 : Sections 6.4 and 6.5& Sections 1.1 to 1.3</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem
Chapter 5 : Sections 2.1 to 2.4 & Sections 3.1 and 3.2</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>
</table>

Recommended Text	Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
Reference Books	1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 3. E. Hille, *Analytic function Thorey*(2 vols.), Gonm& Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

CLO4: Develop Taylor and Laurent series .

CLO5 Explain the infinite products, canonical products and jensen'sformula .

	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">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA3C2</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">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">UNIT-I :</td><td colspan="6">Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2 : Sections 2.1 to 2.9</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8</td></tr>
<tr><td colspan="2">UNIT-III:</td><td colspan="6">Characteristic functions :Properties of characteristic functions – Characteristic functions and moments – semi invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4 : Sections 4.1 to 4.7</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5 :SectionS 5.1 to 5.10</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12.
(Omit Sections 6.5, 6.10,6.13 to 6.15)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	M. Fisz, *Probability Theory and Mathematical Statistics,* John Wiley and Sons, New York, 1963.
Reference Books	1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972 2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974. 4. R.Durrett, *Probability : Theory and Examples*, (2^{nd} Edition) Duxbury Press, New York, 1996. 5. V.K.Rohatgi*An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3^{rd} Print). 6. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999. 7. B.R.Bhat , *Modern Probability Theory* (3^{rd} Edition), New Age International (P)Ltd, New Delhi, 1999
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE IX</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">23MMA3C3</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">4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2">UNIT-I :</td><td colspan="8">Topological spaces :Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.
Chapter 2 : Sections 12 to 17</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="8">Continuous functions: Continuous functions – the product topology – The metric topology.
Chapter 2 : Sections 18 to 21 (Omit Section 22)</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="8">Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness.
Chapter 3 : Sections 23 to 25.</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="8">Compactness :Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="8">Countability and Separation Axiom:
The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)</td></tr>
</table>

Reference Books	1. J. Dugundji ,*Topology* , Prentice Hall of India, New Delhi, 1975. 2. George F.Sinmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963 3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York 4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970. 5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

	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		INDUSTRIAL STATISTICS					
Paper Number		CORE X					
Category	Core	Year	II	Credits	3	Course Code 23MMA3C4	
		Semester	III				

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

Pre-requisite	UG Level Statistics
Objectives of the Course	To introduce Statistical inference, sufficient statistics and learn the Maximum likelihood estimators and discuss the theory of statistical tests.
UNIT-I :	**Introduction to statistical Inference:** Point estimation – confidence intervals for means – confidence intervals for differences of means – test of statistical hypothesis – Additional comments about statistical tests – Chi-Square tests. **Chapter - 6**
UNIT-II	**Sufficient Statistics:** Measures of Quality of Estimators – a sufficient statistic for a parameter– properties of a sufficient statistic – completiness and uniqueness the exponential class of probability density – functions of a parameter. **Chapter – 7 : Sections 7.1 to 7.6**
UNIT-III:	**More about estimation:** Bayesian Estimation – Fisher Information and the Rao – Cramer inequality Limiting Distributions of Maximum Likelihood estimators. Robust M –Estimation. **Chapter – 8**
UNIT-IV	**Theory of statistical tests:** Certain Best tests – Uniformly most powerful tests – Likelihood Ratio Tests – the sequential probability Ratio Test. **Chapter – 9 :Sections 9.1 to 9.4**
UNIT-V:	**Inferences about Normal Models:** The distributions of certain Quadratic forms – A test of the equality of several means – Noncentral χ^2 and noncentral F – multiple comparisons – The analysis of variance – A regression problem – A test of independence. **Chapter – 10 : Sections – 10.1 to 10.7**
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	Robert V. Hogg, Allen T. Craig, Introduction to Mathematical Statistics, Fifth Edition, Pearson Education, 2005.

Reference Books	1. V.K.Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1998 (3rd Print) 2.M.Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963 3. Y. S. Chow and H. Teicher, Probability Theory, 2nd Edition, Springer Verlag, Berlin, 1988.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://www.probability.net

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to
CLO 1: learn Point estimation, confidence intervals for means, confidence intervals for differences of means and test of statistical hypothesis.

CLO 2: explain about the measures of Quality of Estimators and a sufficient statistic for a parameter– properties of a sufficient statistic.

CLO 3: discuss the Bayesian Estimation, Fisher Information and the Rao, Cramer inequality Limiting Distributions of Maximum Likelihood estimators.

CLO 4: understand theCertain Best tests, Uniformly most powerful tests and the Likelihood Ratio Tests – the sequential probability Ratio Test.

CLO 5: learn the distributions of certain Quadratic forms, Noncentral χ^2 and noncentral F – multiple comparisons and the analysis of variance – A regression problem – A test of independence.

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

Title of the Course		**ALGEBRAIC NUMBER THEORY**					
Paper Number							
Category	**DSE-VA**	**Year**	II	**Credits**	3	**Course Code**	**23MMA3E1**
		Semester	III				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	1		--	5	
Pre-requisite		UG level Algebra and Number theory					
Objectives of the Course		The aim of this course is to develop the knowledge in Algebraic Number theory, particularly Rings, Fields, Modules, Conjugate, Discriminant, Algebraic integers, Norms, traces, Quadratic fields and factorization.					
UNIT-I		Algebraic back ground : Rings and Fields – Factorization of Polynomials – Field extensions – Symmetric polynomials – Modules – Free Abelian groups. **Chapter 1 : Sections – 1.1 to 1.6**					
UNIT-II :		Algebraic numbers – Conjugate and Discriminant – Algebraic integers. **Chapter 2 : Sections 2.1 to 2.3**					
UNIT-III		Integral bases – Norms and traces – Rings of integers **Chapter 2 : Sections 2.4 to 2.6**					
UNIT-IV :		Quadratic fields – Cyclotomic fields **Chapter 3 : Sections 3.1 to 3.2**					
UNIT-V:		Historical background – trivial factorization – factorization into irreducible **Chapter 4 : Sections 4.1 to 4.3**					
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		I.Stewart and D.Tall, "Algebraic number theory and Fermat's Last theorem (3rd edition), A.K Peters Ltd., Natick.					
Reference Books		1. Z. I. Borevic and I.R.Safarevic, Number theory, Academic Press, NY, 1966. 2. J.W.S.cassels and A.Frohlich, Algebraic , Number theory, Academic Press, New York,1967. 3. P. Ribenboim, Algebraic numbers, Wiley, New York, 1972.					
Website and e-Learning Source		http://www.math.toronto.edu/~ila/Neukirch_Algebraic_number_theory.pdfhttps://www.pdfdrive.com/download.pdf?id=188938191&h=4d0f9c871d3eb0					

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: define ring,field, Modules and polynomials.

CLO 2: learn the algebraic numbers, Conjugate and Discriminant and Algebraic integers.

CLO 3: know the Integral bases, Norms and traces and Rings of integers.
CLO 4: the Quadratic fields and Cyclotomic fields.
CLO 5 : Historical background, trivial factorization and factorization into irreducible.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FLUID DYNAMICS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-V B</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">23MMA3E2</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Mechanics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The aim of this course is to develop knowledge in fluid dynamics of real fluids, Ideal fluids, Velocity of a fluid at a point, Stream lines, path lines, Unsteady flows, The equation of Continuity, different types of equations, Sources, Sinks, Doublets Images in rigid infinite plane, Stoke’s Stream Function, The Complex Velocity Potential for Two Dimensional Irrotational, Incompressible Flow, The Milne-Thomson Circle Theorem, The Coefficient of Viscosity, Laminar flow and The Navier-Stokes equation of a viscous fluid.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">Kinematics of fluids in motion:
Real fluids and Ideal fluids - Velocity of a fluid at a point - Stream lines 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.
Chapter 2: Sections 2. - 2.9</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Equations of Motion of a Fluid:
Pressure at a point in a fluid at rest - Pressure at a point in a moving fluid - Euler’s equations of Motion - Bernoulli’s equation - Worked Examples - Discussion of the case of steady motion under Conservative Body Forces -Some flows involving axial symmetry.
Chapter 3: Sections 3.1, 3.2, 3.4 - 3.7, 3.9</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Some Three-Dimensional Flows:
Introduction - Sources, Sinks and Doublets Images in rigid infinite plane - Images in solid spheres - Axis symmetric flows - Stoke’s Stream Function.
Chapter 4: Sections 4.1 - 4.5</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Some Two-Dimensional Flows:
The Stream Function - The Complex Velocity Potential for Two - Dimensional Irrotational, Incompressible Flow - Complex Velocity - Potentials for Standard Two-Dimensional Flows - Some Worked - Examples - Two Dimensional Image Systems - The Milne-Thomson - Circle Theorem.
Chapter 5: Sections 5.3-5.8</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Viscous Fluid:
Stress components in a real fluid - Relation between Cartesian - Components of Stress - Translational motion of fluid element – The Coefficient of Viscosity and Laminar flow - The Navier-Stokes equation of a viscous fluid - Some solvable problems in viscous flow - Steady motion between parallel planes only.
Chapter 8: Sections 8.1-8.3, 8.8, 8.9, 8.10.1</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	Frank Chorlton, Textbook of Fluid Dynamics, CBS Publishers & Distributors, 2004.
Reference Books	1.E.Karuse, Fluid Mechanics with Problems and Solutions, Springer, 2005. 2.R.W.Fox and A.T.McDonald, Introduction to Fluid Mechanics, Wiley, 1985.
Website and e-Learning Source	http://www.math.toronto.edu/~ila/Neukirch_Algebraic_number_theory.pdfhttps://www.pdfdrive.com/download.pdf?id=188938191&h=4d0f9c871d3eb0

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: teach the Real fluids and Ideal fluids ans derive the the equation of Continuity.

CLO 2: explain about pressure at a point in a fluid at rest, Euler's equations of Motion, Bernoulli's equation.

CLO 3: define Sources, Sinks, Doublets Images in rigid infinite plane, Axis symmetric flows and Stoke's Stream Function.

CLO 4: work the Stream Function, Complex Velocity, Potentials for Standard Two Dimensional Flows and derive the Milne-Thomson Circle Theorem.

CLO 5: derive the Stress components in a real fluid, Components of Stress, Translational motion of fluid element, The Coefficient of Viscosity, Laminar flow and The Navier-Stokes equation of a viscous fluid.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">STOCHASTIC PROCESSES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></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">23MMA3E3</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Probability concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Acquire the knowledge about the concept of Markov Chain and Queuing system. Understand the methods of birth and death queues with finite and infinite capacity. Develop the ability of Standard Brownian Motion</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">Stochastic Processes:
Some notions – Specification of Stochastic processes – Stationary processes – Markov Chains – Definitions and examples – Higher Transition probabilities – Generalization of independent Bernoulli trails.
Chapter 2 &3: Sections 2.1 to 2.3 and 3.1 to 3.3</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">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 3 Sections: 3.4 to 3.6, 3.8, 3.9,3.11</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">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 4: Sections 4.1 to 4.5</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Renewal processes and Theory:
Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald’s equation – Renewal theorems.
Chapter 6 :Sections 6.1 to 6.5</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Branching Processes:
Introduction – Properties of generating functions of Branching process – Probability of extinction – Distribution of the total number of progeny – Conditional Limit Laws due to Kolmogrov and due to Yaglom – Classical Galton-Watson Process - Bellman-Harris Process.
Chapter 9 :Sections 9.1 to 9.8</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	J. Medhi, Stochastic Processes, 2nd edition, Wiley Eastern, June 1987.
Reference Books	1. Samuel Karlin, Howard M. Taylor, A first course in stochastic processes, Academic press, Second Edition, 1975. 2. Narayan Bhat, Elements of Applied Stochastic Processes, John Wiley, 1972. 3. S.K. Srinivasan and K. Mehata, Stochastic Processes, Tata McGraw Hill, 1976. 4. N.V. Prabhu, Stochastic Processes, Macmillan (NY).
Website and e-Learning Source	http://home.ustc.edu.cn/~alex2014/SPpdf/Stochastic%20Processes%20SM. https://www.pdfdrive.com/download.pdf?id=187079740&h=9e25b152bf6e3c

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: study the specification of Stochastic processes, Stationary processes and Markov Chains

CLO 2: understand the concepts ofclassification of states and chains, stability of a Markov system and Markov chains with continuous state space.

CLO 3: learn the Poisson processes and their extensions, Birth and Death process and Markov processes with discrete state space (continuous time Markov Chains)

CLO 4 : define the Renewal process, Renewal processes in continuous time and Renewal Equation.

CLO 5 :study the Properties of generating functions of Branching process, Probability of extinction and Distribution of the total number of progeny.

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

SKILL ENHANCEMENT COURSE: (Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATLAB an Introduction</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></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">23MMA3SP</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><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 Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course provides basic fundamentals on MATLAB, primarily for numerical computing. To learn the characteristics of script files, functions and function files, two-dimensional plots and three-dimensional plots. To enhance the programming skills with the help of MATLAB and its features which allow to learn and apply specialized technologies.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT- I
Starting with Matlab - Creating arrays - Mathematical operations with arrays.
(Chapters : 1, 2, 3)</td></tr>
<tr><td colspan="6">UNIT-II :
Script files - Functions and function files.
(Chapters : 4, 6)</td></tr>
<tr><td colspan="6">UNIT-III
Two-dimensional plots - Three-dimensional plots.
(Chapters : 5, 9)</td></tr>
<tr><td colspan="6">UNIT-IV :
Programming in MATLAB.
(Chapter : 7)</td></tr>
<tr><td colspan="6">UNIT – V
Polynomials, Curve fitting and interpolation - Applications in numerical analysis.

(Chapters: 8, 9)</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">“MATLAB An Introduction with Application” by A. Gilat, John Wiley & Sons, Singapore, 2004.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">http://mirrors.ctan.org/info/lshort/english/lshort.pdf
https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO 1: Understand basic concepts of Text formatting and MATLAB file

CLO 2: Demonstrating command names and arguments, Special characters.

CLO 3: Apply the commands to create document layout and displayed output

CLO 4: Create Table, Printing Text, Foot notes and marginal notes

CLO 5 : Apply MATLAB commands to mathematical formulae

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

Note: Internal Examination only

ABILITY ENHANCEMENT COURSE: (Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">SUBJECTIVE SKILLS IN MATHEMATICS – I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">AECC</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">23MMA3AP</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">2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Basic Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To update the skills of Abstract Algebra, Linear Algebra, Differential equations, Sequences and series and Real Analysis.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="8">ABSTRACT ALGEBRA :
Groups -Subgroups – Cyclic Groups – Cosets and Lagrange's Theorem -Normal Subgroups and Quotient Groups – Isomorphism – Homomorphism -Rings – Isomorphism – Types of rings – Characteristic of a ring – Subrings – Ideals – Quotient rings- Maximal and Prime Ideals – Homomorphism of rings – Field of quotients of an Integral domain.</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="8">LINEAR ALGEBRA:
Vector Spaces – Subspaces – Linear Transformation – Span of a set- Linear Independence – Basis and Dimension – Rank and Nullity-Matrix of a Linear Transformation – Inner Product Space – Definition and examples – Orthogonality – Orthogonal complement-Algebra of Matrices – Types of Matrices – The inverse of a matrix – Elementary Transformations – Rank of a Matrix– Simultaneous linear equations- Characteristic Equation and Cayley – Hamilton theorem Eigen values and Eigen Vectors.</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="8">DIFFERENTIAL EQUATIONS
Exact Differential Equations – Equations of the first order but of higher degree – Equations solvable for p, x, y, clairaut's form –Linear Equation with constant coefficients-Linear equations with variable coefficients – Equations reducible to the linear equations – Simultaneous Differential Equations – First order and first degree – Simultaneous linear Differential Equations – Method of Variation of parameters.</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="8">SEQUENCES AND SERIES
Sequences – bounded sequences – Monotonic sequences – Convergent sequences – Divergent and Oscillating sequences – Cauchy sequences – infinite series – Comparison test –Kummer's test – Root test and Condensation test – Integral test – Alternating series – Absolute convergence.</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="8">REAL ANALYSIS
Sets and functions – Countable and Uncountable sets – Metric spaces – Bounded sets – Open sets - Subspace – Interior of a set – Closed sets – Closure – limit point – Dense sets – Completeness – Continuity – Homeomorphism – Uniform continuity-Connectedness – Compact Metric spaces – Compact subsets of R.</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Reference Books	Under Graduate Books
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

CLO 1: learn the concepts of Abstract Algebra.

CLO 2: understand the concepts of Linear Algebra.

CLO 3: solve the problems in Differential equation.

CLO 4: analysisthe concepts of Sequences and series.

CLO 5: understand the concepts of Real Analysis.

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

Note: Internal Examination only

SEMESTER-IV

<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 rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA4C1</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td>1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To 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">UNIT-I :</td><td colspan="6">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="2">UNIT-II :</td><td colspan="6">Hilbert Spaces:The definition and some simple properties– Orthogonalcomplements–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="2">UNIT-III :</td><td colspan="6">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="2">UNIT-IV :</td><td colspan="6">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="2">UNIT-V:</td><td colspan="6">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,IntroductiontoTopologyandModernAnalysis,McGrawHillEducation(India)Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India)Private Limited, NewDelhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International,1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, NewYork, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, NewDelhi, 2002.
Website and 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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DIFFERENTIAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE XII</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">23MMA4C2</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>4</td><td>1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear Algebra concepts and Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsic properties of surface and the differential geometry of surfaces are explored</td></tr>
<tr><td colspan="2">UNIT-I :</td><td colspan="6">Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.
Chapter I : Sections 1 to 9</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.
Chapter II: Sections 1 to 9</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.
Chapter II: Sections 10 to 18</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Non Intrinsic properties of a surface:
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.
Chapter III: Sections 1 to 8</td></tr>
<tr><td colspan="2">UNIT-V :</td><td colspan="6">Differential Geometry of Surfaces :
Compact surfaces whose points are umblics- Hilbert’s lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert’s Theorem – Conjugate points on geodesics.
Chapter IV : Sections 1 to 8</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	T.J.Willmore, *An Introduction to Differential Geometry,* Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)
RefereEce Books	1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry,* Interscience Publishers, 1963. 3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe *Elementary topics in Differential Geometry*,Under-graduate Texts in Mathematics, Springer - Verlag 1979.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2:Evaluate these concepts with related examples.

CLO3: Compose problems on geodesics.

CLO4: Recognize applicability of developable.

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

	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">MECHANICS</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">4</td><td rowspan="2">Course Code</td><td rowspan="2">23MMA4C3</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">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Calculus and Differential equations.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum, to study mechanics developed by Newton, Langrange, Hamilton Jacobi and Theory of Relativity due to Einstein.</td></tr>
<tr><td colspan="2">UNIT-I :</td><td colspan="6">Mechanical Systems : The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum
Chapter 1 : Sections 1.1 to 1.5</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Lagrange's Equations: Derivation of Lagrange's equations- Examples- Integrals of motion.
Chapter 2 : Sections 2.1 to 2.3</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">Hamilton's Equations : Hamilton's Principle - Hamilton's Equation - Other variational principle.
Chapter 4 : Sections 4.1 to 4.3</td></tr>
<tr><td colspan="2">UNIT – IV :</td><td colspan="6">Hamilton-Jacobi Theory :
Hamilton Principle function – Hamilton-Jacobi Equation - Separability
Chapter 5 : Sections 5.1 to 5.3</td></tr>
<tr><td colspan="2">UNIT-V :</td><td colspan="6">Canonical Transformation : Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.
Chapter 6 : Sections 6.1 to 6.3</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">D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.</td></tr>
</table>

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Demonstrate the knowledge of core principles in mechanics.

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

CLO3: Apply the variation principle for real physical situations.

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ADVANCED NUMERICAL ANALYSIS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE-VI A</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">23MMA4E1</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">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Numerical Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">Aim of the paper is to develop the knowledge transcendental and Polynomial Equations, System of Linear Algebraic Equations and Eigen Value Problems, Interpolation and Approximation, Differentiation and Integration and Ordinary Differential Equations.</td></tr>
<tr><td colspan="2">Unit – I:</td><td colspan="8">Transcendental and Polynomial Equations:
Iterationmethodsbasedonseconddegreeequation– Rateofconvergence–Iterationmethods– Methods forcomplexroots– Polynomial equations.
Chapter2: Sections 2.4 to 2.8</td></tr>
<tr><td colspan="2">Unit – II:</td><td colspan="8">System of Linear Algebraic Equations and Eigen Value Problems :
Directmethods–Triangularisation,CholeskyandPartitionmethods– Erroranalysis–Iteration methods – Eigen values and Eigenvectors – Jacobi”s method, Given”s method,Rutishaughermethodand Power method.
Chapter3: Sections 3.2 to 3.5</td></tr>
<tr><td colspan="2">Unit III :</td><td colspan="8">Interpolation and Approximation:HermiteInterpolations– PiecewiseandSplineInterpolation–Bivariateinterpolation– Approximation– Least Squareapproximation– Uniform approximation.
Chapter4: Sections 4.5 to 4.10</td></tr>
<tr><td colspan="2">Unit IV:</td><td colspan="8">Differentiation and Integration:NumericalDifferentiation– PartialDifferentiation– NumericalIntegrationmethodsbasedonundetermined coefficients – Double integration.
Chapter5:Sections 5.2,5.5, 5.6, 5.8, 5.11</td></tr>
<tr><td colspan="2">Unit V:</td><td colspan="8">Ordinary Differential Equations: Numericalmethods– Singlestepmethods–Multistepmethods–Predictor–Correctormethods.
Chapter 6: Sections 6.2 to 6.5</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	M.K.Jain,S.R.K.IyengarandR.K.Jain,NumericalMethodsForScientificandEngineeringComputation, 3rdEdition,New age International,1993.
Reference Books	1.S.D.CorteanddeBoor,ElementaryNumericalAnalysis–AnAlgorithmicapproach,3rd Edition, McGrawHillInternationalBookCompany, 1980. 2. JamesB.Scarboraugh,NumericalMathematicalAnalysis,Oxford&IBHPublishingCompany,New Delhi 3.F.B.Hildebrand,IntroductionToNumericalAnalysis, McGrawHill,NewYork,1956. .
Website and e-Learning Source	1. https://www.math.upenn.edu/~wilf/DeturckWilf. 2.https://web.archive.org/web/20120225082123 3. /http://kr.cs.ait.ac.th/~radok/math/mat7/stepsa.htm

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the Iterationmethodsbasedonseconddegreeequation, Rateof convergence and Polynomial equations.

CLO2: define the direct methods, Triangularisation, Cholesky and Partition methods, Eigen values and Eigen vectors, Jacobi"s method and Given"s method.

. **CLO 3:** study the Hermite Interpolations,Piecewise and Spline Interpolation, Bivariate Interpolation, Approximation and Least Square and Uniform approximation.

CLO 4:learn the Numerical Differentiation, Partial Differentiation and Numerical Integration methods based on undetermined coefficients.

CLO 5:discuss the single step methods, Multi step methods and Predictor–Corrector methods.

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

Title of the Course		**ALGEBRAIC TOPOLOGY**					
Paper Number							
Category	**DSE-VI B**	**Year**	**II**	**Credits**	3	**Course Code**	**23MMA4E2**
		Semester	IV				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	1		--	5	
Pre-requisite		UG level Algebra and Analysis					
Objectives of the Course		The aim of this course is to develop the knowledge in algebraic topology of Homotopy of paths, Fundamental Group, Fundamental Group of the circle, Deformation Retracts,Homotopy Type, Direct sums of Abelian Groups, Free Groups, The Fundamental Group of a wedge of circles, Homology of surfaces,constructing compactsurfaces, the Universal covering space and covering transformations.					
UNIT-I		Homotopy of paths - Fundamental Group – Covering space - The Fundamental Group of the circle – Retractions and Fixed points **Chapter 9: Sections 51 to 55**					
UNIT-II :		The Fundamental Theorem of Algebra – Borsuk–Ulam Theorem – Deformation Retracts and Homotopy Type – The Fundamental Group of S_n - Fundamental Groups of some surfaces. **Chapter 9 : Sections 56 to 60**					
UNIT-III		Direct sums of Abelian Groups – Free products of Groups – Free Groups – The Seifert–van Kampen Theorem – The Fundamental Group of a wedge of circles. **Chapter 11 : Sections 67 to 71**					
UNIT-IV :		Fundamental groups of surfaces – Homology of surfaces – cutting and pasting – The classification theorem – constructing compact surfaces. **Chapter 12 : Sections 74 – 78**					
UNIT-V:		Equivalence of covering spaces – The Universal covering space – covering transformations – Existence of covering spaces **Chapter 13 : Sections 79 to 82**					
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.R.Munkres, Topology, Pearson Education Asia , Second Edition 2002.					

Reference Books	1. M.K.Agoston, Algebraic topology – A First Course, Marcel Dekker, 1962. 2. Satya Deo, Algebraic Topology , Hindustan Book Agency, New Delhi, 2003. 3. M.Greenberg and Harper, Algebraic Topology – A First course, Benjamin/Cummings, 1981.
Website and e-Learning Source	https://pi.math.cornell.edu/~hatcher/AT/AT https://www.maths.ed.ac.uk/~v1ranick/papers/diecktop

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the quotient topology and their the identification works.

CLO 2: discuss on the concept of homotopy and homotopy equivalence of topological spaces.

CLO 3: compute the fundamental groups of standard topological spaces

CLO 4 :learn thoroughly covering homotopy theorem.

CLO 5:appreciate and deduce the important Brouwer's fixed point theorem.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FINANCIAL MATHEMATICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></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">23MMA4E3</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">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">In this course, the students are on posed to the basic concepts of Probability theory, The Central limit theorem. The concepts of Geometric Brownian motion, Option pricing. The derivatives of Blackschole formula and its applications. The concept of call option on Dividend paying securities, estimating the volatility parameter. The limitations of Arbitrage pricing, the portfolio selection problem.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">Stochastic Order Relations: First-Order Stochastic Dominance - Using Coupling to Show Stochastic Dominance - Likelihood Ratio Ordering -A Single-Period Investment Problem-Second-Order Dominance.
Chapter 10 : Sections 10.1 to 10.5</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">Optimization Models:Introduction- A Deterministic Optimization Model -Probabilistic Optimization Problems
Chapter 11 : Sections 11.1 to 11.3</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="6">Stochastic Dynamic Programming:The Stochastic Dynamic Programming Problem - Infinite Time Models - Optimal Stopping Problems.
Chapter 12 : Sections 12.1 to 12.3</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">Exotic Options: Introduction -Barrier Options - Asian and Lookback Options - Monte Carlo Simulation -Pricing Exotic Options by Simulation - More Efficient Simulation Estimators.
Chapter 13 : Sections 13.1 to 13.6</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Beyond Geometric Brownian Motion Models: Introduction -Crude Oil Data - Models for the Crude Oil Data - Final Comments.
Chapter 14 : Sections 14.1 to 14.4</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">Sheldon M.Ross, An Elementary Introduction to Mathematical Finance,2nd Edition Cambridge University press 2005</td></tr>
</table>

Reference Books	1. S.M.Ross, A First Course in Probability, Englewood cliffs N J Prentice Hall, 2002. 2. J.Cox,M.Rubinstein,Option Market , Englewood cliffsNJ, Prentice Hall,1985. 3. J.E.Ingersoll, Theory of Financial decision Making ,MD Rowerman of Little Fields, 1987.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: understand the first-Order Stochastic Dominance, a Single-Period Investment Problem and second-Order Dominance.

CLO 2: study Deterministic Optimization Model andProbabilistic Optimization Problems.

CLO 3: learnthe Stochastic Dynamic Programming Problem, Infinite Time Models and Optimal Stopping Problems.

CLO 4:discuss on Barrier Options with Simulation.

CLO 5 :study theCrude Oil Data and Models.

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

SKILL ENHANCEMENT COURSE: (Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MATHEMATICAL ECONOMICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8"></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">23MMA4SP</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">3</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">The aim of this course is to studythe knowledge in Mathematical concepts in Economics</td></tr>
<tr><td colspan="2">UNIT- I</td><td colspan="8">Introduction to Mathematical Economics
(Chapters : 1)</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="8">An introduction to Mathematical Economic Applications
(Chapter : 2)</td></tr>
<tr><td colspan="2">UNIT-III</td><td colspan="8">Applications of Matrix Theory to Linear Models
(Chapter : 4)</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="8">Multivariate Calculus: Theory
(Chapter: 5)</td></tr>
<tr><td colspan="2">UNIT – V</td><td colspan="8">Multivariate Calculus: Applications
(Chapter : 6)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Mathematical applications knowledge</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Mathematical Economics, Jeffrey Baldani,James Bradfieldand Robert W. Turner, The Dryden Press Harcourt Brace College Publishers, 1996.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="8">http://mirrors.ctan.org/info/lshort/english/lshort.pdf
https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

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

CLO 1: Understand basic concepts of economics concepts in Mathematics

CLO 2: knowing the applications of Mathematical Economics

CLO 3: understand the applications of Matrix Theory to Linear Models

CLO 4:understand the multivariate calculus concepts

CLO 5 :study the multivariate calculus applications

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

Note: Internal Examination only

ABILITY ENHANCEMENT COURSE:(Internal Paper)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SUBJECTIVE SKILLS IN MATHEMATICS – II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">AECC-III</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>23MMA4AP</td></tr>
<tr><td>Semester</td><td>IV</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>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>--</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To update the skills of Complex analysis, Statistics - I & II, Graph Theory and Operations Research.</td></tr>
<tr><td colspan="2">UNIT-I</td><td colspan="6">COMPLEX ANALYSIS
Functions of a Complex variable – Continuous functions – Differentiability – The Cauchy – Riemann equations – Analytic functions – Harmonic functions – Bilinear Transformations – Cross ratio – Fixed points-Complex integration – Definite integral – Cauchy’s Theorem – Cauchy’s Integral formula – Higher derivatives - Zeros of an analytic function Singularities-Residues – Cauchy’s Residue Theorem.</td></tr>
<tr><td colspan="2">UNIT-II :</td><td colspan="6">STATISTICS – I
Central Tendencies – Arithmetic Mean –Mode – Geometric Mean and Harmonic Mean – Measures of Dispersion -Moments – Skewness and Kurtosis -Correlation – Rank correlation Regression – Analysis of Time series – Time series – Components of a Time series – Measurement of Trends - Probability – Conditional Probability – Random variables – Discrete Random Variable – Continuous Random Variable – Mathematical Expectations – Moment Generating Function – Characteristic function.</td></tr>
<tr><td colspan="2">UNIT-III :</td><td colspan="6">STATISTICS – II
Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Sampling – Tests of Significance for large samples- Tests of Significance based on ‘t’ Distribution – F-Test – Test for Significance of an Observed sample correlation - Test based on Chi - Square Distribution – Chi - Square Test for Population variance – Chi - Square Test – To test the Goodness of fit – Test for Independence of Attributes – Analysis of Variance – One Criterion of Classification – Two Criteria of Classification – Three criteria of Classification – Latin Square.</td></tr>
<tr><td colspan="2">UNIT-IV :</td><td colspan="6">GRAPH THEORY:
Graphs – Degrees – Sub graphs – Isomorphism – Independent Sets and Coverings – Matrices – Dergee Sequences – Graphic sequences – Walks, Trials and Paths – Connectedness and Components – Blocks – Connectivey – Eulerian Graphs – Hamiltonian Graphs - Trees – Centre of a Tree – Matchings-Planer graphs and properties – Chromatic number.</td></tr>
</table>

	UNIT-V: **OPERATIONS RESEARCH** Origin and Development of O.R – Linear Programming problem – Mathematical formulation of the problem –Graphical solution method – Canonical and Standard forms of L.P.P – Simplex method - Artificial variables (Big M method – Two Phase method) Duality in linear programming – General primal and dual pair – Formulating a Dual problem – Primal – Dual pair in matrix form – Duality and Simplex method – Dual simplex method -Formulation of T.P. – Existence of solution in T.P. – Assignment problem – Introduction – Mathematical formulation of the problem – Test for optimality by using Hungarian method – Maximization case in Assignment problem.
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Reference Books	Under Graduate Books
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

CLO 1: understand the concepts of Complex Analysis.

CLO 2:learn the Statistical concepts

CLO 3: solve the problems in Statistics

CLO 4: update the concepts of Graph Theory.

CLO 5: solve the problems in Operations Research.

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

Note: Internal Examination only

Title of the Course		**PROJECT WITH VIVA VOCE**					
Paper Number		**CORE IVX**					
Category	Core	**Year**	II	**Credits**	3	**Course Code**	**23MMA4PR**
		Semester	IV				
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		4		--		--	4
Pre-requisite		UG Level Mathematics					

1.Question pattern for Skill Enhancement Course (SEC 1 & SEC 2):

Maximum Marks: 100

Part – A (10×2 = 20)

10 questions

Part – B (5×6 = 30)

Either (or) type 5 questions

Part – C (5×10 = 50)

Open choice 5 out of 8 questions

2. Question pattern for Ability Enhancement Course:

Maximum Marks = 100

100 Objective questions: 100×1=100

3. Internship report –Marks -Vivo-voce (25) + reports (50) + internal (25) = 100

4. Project Dissertation- Marks -Vivo-voce (50) + thesis (100) + internal (50) = 200