D.K.M COLLEGE FOR WOMEN

VELLORE-1

(AUTONOMOUS)

M.Sc Mathematics

SYLLABUS

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

[With effect from the year 2024 – 2025]

M.SC. MATHEMATICS

Programme Educational Objectives (PEOs)

PEO1: Attain Academic and Professional Excellence

Build a strong academic foundation and skill set that will enable success in higher education, competitive examinations, teaching, research, industry, and entrepreneurial ventures.

PEO2: Emerge as Empowered Individuals

Develop into confident, self-reliant, and economically independent women capable of applying scientific knowledge to enhance personal growth, family welfare, and community development.

PEO3: Advance Research and Innovation

Demonstrate the ability to investigate real-world challenges and contribute contextually relevant, research-driven, and innovative solutions across scientific disciplines.

PEO4: Uphold Ethical and Cultural Values

Adhere to high ethical standards, respect cultural diversity, and engage responsibly in scientific practices that contribute to a just and inclusive society.

PEO5: Respond to Societal and National Needs

Utilize scientific understanding to support public health, environmental conservation, and technological advancement, fostering inclusive regional and national progress.

PEO6: Exhibit Leadership and Social Responsibility

Lead scientific and community initiatives with integrity, inspire collaborative action, and actively contribute to positive social transformation at local and global levels.

PEO7: Engage in Lifelong and Global Learning

Pursue continuous personal and professional development while staying abreast of global trends, innovations, and interdisciplinary scientific advancements.

Programme Outcomes (POs)

PO1: Comprehend and Apply Scientific Knowledge

Acquire and apply core knowledge from scientific disciplines to understand natural phenomena, solve complex problems, and support innovation across various domains of life and industry.

PO2: Demonstrate Analytical and Critical Thinking

Develop the ability to think critically and analytically by formulating hypotheses, interpreting experimental results, evaluating scientific literature, and drawing evidence-based conclusions.

PO3: Exhibit Technical and Laboratory Competency

Gain proficiency in laboratory techniques, handling of scientific instruments, and use of software tools, while

adhering to safety protocols, accuracy, and reproducibility in experimental work.

PO4: Communicate Effectively

Present scientific concepts and findings clearly and coherently through oral presentations, technical writing, and the use of digital tools, adapting to both academic and professional contexts.

PO5: Uphold Ethical Values and Environmental Consciousness

Integrate ethical principles and environmental awareness into scientific practices, promoting sustainable solutions and a sense of accountability towards society and nature.

PO6: Engage in Lifelong Learning

Cultivate an inquisitive mindset and adaptability to emerging scientific advancements, technologies, and interdisciplinary approaches, thereby remaining relevant and competent throughout life.

PO7: Collaborate and Lead in Scientific and Social Contexts

Participate effectively in collaborative scientific projects and community-based activities, demonstrating leadership, decision-making, and commitment to women's empowerment and societal progress.

◈ Programme Specific Outcomes (PSOs) – M.Sc. Mathematics

PSO1: Mastery of Advanced Mathematics

Attain deep knowledge in advanced mathematical areas such as real and complex analysis, topology, algebra, and differential geometry.

PSO2: Research and Problem-Solving Skills

Formulate, analyze, and solve advanced mathematical problems and develop models applicable to scientific and technological fields.

PSO3: Integration of Theory and Computation

Apply theoretical concepts along with computational tools to carry out simulations, solve equations, and analyze data.

PSO4: Research and Innovation

Critically analyze current research, identify knowledge gaps, and contribute original work in mathematical sciences.

PSO5: Academic and Professional Communication

Effectively present mathematical research, theories, and solutions through academic writing, seminars, and publications.

PSO6: Ethical Practice and Cultural Sensitivity

Uphold ethical standards, academic integrity, and respect for diversity in all mathematical and professional practices.

PSO7: Career Advancement and Lifelong Learning

Prepare for advanced research, teaching, data science, actuarial science, and global opportunities through continuous self-improvement.

Department of Mathematics with effect from 2024-2025
CBCS PATTERN
The course of study and Scheme of Examination

S. No.	Part	Category	Ins. Hrs/ Week	Credit	Title of the paper	Maximum marks		
						CIA	Sem. Exam	Total
SEMESTER I								
1	Part I	Core Paper I	7	5	Algebraic Structures	25	75	100
2		Core Paper II	7	5	Real Analysis I	25	75	100
3		Core Paper III	6	4	Ordinary Differential Equations	25	75	100
4		Discipline Centric Elective-I	5	3	(Choose any one out of two) (a) Graph Theory and Applications (b) Number Theory and Cryptography	25	75	100
5		Discipline Centric Elective – II	5	3	(Choose any one out of two) (a) Mathematical Programming (b) Discrete Mathematics	25	75	100
			30	**20**				**500**
SEMESTER II								
6	Part I	Core Paper IV	6	5	Advanced Algebra	25	75	100
7		Core Paper V	6	5	Real Analysis II	25	75	100
8		Core Paper VI	6	4	Partial Differential Equations	25	75	100
9		Discipline Centric Elective-III	3	3	(Choose any one out of two) (a) Mathematical Statistics (b) Tensor Analysis and Relativity (c) R Programming Lanquage (only Practical)	25	75	100
10		Generic Elective – IV	3	3	(Choose any one out of two) (a) Difference Equations (b) Machine Learning and Artificial Intelligence	25	75	100
11	Part II	Skill Enhancement I	4	2	Mathematical documentation using LATEX	25	75	100
12		Compulsory Paper	2	2	Human rights	25	75	100
13		MOOC course/Self	-	2	Online course/Self Study Paper:Skill	-	-	-

		Study Paper			Enhancement in Algebra and Analysis			
			30	**26**				**700**
SEMESTER III								
14	Part I	Core Paper VII	6	5	Complex Analysis	25	75	100
15		Core Paper VIII	6	5	Probability Theory	25	75	100
16		Core Paper IX	6	5	Topology	25	75	100
17		Core Paper X	6	4	Mechanics(Core Industry Modules)	25	75	100
18		Discipline Centric Elective-V	3	3	(Choose any one out of two) (a) Algebraic Number Theory (b) Stochastic Processes (c) Fluid Dynamics	25	75	100
19	Part II	Skill Enhancement II	3	2	Professional communication skill : Term paper & Seminar Presentation (OR) Computational Mathematics using SageMath	25	75	100
20		Internship/ Industrial Activity	-	2	(Carried out in Summer Vacation at the end of I year–30 hours) Summer Internship Report to be submitted to the Department.	-	-	-
			30	**26**				**600**
SEMESTER IV								
21	Part I	Core Paper XI	6	5	Functional Analysis	25	75	100
22		Core Paper XII	6	5	Differential Geometry	25	75	100
23		Core Project	10	7	Project with viva-voce	25	75	100
24		Elective – VI	4	3	(Choose any one out of two) (a) Resource Management Techniques (b) Modeling and Simulation with excel	25	75	100
25	Part II	Skill Enhancement Course/ Professional Competency Skill	4	2	Professional Competency Skill Enhancement Course 1.Training for Competitive Examinations Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours) 2.General Studies for UPSC / TNPSC /Other Competitive Examinations	25	75	100

					(2 hours) OR Mathematics for Advanced Research Studies (4 hours)- Research Tools and Techniques			
26	Part III		-	1	Extension activity	-	-	-
			30	**23**				**500**
		Total	**120**	**95**				**2300**

Consolidated Table for Credit Distribution

	Category of Courses	**Credits for each courses**	**Number of Courses**	**Number of Credits in each Category of courses**	**Total Credits**	**Total Credits for the Programme**
Part I	Core Theory	5	9	45	82	92(CGPA)
		4	3	12		
	Project with viva-voce	7	1	7		
	Discipline centric/Generic centric elective	3	6	18		
Part II	Skill Enhancement	2	3	6	10	
	Human rights	2	1	2		
	MOOC course	2	1	2		
	Summer Internship	2	1	2	3	3(Non CGPA)
Part III	Extension activity	1	1	1		

Total 95 Credits for PG Courses

Internal Assessment

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

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

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

Question paper Model

Intended Learning Skills	**Maximum 75 Marks** **Passing Minimum: 50%** **Duration : Three Hours**
	Part – A (5 x 6 = 30 Marks) **Answer ALL questions** **Each questions carries 5 Marks**
Descriptions/ Application (problems)	**Either-or Type** Both parts of each question from the same UNIT
	Question 1(a) or 1(b) To **Question 5(a) or 5(b)**
	Part-B (3x 15 = 45 Marks) **Answer any THREE questions** **Each question carries 10 Marks**
Analysis /Synthesis / Evaluation	There shall be FIVE questions covering all the five units
	Question 6 to Question 10

Each question should carry the course outcome and cognitive level

For instance,

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">ALGEBRAIC STRUCTURES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">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">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Modern Algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).
Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)</td></tr>
<tr><td colspan="8">UNIT-II : Solvable groups - Direct products - Finite abelian groups- Modules
Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5</td></tr>
<tr><td colspan="8">UNIT-III : Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.
Chapter 6: Sections 6.4, 6.5</td></tr>
<tr><td colspan="8">UNIT-IV : Jordan form - rational canonical form.
Chapter 6 : Sections 6.6 and 6.7</td></tr>
<tr><td colspan="8">UNIT-V: Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.
Chapter 6 : Sections 6.8, 6.10 and 6.11 (Omit 6.9)</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="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">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

Title of the Course	**REAL ANALYSIS I**
Paper Number	**CORE II**

<table>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>6</td><td>1</td><td>--</td><td>7</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="4">UG level real analysis concepts</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="4">To work comfortably with functions of bounded variation, Riemann-Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence and its interplay between various limiting operations.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="4">UNIT-I : Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8
Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.
Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18</td></tr>
<tr><td colspan="4">UNIT-II : The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler’s summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.
Chapter - 7 : Sections 7.1 to 7.14</td></tr>
<tr><td colspan="4">UNIT-III : The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals. Chapter - 7 : 7.15 to 7.26</td></tr>
</table>

	UNIT-IV : Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series – Cesaro summability - Infinite products. **Chapter - 8 Sec, 8.20, 8.21 to 8.26** **Power series** - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem **Chapter 9 : Sections 9.14 9.15, 9.19, 9.20, 9.22, 9.23**
	UNIT-V: Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence. **Chapter -9 Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="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"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td>Lab Practice
--</td><td>Total
6</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="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I : Linear equations with constant coefficients
Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.
Chapter 2: Sections 1 to 6</td></tr>
<tr><td colspan="6">UNIT-II : Linear equations with constant coefficients
Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation-Algebra of constant coefficient operators.
Chapter 2 : Sections 7 to 12.</td></tr>
<tr><td colspan="6">UNIT-III : Linear equation with variable coefficients
Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.
Chapter : 3 Sections 1 to 8 (Omit section 9)</td></tr>
<tr><td colspan="6">UNIT-IV :Linear equation with regular singular points
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel Function.
Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)</td></tr>
<tr><td colspan="6">UNIT-V : Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.
Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.
Reference Books	1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967. 2. George F Simmons, *Differential equations with applications and historical notes*, Tata McGraw Hill, New Delhi, 1974. 3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965. 4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971 5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New 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">GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>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 Graph Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study and develop the concepts of graphs, sub graphs, trees, connectivity,Euler tours, Hamilton cycles, matching, coloring of graphs, independent sets, cliques, vertex coloring, and planar graphs</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I: Graphs, Subgraphs and Trees

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

Chapter 1 (Section 1.1 - 1.7) ; Chapter 2 (Section 2.1 - 2.3)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-II: Connectivity, Euler Tours and Hamilton Cycles

Connectivity - Blocks - Euler tours – Hamilton

Chapter 3 (Section 3.1 -3.2) ; Chapter 4(Section 4.1 - 4.2)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-III: Matchings, Edge Colourings
Matchings - Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number - Vizing’s Theorem.

Chapter 5 (Section 5.1 - 5.2) ; Chapter 6 (Section 6.1 - 6.2)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-IV:Independent Sets and Cliques, Vertex Colourings

Independent sets - Ramsey’s Theorem – Chromatic Number - Brooks’ Theorem - Chromatic Polynomials.
Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4)</td></tr>
<tr><td colspan="2"></td><td colspan="8">UNIT-V: Planar Graphs

Plane and planar Graphs - Dual graphs - Euler’s Formula - The Five-Colour Theorem andthe Four-Colour Conjecture.

Chapter 9 (Section 9.1 - 9.3, 9.6)</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="8">Questions related to the above topics, from various competitive examinationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London,1976.
Reference Books	1.J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi,1995. 2.R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989. 3.A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge,1989. 4.R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley andSons, New York, 1989. 5.R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004,Indian Print. 6.S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.
Website and e-Learning Source	https://nptel.ac.in/courses/111106050/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Grasp features and properties of various types of graphs.

CLO2: Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.

CLO3: Understand the definitions and properties of matching and independent sets.

CLO4: Apply the concepts of graphs to model them in real life situations.

CLO5: Explicate the applications of planarity and colorability..

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">NUMBER THEORY AND CRYPTOGRAPHY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><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="7">UG level Number Theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. Demonstrate ability to learn elementary ideas from number theory which will haveapplications in cryptography.
2.Introduce various cryptosystems and apply them in the necessary fields.
3.Understand the concepts of public key and primality.
4.Learn the public key cryptography and RSA algorithm.
5.Get the knowledge about Factoring concepts.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="7">UNIT–I: Some topics in Elementary Number Theory
Time Estimates for doing arithmetic – Divisibility and
Euclidean Algorithm –Congruence's–Some
applications to Factoring.
Chapter 1</td></tr>
<tr><td colspan="7">UNIT–II: Cryptography
Some simple cryptosystems – Enciphering matrices.
Chapter 3</td></tr>
<tr><td colspan="7">UNIT–III:
Quadratics – Residues and reciprocity.
Chapter 2</td></tr>
<tr><td colspan="7">UNIT–IV: Public Key
The idea of Public key Cryptography – RSA –Discrete Law– Knapsack –Zero–Knowledge.
Chapter 4: Sections 1 to 5</td></tr>
</table>

	UNIT–V: Primality and Factoring Pseudo–primes – The rho method – Fermat factorization and factor bases – The continued fractionmethod – The quadratic sieve method. **Chapter 5: Sections 1 to 5**
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987
Reference Books	1.I.Niven and H.S.Zuckermann, An Introduction to Theory of Numbers(Edn. 3), Wiley Eastern Ltd., New Delhi,1976 2.David M.Burton, Elementary Number Theory, Brown Publishers,Iowa,1989 3.K.Ireland and M.Rosen, A Classical Introduction to Modern NumberTheory, Springer Verlag, 1972 4.N.Koblitz, Algebraic Aspects of Cryptography, Springer 1998.
Website and e-Learning Source	1.https://nptel.ac.in/courses/111101137 2.https://archive.nptel.ac.in/courses/106/103/106103015/ 3.https://onlinecourses-archive.nptel.ac.in/noc17_cs36/preview

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Acquire the knowledge of elementary number theory

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL PROGRAMMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="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"></td><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course introduces advanced topics in Linear and non-linear Programming.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Integer Linear Programming
Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory‘s All Integer Cutting Plane Method - Gomory‘s mixed Integer Cutting Plane method - Branch and Bound Method. - Zero-One Integer Programming. Dynamic Programming: Characteristics of Dynamic Programming Problem - Developing Optimal Decision Policy - Dynamic Programming Under Certainty - DP approach to solve LPP.
Chapter-7: 7.1 - 7.7 Chapter-20: 20.1 - 20.5

UNIT-II : Classical Optimization Methods
Unconstrained Optimization - Constrained Multi-variableOptimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints Non-linear Programming Methods: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe‘s modified Simplex Methods - Beale‘s Method
Chapter-23: 23.1 - 23.4 Chapter-24: 24.1 - 24.4

UNIT-III: Theory of Simplex Method
Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution.
Chapter-25: 25.1 - 25.4, 25.6-25.9

UNIT-IV: Revised Simplex Method
Standard forms for Revised simplex Method - Computationalprocedure for Standard form I - comparison of simplex method and Revised simplex Method. Bounded Variables LP problem: The simplex algorithm
Chapter-26: 26.1 - 26.4 Chapter-28: 28.1, 28.2

UNIT-V: Parametric Linear Programming
Variation in the coefficients cj , Variations in the Right hand side, bi . Goal Programming: Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.
Chapter-29: 29.1 - 29.3</td></tr>
</table>

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	J.K.Sharma, Operations Research, Theory and Applications, Third Edition (2007) Macmillan India Ltd.
Reference Books	1. Hamdy A. Taha, Operations Research, (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997. 2. F.S. Hillier & J.Lieberman Introduction to Operation Research (7th Edition) TataMcGraw Hill ompany, New Delhi, 2001. 3. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979 4. S.S. Rao - Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi. 1990
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: To know about integer programming.

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

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

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

CLO 5: To know parametric linear programming problems.

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

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

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2: Model the switching circuits with applications.

CLO3: Understand the finite fields and its mathematics properties.

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

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

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

<table>
<tr><td>Title of the Course</td><td colspan="7">ADVANCED ALGEBRA</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2">5</td><td>1</td><td>--</td><td colspan="3">6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Algebraic Structures</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I :Extension fields – Transcendence of e.
Chapter 5: Section 5.1 and 5.2</td></tr>
<tr><td colspan="7">UNIT-II : Roots or Polynomials.- More about roots
Chapter 5: Sections 5.3 and 5.5</td></tr>
<tr><td colspan="7">UNIT-III : Elements of Galois theory.
Chapter 5 : Section 5.6</td></tr>
<tr><td colspan="7">UNIT-IV : Finite fields - Wedderburn's theorem on finite division rings.
Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)</td></tr>
<tr><td colspan="7">UNIT-V :Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.
Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
Chapter 7 : Sections 7.3 and 7.4</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="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>Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td>Recommended Text</td><td colspan="7">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="8">REAL ANALYSIS II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To introduce measure on the real line, Lebesgue measurability and integrability, Fourier Series and Integrals, in-depth study in multivariable calculus.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="8">UNIT-I :Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)</td></tr>
<tr><td colspan="8">UNIT-II : Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)</td></tr>
<tr><td colspan="8">UNIT-III : Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point –Cesarosummability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)</td></tr>
<tr><td colspan="8">UNIT-IV : Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1
Chapter 12 : Section 12.1 to 12.14 (Apostol)</td></tr>
</table>

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

Title of the Course	**PARTIAL DIFFERENTIAL EQUATIONS**

<table>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE VI</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"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level partial differential equations</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I :Mathematical Models and Classification of second order equation : Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution
Chapter 2 : Sections 2.1 to 2.6
Chapter 3 : Sections 3.1 to 3.4 (Omit 3.5)</td></tr>
<tr><td colspan="8">UNIT-II :Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.
Chapter 4 : Sections 4.1 to 4.11</td></tr>
<tr><td colspan="8">UNIT-III :Method of separation of variables: Separation of variable-Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations
Chapter 6 : Sections 6.1 to 6.6 (Omit section 6.7)</td></tr>
<tr><td colspan="8">UNIT-IV : Boundary Value Problems : Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.
Chapter 8 : Sections 8.1 to 8.9</td></tr>
<tr><td colspan="8">UNIT-V : Green’s Function: The Delta function – Green’s function – Method of Green’s function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.
Chapter 10 : Section 10.1 to 10.9</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 6. S.G Venkatachalapathy,Partial Differential Equations,Margham Publications,Chennai-6000017
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

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

.

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To know about Statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural etc.
2. To apply problem solving technique to solve real world event and acquire knowledge about hypothesis testing and the significance test.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I :Significance Test(Large samples)
The notion of a sample - The notion of a statistic - The distribution of the arithmetic mean of - independent normally distributed random variables –Test for sample proportions-Test for means.
Chapter 9: Sections 9.1 to 9.4</td></tr>
<tr><td colspan="7">UNIT-II :Significance Test(Small samples)
The chi-square distribution - The distribution of the statistic - Student’s t-distribution –Fisher’s Z-distribution.
Chapter 9: Sections 9.5 to 9.7</td></tr>
<tr><td colspan="7">UNIT-III : Significance Test
The concept of a statistical test - Parametric test for small samples - Parametric tests for large – samples- Examples based on small and large samples - The chi – square test - Independence tests by contingency tables.
Chapter 12: Sections 12.1 to 12.4</td></tr>
<tr><td colspan="7">UNIT-IV :Theory of Estimation
Preliminary notions - Consistent estimate - Unbiased estimate -Sufficiency – efficiency - Asymptotically most efficient estimate - Methods of finding estimates. (K1,K2,K3,K4,K5,K6)
Chapter 13: Sections 12.7, 13.1 to 13.4</td></tr>
<tr><td colspan="7">UNIT-V : Theory of estimation(contd…)
Aim of the Design of experiments - Basic Principles of Experimental Design - Some Basic Designs of Experiment - Analysis of variance - Comparison of RBD and LSD - Examples based on analysis of variance.
Chapter 13: 13.5 to 13.7</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1. Marek Fisz - Probability Theory and Mathematical Statistics, 3rd Edition – John Wiley and Sons Inc, 1963.</td></tr>
</table>

Reference Books	1. Suddhenda Biswas and G. L. Sriwastav – Mathematical Statistics – Narosa Publishing House, 2011. 2. Alexander M. Mood, Franklin A.Graybill and Duane C.Bose – Introduction to Theory of Statistics, 3rd Edition - Tata McGraw Hill, 1974. 3. P. Kandasamy, K. Thilagavathy and K. Gunavathy - Probability, Statistics and Queuing Theory, 2nd Edition - Sultan Chand and Sons, 2005.
Website and e-Learning Source	1. https://www.scribd.com/document/294762054/Probability-Theory-and-Mathematical 2. https://r.search.yahoo.com/_ylt=AwrKAnSkarVk9P8.IiPnHgx.;_ylu=Y29sbwMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1689639716/RO=10/RU=https%3a%2f%2fdrive.google.com%2ffile%2fd%2f0B3ouU3Ur4aahVy13TzBfYjdUN3c%2fedit%3fusp%3dsharing/RK=2/RS=cZtZhaJAGtGLVB_.TFsHTeJhluc- 3. http://mathforum.org 4. http://ocw.mit.edu/ocwweb/Mathematics 5. http://www.opensource.org 6. https://nptel.ac.in 7. https://www.probability.net 8. www.coursera.org 9. https://swayam.gov.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the sample moments and their functions and analyze chi-square, Student-t, Fishers-Zdistributions.

CLO2: Demonstrate the knowledge of the properties of parametric testing procedures.

CLO3: Estimate population parameters from data sets and use the sampling distributions to compute confidence intervals for these population parameters.

CLO4: Learn the basic components of hypothesis testing and perform hypothesis test on population means.

CLO5: Understand the basic terms used in design of experiments and use appropriate experimental designs to analyze the experimental data.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">TENSOR ANALYSIS AND RELATIVITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="5"></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">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="7">UG level Vector Calculus and Mechanics.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The course aims to introduce vector algebra and vector calculus and special relativity and relativistic kinematics, dynamics and acceleratedsystems.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Tensor Algebra
Systems of Different orders - Summation Convention - Kronecker Symbols - Transformation of coordinates in Sn - Invariants - Covariant and Contravariant vectors - Tensors of Second Order - Mixed Tensors - Zero Tensor - Tensor Field Algebra of Tensors - Equality of Tensors - Symmetric and Skew – symmetric tensors - Outer multiplication, Contraction and Inner Multiplication - Quotient Law of Tensors - Reciprocal Tensor of Tensor Relative Tensor - Cross Product of Vectors.
Chapter I : I.1 - I.3, I.7 and I.8 and Chapter II : II.1 - II.19</td></tr>
<tr><td colspan="7">UNIT-II: Tensor Calculus
Riemannian Space - Christoffel Symbols and their properties
Chapter III: III.1 and III.2</td></tr>
<tr><td colspan="7">UNIT- III: Tensor Calculus (Contd)
Covariant Differentiation of Tensors - Riemann - Christoffel Curvature Tensor - Intrinsic Differentiation.
Chapter III: III.3 - III.5</td></tr>
<tr><td colspan="7">UNIT- IV: Introduction to Relativity
Introduction- Maxwell’s equation-the ether theory-the principle of relativity-relativistic kinematics –Events and simultaneity – examples</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V: Introduction to Relativity(Cont…..)
Time dilation – longitudinal contradiction-the invariant interval-proper time and proper distance –the world line line –example addition of velocities-example –the relativistic Doppler effect-example.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. (For Units I,II and III)
2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. (For Units IV and V)
.</td></tr>
</table>

Reference Books	1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949. 2. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930. 3. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942 4.C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938. 5.Goldstein , Classical Mechanics (Addition Wesley) 6.N E Rana & P.S Joag, Classical Mechanics (Tata McGraw Hills) 7. Schaum's outline series, vector analysis metric editions schaum's R.spiegell
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: Understand the system of different orders in Tenor Algebra.

CLO2: Explain about Tensor Calculus in Riemann spaces.

CLO3: Understand the concept of Covariant of differentiation and intrinsic differentiation

CLO4: Explain about the theory of relativity and Doppler effect.

CLO5: Analyze about the conservation of mass and energy.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">R PROGRAMMING LANGUAGE(ONLY PRACTICAL)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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>--</td><td colspan="2">--</td><td colspan="2">3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To master the use of R interactive environment with an understanding of the use of R documentation.
2. To use R for descriptive statistics and write simple programs in R.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">1. Perform arithmetic operations.
2. Create a Sequence and find the mean of numbers.
3. Find the first 10 Fibonacci numbers.
4. Find the factors of a given number.
5. Find the Maximum and Minimum of a given vector.
6. Read the CSV file and display the content.
7. Create matrix and perform matrix operations.
8. Create a bar plot,a scatter plot and a line graph.
9. Create a data frame and display the details.
10. Extract rows and columns from a data frame.
11. Create a list containing strings, numbers and vectors.
12. Find the Correlation and the Linear Regression between two variables.
13. Perform conditional executions.
14. Fit Binomial, Poisson and Normal distributions.
15. Perform Chi Square test for independence of attributes.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">1.W. John Braun, Duncan J. Murdoch, A first course in statistical programming with R, Cambridge University Press, 2007.</td></tr>
</table>

Reference Books	1. Gardener, M. Beginning R: The statistical programming language, John Wiley & Sons,2012. 2. Martin, T. The Undergraduate Guide to R. A beginner's introduction to R programming Language, 2009. 3. Chambers, J. Software for data analysis: programming with R. Springer Science & Business Media, 2008.
Website and e-Learning Source	1. http://assets.cambridge.org/97805218/72652/frontmatter/9780521872652_frontmatter.pdf 2. http://students.aiu.edu/submissions/profiles/resources/onlineBook/A7E7d8_Beginning%20R%20statistics.pdf 3. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf 4. https://www.cs.upc.edu/~robert/teaching/estadistica/TheRBook.pdf 5. https://nptel.ac.in/ 6. https://swayam.gov.in/nc_details/NPTEL 7. https://www.coursera.org/ 8. https://spoken-tutorial.org/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

CLO3: Demonstrate understanding and use data frames.

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">DIFFERENCE EQUATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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>3</td><td colspan="2">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To provide basic knowledge about the discretization process, the discrete version of difference equations and understand the Linear periodic systems.
2. Develop the students ability to difference equations using Z-transforms.
3. Enable to use of Oscillation Theory.
4. Study oscillation and asymptotic behavior of solutions of certain classes of differenceequations.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I:Linear Difference Equations of Higher Order
Difference Calculus-General Theory of Linear Difference Equations-Linear Homogeneous Equationswith Constant coefficients – Non-homogeneous equations: Method of Undetermined Coefficients, the method of variation of constants - Limiting behavior of Solutions.
Chapter 2: Sections 2.1 to 2.5</td></tr>
<tr><td colspan="7">UNIT- 2: System of Linear Difference Equations
Autonomous Systems - The Basic Theory - The Jordan form – Linear periodic systems.
Chapter3: Sections 3.1to 3.4</td></tr>
<tr><td colspan="7">UNIT- 3:The Z-Transform Method
Definitions and Examples, Properties of Z-transform-The Inverse Z-transformand Solutions Difference Equations: Power series method, partial fraction method, the inverse integral method
Chapter 6: Sections 6.1 to 6.3</td></tr>
<tr><td colspan="7">UNIT- 4:Oscillation Theory
Three-term difference Equations– Self- Adjoint Second Order Equations-Non linear Difference Equations.
Chapter 7: Sections7.1 to 7.3</td></tr>
<tr><td colspan="7">UNIT- 5: Asymptotic Behaviour of Difference Equation
Tools of Approximation - Poincare‟s Theorem - Asymptotically Diagonal Systems – High-OrderDifference Equations - Second Order Difference Equations.
Chapter 8: Sections 8.1 to 8.5</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	Saber N .Elaydi, An Introduction to Difference Equations, Third Edition, Springer Verlag, NewYork, 2005(First Indian Reprint 2008).
Reference Books	1.RonaldE.Mickens, Difference Equations Theory, Applications and Advanced Topics, Third Edition, CRC Press, NewYork,2015. 2.R.P.Agarwal.,DifferenceEquationsandInequalities,MarcelDekker,1999. 3.S.Goldberg,IntroductiontoDifferenceEquations,DoverPublications,1986 4.V.LakshmikanthamandTrigiante,Theory of Difference Equations Numerical Methods and Applications, Second Edition, Academic Press, New York,1988. 5.WalterG.Kelly,AllanC.Peterson,DifferenceEquations,AnIntroductionwithApplications, Academic Press, NewYork, 2001(FirstIndianReprint2006).
Website and e-Learning Source	http://people.math.aau.dk/~matarne/11-mat/notes2011a.pdf, http://pj.freefaculty.org/guides/stat/Math/Difference Equations/Difference Equations-guide.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Solve problems on Linear Difference Equations of Higher order.

CLO 2: Understand the system of Linear Difference Equation

CLO 3: Apply Z-transform techniques indifference equations.

CLO 4: Explain on Oscillation Theory.

CLO 5: Discuss on Asymptotic Behavior of Difference Equation.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MACHINE LEARNING AND ARTIFICAL INTELLIGENCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">1</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1.To Learn about Machine Intelligence and Machine Learning applications
2.To implement and apply machine learning algorithms to real-world applications.
3.To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems. To understand how to perform evaluation of learning algorithms and model selection.
4.To understand about the basic theory of problem solving paradigmsand search strategies in artificial intelligence
5.To make the students familiar with knowledge representation, planning, learning, natural language processing and robotics</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="7">UNIT- I: Introduction
Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.</td></tr>
<tr><td colspan="7">UNIT-II: NeuralNetworks and Genetic Algorithms
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms
– Advanced Topics – Genetic Algorithms– Hypothesis Space Search –Genetic programming –Models of Evaluation and Learning.</td></tr>
<tr><td colspan="7">UNIT-III: Bayesian and Computational Learning
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier –Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity –Finite and Infinite Hypothesis Spaces – Mistake Bound Model.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT – IV:
Introduction - Intelligent Agents- Problem Solving - by Searching - Informed Search Strategies-Optimization Problems - Adversarial Search-Knowledge and Reasoning - Logical Agents - First-Order Logic - Inference in First-Order Logic - Knowledge Representation</td></tr>
</table>

	UNIT – V: Planning – Planning and Acting in the Real World - Uncertain knowledge and reasoning - Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions
Extended Professional Component	Questions related to the above topics, from various competitive examination UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Tom M. Mitchell,―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013. 2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Third Edition, Prentice Hall of India, New Delhi, 2010.
Reference Books	1. Ethem Alpaydin,―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004. 2. Stephen Marsland,―Machine Learning: An Algorithmic Perspective, CRC Press,2009. 3. Michael Affenzeller, Stephan Winkler, Stefan Wagner, Andreas Beham, ‑Genetic Algorithms and Genetic Programming‖,CRC Press Taylor and Francis Group. 4. Elaine Rich, Kevin Knight, B. Nair, "Artificial Intelligence," Third Edition, Tata McGraw-Hill, New Delhi, 2017. 5. Eugene Charniak, Drew McDermott, "Introduction to Artificial Intelligence," Pearson, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

CLO4: Understand the computation intelligence.

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

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

SKILL ENHANCEMENT COURSE

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MATHEMATICAL DOCUMENTATION USING LATEX</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC-I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>2</td><td colspan="2">2</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. Inculcate the computer knowledge.
2. Introduce the LaTeX software
3. Train in the Preparation of Project and dissertations using LaTex.
4. Educate the Latex coding.
5.Understand the concepts of Cross References, Footnotes,
6.Margin pars and Endnotes</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="7">UNIT – I:Basic Document and Bibliography
What is LATEX – Simple typesetting – Fonts Type size – Document numbering – Formatting lengths – parts of a document – Dividing the document – what next? –Introduction – natbib – The BIBTEX program – BIBTEX Style files – Creating a bibliographicdatabase.
Chapter: 1 to 4</td></tr>
<tr><td colspan="7">UNIT – II:Contents, Index, Glossary, Text, Row and Column Tables. of contents – Index – Glossary. Borrowed words – Poetry in typing – Making lists – Whenorder matters – Description and definition
Chapter: 5 to 6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT – III:Typesetting Equations and Theorems
Keeping tabs – Tables – The basics – Custom commands – More on miscellany – New operations– The many fact of mathematics – Symbols – Theory in LATEX – Designer theorem-the amsthm package – Housekeeping.
Chapter: 7 to 9</td></tr>
</table>

	UNIT – IV:Several Kinds of Boxes and Floats LR boxes – Paragraph boxes – Paragraph boxes with specific height – Nested boxes – Roleboxes – The figure environment – The table environment. **Chapter: 10 to 11**
	UNIT – V: Cross References in Latex, Footnotes, Margin pars and endnote Why cross reference? – Let LATEX do it – Pointing to a page-the package varioref – Pointing outside-the package xr – Lost the keys? Use lables.tex – Footnotes – Marginal notes – Endnotes. **Chapter: 12 to 13**
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	A Primer, Latex Tutorials, Indian TEX users group, Trivandrum, India.
Reference Books	1. Peter Flynn, A beginner‟s introduction to typesetting with 2. LATEX,Silmaril Consultants,Textual Therapy Division, 2003. 3. George Gratzer,More Math Into LATEX, 4th Edition, Springer Science (2007). 4. Frank Mittelbach,Michel Goossens,The LaTex Companion, Second Edition, Addison-Wesley, 2004.
Website and e-Learning Source	https://www.latex-tutorial.com/tutorials/ https://www.latex-tutorial.com/ http://www.tug.org.in/tutorials.html

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">HUMAN RIGHTS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">COMPULSORY PAPER</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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">2</td><td colspan="2">-</td><td colspan="2">-</td><td>2</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="8">Unit – I :
Definition of Human Rights – Nature, Content, Legitimacy and Priority – Theories of Human Rights – Historical Development of Human Rights.</td></tr>
<tr><td colspan="8">Unit- II:
International Human Rights – Prescription and Enforcement upto World War II – Human Rights and the U. N. O. – Universal Declaration of Human Rights – International Covenant on Civil and Political Rights – International Covenant or Economic, Social and Cultural Rights and Optional Protocol.</td></tr>
<tr><td colspan="8">Unit –III:
Human Rights Declarations – U.N. Human Rights Declarations – U.N. Human Rights Commissioner.</td></tr>
<tr><td colspan="8">Unit-IV:
Amnesty International – Human Rights and Helsinki Process – Regional Developments – European Human Rights System – African Human Rights System – International Human Rights in Domestic courts.</td></tr>
</table>

	Unit-V: Contemporary Issues on Human Rights: Children's Rights – Women's Rights – Dalit's Rights – Bonded Labour and Wages – Refugees – Capital Punishment. Fundamental Rights in the Indian Constitution – Directive Principles of State Policy – Fundamental Duties – National Human Rights Commission.
Reference Magazines	1. The Lawyer, Bombay. 2. Human Rights Today, Columbia University. 3. International Instruments of Human Rights, UN Publication.
Books for Reference	1. International Bill of Human Rights, Amnesty International Publication, 1988. 2. Human Rights, Questions and Answers, UNESCO, 1982. 3. Mausice Cranston- What is Human Rights. 4. Desai, A.R - Violation of Democratic Rights in India. 5. Pandey - Constitutional Law. 6. Timm R.W - Working for Justice and Human Rights. 7. Human Rights- A Selected Bibliography, USIS. 8. J.C. Johari - Human Rights and New World order. 9. G.S. Bajwa - Human Rights in India. 10. Amnesty International - Human Rights in India. 11. P.C. Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security, Social Justice and Human Rights (Vols. 1 - 7). 12. Devasia, V.V - Human Rights and Victimology.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Highlight the Definition of Human Rights
CLO2: State the Role of Universal Declaration of Human Rights
CLO3: Explain Human Rights Declarations
CLO4: Discuss about the International Human Rights in Domestic Courts.
CLO5: Understand about Contemporary Issues on Human Rights

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

SELF STUDY PAPER

SKILL ENHANCEMENT IN ALGEBRA AND ANALYSIS

Semester	Subject Code	Category	Lecture		Theory		Practical	Credit
II		Optional	Hrs/week	Hrs/Sem	Hrs/week	Hrs/Sem	0	2
			-	-	-	-		

COURSE OBJECTIVES

The students will be able to

- To prepare the students to develop the in- depth knowledge in Algebra and Analysis.
- To Crack lectureship and fellowship exams approved by UGC like CSIR – NET and SET.

COURSE OUTCOMES:

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

CO Number	CO Statement	Knowledge Level (K1-K4)
CO1	Study the concept of Group Theory.	K2
CO2	Acquire the knowledge of permutations.	K3
CO3	Understand and analyze the concept of Rings and fields.	K4
CO4	Develop the knowledge about set theory and real number system.	K4
CO5	Develop and apply complex number and analytic function in finding solutions to the problems.	K4

Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze.

MAPPING WITH PROGRAMME OUTCOMES:

COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	M	S	M
CO2	M	S	M	S	M	S
CO3	S	M	S	M	M	S
CO4	S	M	M	M	M	M
CO5	S	S	S	M	S	M

S- Strong; M-Medium; L-Low

UNIT I: Groups

Introduction to Groups – Sub Groups – Coset - Ablian Group - Normal Sub Groups - Cyclic Groups.Quotient Groups -Direct Products - Some important Groups - Homomorphism - Normalizer of Subgroups - Centralizer of an Element or Normalizer of an Element - Commutator Subgroups – Fundamental theorem of Finite Abelian groups – Number of Non isomorphic Ablian Groups - Sylows theorem.

UNIT II: Permutations

Permutations – Symmetric Group S_n – Alternating Group An – Conjugacy Classes and Conjugacy Relation.

UNIT III: Rings and Fields

Rings-Ideals, Prime and maximal ideals,Quotient Rings, Fields,Finite Fields-Field Extensions- Galois Theory

UNIT IV: **Set theory and Real Number System**

Elementary Set Theory – Finite Countable and Uncountable Sets – Real number system as a complete ordered field – Archimedean property-Supremum-Infimum-Sequence and series- convergence- limit sup-limit inf-Bolzano Weirstrass theorem- Heine Boral theorem

UNIT V: Complex Number and Analytic functions

Algebra and complex numbers- The complex plane –polynomials-power series-Transcendental functions such as Exponential, Trignometry and Hyperbolic and function –Analytic function.

TEXT BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1.	I.N.Herstein	Topics in Algebra	Wesley Wiley Eastern Limited, New Delhi	1975, II Edition
2.	Walter Rudin	Real Analysis	Narosa Publishing House,New Delhi	1999.

REFERENCE BOOKS:

S.NO	AUTHORS	TITLE	PUBLISHERS	YEAR OF PUBLICATION
1	M.Artin	Algebra	Prentice Hall of India	1991
2	P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul	Basic Abstract Algebra	Cambridge University Press	1997

WEB SOURCES:

1. http://www.math.toronto.edu/ivrii/PDE-textbook/
2. https://www.math.ust.hk/-machas/differential-equation pdf

TEACHING METHODOLOGY:

1. Class room Teaching
2. Assignments
3. Seminars
4. Discussions
5 .PPT Presentations

<table>
<tr><td>Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE VII</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional Hours per week</td><td colspan="2">Lecture
5</td><td colspan="2">Tutorial
1</td><td colspan="2">Lab Practice
--</td><td>Total
6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">UG level Complex Analysis</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">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>Course Outline</td><td colspan="7">UNIT-I : Cauchy’s Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors’s Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3
Chapter 4 : Section 3 : 3.1 to 3.4</td></tr>
<tr><td></td><td colspan="7">UNIT-II :The general form of Cauchy’s Theorem : Chains andcycles-Simple Continuity - Homology - The General statement of Cauchy’s Theorem - Proof of Cauchy’s theorem - Locally exact differentials-Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7
Chapter 4 : Section 5: 5.1 and 5.2</td></tr>
<tr><td></td><td colspan="7">UNIT-III :Evaluation of Definite Integrals and Harmonic Functions Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3
Chapter 4 : Sections 6 : 6.1 to 6.3</td></tr>
<tr><td></td><td colspan="7">UNIT-IV :Harmonic Functions and Power Series Expansions: Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor’s Series – Laurent series .
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3</td></tr>
<tr><td></td><td colspan="7">UNIT-V: Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen’s formula – Hadamard’s Theorem
Chapter 5 : Sections 2.1 to 2.4
Chapter 5 : Sections 3.1 and 3.2</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="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>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	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's formula .

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROBABILITY THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level algebra and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To introduce axiomatic approach to probability theory, to study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT-I : Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2 : Sections 2.1 to 2.9</td></tr>
<tr><td colspan="7">UNIT-II : Parameters of the Distribution : Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8</td></tr>
<tr><td colspan="7">UNIT-III: Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4 : Sections 4.1 to 4.7</td></tr>
<tr><td colspan="7">UNIT-IV : Some Probability distributions: One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal- gamma – Beta – Cauchy and Laplace (continuous) distributions.
Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)</td></tr>
<tr><td colspan="7">UNIT-V: Limit Theorems : Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6 : Sections 6.1 to 6.4, 6.6 to 6.9 , 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)</td></tr>
</table>

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

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

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

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

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

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

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">TOPOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE 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">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Topological spaces : Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.
Chapter 2 : Sections 12 to 17</td></tr>
<tr><td colspan="8">UNIT-II :Continuous functions: Continuous functions – the product topology – The metric topology.
Chapter 2 : Sections 18 to 21 (Omit Section 22)</td></tr>
<tr><td colspan="8">UNIT-III :Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness.
Chapter 3 : Sections 23 to 25.</td></tr>
<tr><td colspan="8">UNIT-IV : Compactness : Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.</td></tr>
<tr><td colspan="8">UNIT-V: Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="8">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<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(homeomorphic).

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">MECHANICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">CORE X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core
Industry
Module</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">UG level Calculus and Differential equations.</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. Understand mechanical systems under generalized coordinate systems.
2. Apply mechanics techniques in virtual work.
3. Develop students ability to deal with Energy and momentum.
4. Look at the concept of Hamilton, Lagrange.
5. Discuss the Canonical Transformation.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">Unit – 1:Mechanical Systems
The Mechanical system-Generalized coordinates- Constraints-
Virtual work–Energy and Momentum.
Chapter1: Sections 1.1 to 1.5</td></tr>
<tr><td colspan="8">Unit – 2:Lagrange’s Equations
Derivation of Lagrange's equations- Examples - Integrals of motion.
Chapter 2: Sections2.1 to 2.3</td></tr>
<tr><td colspan="8">Unit – 3:Hamilton’s Equations
Hamilton’s Principle - Hamilton's Equation - Other variationalprinciple.
Chapter4: Sections 4.1 to 4.3</td></tr>
<tr><td colspan="8">Unit – 4:Hamilton-Jacobi Theory
Hamilton’s Principle Function – Hamliton – Jacobi Equation – Separability
Chapter 5 : Section 5.1 to 5.3</td></tr>
<tr><td colspan="8">UNIT–5:Canonical Transformation
Differential forms and generating functions - Lagrange and Poisson brackets.
Chapter 6: Sections6.1 and 6.3</td></tr>
<tr><td colspan="2">Extended Professional Component</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	D.T.Greenwood, *Classical Dynamics*, Prentice Hall Of India,NewDelhi,1985.
Reference Books	1.H.Goldstein,*ClassicalMechanics*,(2ndEdition) Narosa Publishing House, NewDelhi. 2.N.C.RaneandP.S.C.Joag, *ClassicalMechanics*,TataMcGrawHill,1991. 3.J.L.Synge and B.A.Griffth, *Principles of Mechanics* (3rd Edition) McGraw HillBookCo.,New York, 1970.
Website and e-Learning Source	https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

CLO1: Explain the basics concepts of mechanical systems under generalized coordinate systems.

CLO2: Identify the Lagrange's equations and its application. Identify the Lagrange's equations and its application.
CLO3: Derive the Hamilton Equation.

CLO4: Analyze the Hamilton's Principle and Hamilton-Jacobi Equation and separability.
CLO5: Discuss the Lagrange and Poisson brackets.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALGEBRAIC NUMBER THEORY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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>2</td><td colspan="2">1</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">UG level Number Theory and Algebra Concept</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">The course aims to provide a study on modules over rings, finite fields, algebraic extensions, number fields and cyclotomic fields, Noetherian rings and modules and Dedekind rings.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Algebraic Background
Rings and Fields- Factorization of Polynomials - Field Extensions - Symmetric Polynomials - Modules - Free Abelian Groups.
Chapter 1: Sec. 1.1 to 1.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-II: Algebraic Numbers
Algebraic numbers - Conjugatesand Discriminants - Algebraic Integers - Integral Bases - Norms and Traces - Rings of Integers.
Chapters 2: Sec. 2.1 to 2.6</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-III: Quadratic and Cyclotomic Fields
Quadratics and cyclotomatic fields : Factorization into irreducibles: Trivial factorization - Factroization into irreducibles - Examples of non-uniquefactorization into irreducibles.
Chapter 3: Sec. 3.1 and 3.2 ; Chapter 4: Sec. 4.2 to 4.4</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- IV:
Prime Factroization - Euclidean Domains - Euclidean Quadratic fields - Consequences of unique factorization - The Ramanujan -NagellTheorem.
Chapter 4: Sec. 4.5 to 4.9</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- V :Ideals
Prime Factorization of Ideals - The norms of anIdeal - Non-unique Factorization in Cyclotomic Fields..
Chapter 5 : Sec. 5.2 to 5.4</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">I. Steward and D.Tall. Algebraic Number Theory and Fermat‘s Last Theorem (3rd Edition) A.K.Peters Ltd., Natrick, Mass. 2002.</td></tr>
</table>

Reference Books	1. Z.I.Bosevic and I.R.Safarevic, Number Theory, Academic Press, New York, 1966. 2. J.W.S.Cassels and A.Frohlich, Algebraic Number Theory, Academic Press, New York, 1967. 3. P.Ribenboim, Algebraic Numbers, Wiley, New York, 1972. 4. P. Samuel, Algebraic Theory of Numbers, Houghton Mifflin Company, Boston, 1970. 5. A.Weil. Basic Number Theory, Springer, New York, 1967.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Course Learning Outcome (for Mapping with POs and PSOs)
Students will be able to

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

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

CLO3: To understand factorization to irreducible polynomials.

CLO4: To understand Euclidean Quadratic fields

CLO5: To know concepts of ideals .

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">STOCHASTIC PROCESSES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td>3</td><td colspan="2">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">This course aims to introduce advanced topics in Markov process, Markov chains and Renewal theory.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT - I : Stochastic Processes
Stochastic processes – Specification of Stochastic processes – Markov Chains : Definitions and Examples – Higher transition probabilities – Generalization of independent Bernoulli trials.
Chapter1 :1.5; Chapter2 :2.1to 2.3

UNIT - II : Markov Chains
Stability of Markov system – Graph theoretic approach – Markov chain with denumerable number of states – Reducible chains – Statistical inference for Markovchains.
Chapter2:2.6 to2.10

UNIT - III : Markov Processes with Discrete State Space
Poisson process: Poisson process and Related distributions – Generalizations of Poisson process.
Chapter3 :3.1 to 3.3

UNIT - IV : Markov Processes with Discrete State Space (Cont…..)
Birth and death process – Markov processes with discrete state space (Continuoustime Markov chain).Continuous time Markov chain).
Chapter3 :3.4 and 3.5

UNIT - V : Markov Processes with Continuous State Space
Brownian motion – Weiner process – Differential equations for Weiner Process – Kolmogorov equations – First passage time distribution for Weiner process.
Chapter4 :4.1 to 4.5</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	J. Medhi, Stochastic Processes (3Rd Edition), New Academic Science Limited,2012.
Reference Books	1.S. Karlin, A first course in Stochastic Processes, (2nd Edition), Academic Press,1958. 2.U.N. Bhat, Elements of Applied Stochastic Prcesses, John Wiley Sons, 1972. 3.E. Cinlar, Introduction to Stochastic Processes, PHI, 1975 4.S.K. Srinivasan and A. Vijayakumar, Stochastic Processes, Narosa, 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: To know the classification of stochastic processes.

CLO2: To know Markov chains and the stability condition.

CLO3: To understand Poisson process and its properties.

CLO4: To Discuss about Poisson process and birth and death process.

CLO5: To understand Brownian process and Weiner process.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FLUID DYNAMICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td colspan="2">--</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">To discuss Kinematics in motion, to know about three dimensional flow and to analyze viscous flows.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT-I: Kinematics of Fluids in Motion
Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows –Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples.
Chapter 2: Sections 2.1 to 2.8

UNIT-II: Equations of Motion of Fluid
Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion –Discussion of the case of steady motion under conservative body forces.
Chapter 3: Sections 3.1 to 3.7

UNIT-III: Some Three Dimensional Flows
Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetricflows – Stokes stream function.

Chapter 4: Sections 4.1, 4.2, 4.3, 4.5

UNIT-IV: Some Two Dimensional Flows
The stream function – The complex potential for two dimensional, irrational incompressible flow –Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems –The Milne Thompson circle Theorem.
Chapter 5: Sections 5.3 to 5.8</td></tr>
</table>

	UNIT-V: Viscous Flows Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements –The co-efficient of viscosity and Laminar flow – The Navier Stokes equations of motion of a Viscous fluid. **Chapter 8: Sections 8.1 to 8.3, 8.8 and 8.9**
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	F. Chorlton, Text Book of Fluid Dynamics,CBS Publications. Delhi ,1985.
Reference Books	1.R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985. 2.E.Krause, Fluid Mechanics with Problems and Solutions, Springer,2005. 3.B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005 4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002. 4.T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics,Springer, Berlin, 2004.
Website and e-Learning Source	http://web.mit.edu/1.63/www/lecnote.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the concepts of kinematics of fluids in motions.

CLO2: Find the pressure at a point in a moving fluid.

CLO3: Discuss Stokes stream function.

CLO4: Analyse complex velocity potential for two dimensional flows.

CLO5: Derive the Navier – Stokes equations of motion of a Viscous fluid

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

Title of the Course	TERM PAPER & SEMINAR PRESENTATION					
Paper Number	Skill Enhancement Course – II					
Category SEC	Year	II	Credits	2	Course Code	
	Semester	III				
Instructional Hours per Week	Lecture	Tutorial	Lab Practice	Total		
	2	1	-	3		
Course outline	Professional Communication Skill : Term paper & Seminar presentation Assignment of Problem by faculty Lecture - I (by the student) 25% Lecture - II (by the student) 25% Lecture - III (by the student) 25% Submission of a write-up (10 to 15 pages using LaTex) 25% Marks / Grade Points / Lecture Grade as per the Regulation)					

Title of the Course	COMPUTATIONAL MATHEMATICS USING SAGEMATH					
Paper Number	SEC-II					
Category Skill Enhancement	Year	II	Credits	2	Course Code	
	Semester	III				
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total		
	2	1	--	3		
Course Outline	**UNIT- I: First Steps** The Sage Program -Sage as a Calculator					
	UNIT- II: Analysis and Algebra Symbolic Expressions and Simplification – Equations – Analysis Basic Linear Algebra					
	UNIT- III: Programming and Data Structures Syntax –Algorithmics -Lists and Other Data Structures					
	UNIT- IV: Graphics 2D Graphics - 3D Curves					
	UNIT- V: Computational Domains Sage is Object-Oriented- Elements, Parents, Categories-Domains with a Normal Form-Expressions vs Computational Domains					
Extended Professional Component	Questions related to the above topics, from various competitive examinationsUPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)					

Skills acquired fromthis course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	1. Mathematical Computation with SageMath ,Paul Zimmermann Alexandre Casamayou.

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

Title of the Course		**INTERNSHIP / INDUSTRIAL ACTIVITY**					
Category		**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	
		--		--		--	

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">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td>--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Elements of Real Analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To provide students with a strong foundation in functional analysis, focusing on spaces, operators and fundamental theorems. To develop student’s skills and confidence in mathematical analysis and proof techniques.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT-I :Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator.
Chapter 9:Sections 46-51</td></tr>
<tr><td colspan="6">UNIT-II :Hilbert Spaces: The definition and some simple properties–Orthogonal complements–Ortho normal sets– The conjugate space H^*-The adjoint of an operator–self- adjoint operators-Normal and unitary operators –Projections.
Chapter10:Sections52-59</td></tr>
<tr><td colspan="6">UNIT-III : Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem.
Chapter 11:Sections 60-62</td></tr>
<tr><td colspan="6">UNIT-IV : General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi- simplicity.
Chapter 12:Sections 64-69</td></tr>
<tr><td colspan="6">UNIT-V: The Structure of Commutative BanachAlgebras: The Gelfand mapping – Application of the formula $\|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand-Neumark theorem.
Chapter 13:Sections 70-73</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	G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.
Reference Books	1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973. 2. B.V. Limaye, Functional Analysis, New Age International,1996. 3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987. 4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978. 5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

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

CLO2: Prove Hahn Banach theorem and open mapping theorem.

CLO3: Describe operators and fundamental theorems.

CLO4: Validate orthogonal and orthonormal sets.

CLO5: Analyze and establish the regular and singular elements.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">DIFFERENTIAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">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">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8">Linear Algebra concepts and Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non-intrinsicproperties of surface and the differential geometry of surfaces
are explored</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="8">UNIT-I : Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.
Chapter I : Sections 1 to 9.

UNIT-II :Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.
Chapter II: Sections 1 to 9.

UNIT-III : Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.
Chapter II: Sections 10 to 18.

UNIT-IV : Non Intrinsic properties of a surface:
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.
Chapter III: Sections 1 to 8.

UNIT-V :Differential Geometry of Surfaces :
Compact surfaces whose points are umblics- Hilbert’s lemma
– Compact surface of constant curvature – Complete surface and their characterization – Hilbert’s Theorem – Conjugate points on geodesics.
Chapter IV : Sections 1 to 8 (Omit 9 to 15).</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	T.J.Willmore, *An Introduction to Differential Geometry*, Oxford University Press,(17th Impression) New Delhi 2002.(Indian Print)
Reference Books	1. Struik, D.T. *Lectures on Classical Differential Geometry*,Addison – Wesley, Mass. 1950. 2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Inter science Publishers, 1963. 3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978. 4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag1979.
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="7">PROJECT WITH VIVA VOCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Core Project</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">7</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>6</td><td colspan="2">--</td><td colspan="2">10</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">UG Level Mathematics</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">RESOURCE MANAGEMENT TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">--</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To be familiar with resource management techniques.
2. To Learn to solve problems in linear programming and Integer programming.
3. To understand CPM and PERT techniques in scheduling problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT- I : Linear Programming
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution –Resource allocation problems – Simplex method.</td></tr>
<tr><td colspan="7">UNIT – II: Duality and Networks
Introduction- Definition of dual problem–General Primal– Dual pair – Formulating a dual problem – Dual relationships – Dual simplex methods.</td></tr>
<tr><td colspan="7">UNIT- III: Integer Programming
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.</td></tr>
<tr><td colspan="7">UNIT- IV: Classical Optimisation Theory
Unconstrained external problems, Newton – Ralphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.</td></tr>
<tr><td colspan="7">UNIT- V: Object Scheduling
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved (To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">H.A. Taha, ‑Operation Research‖, Prentice Hall of India, 2002.</td></tr>
</table>

Reference Books	1. Paneer Selvam, Operations Research', Prentice Hall of India, 2002 2. Anderson Quantitative Methods for Business', 8th Edition, Thomson Learning, 2002. 3. Winston Operation Research', Thomson Learning, 2003. 4. Vohra, Quantitative Techniques in Management', Tata Mc Graw Hill, 2002. 5. Anand Sarma, Operation Research', Himalaya Publishing House, 2003.
Website and 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 solve linear programming problems by using simplex method

CLO2: To solve transportation and assignment problems.

CLO3: To solve integer and dynamic programming.

CLO4: To know optimization theory .

CLO5: To know CPM and PERT for project scheduling .

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">MODELING AND SIMULATION WITH EXCEL</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">ELECTIVE VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT–I : Presentation Of Quantitative Data
Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation.
Analysis of Quantitative Data : Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analysis of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data—Forecasting/Data Relationship Tools.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- II : Presentation Of Qualitative Data
Introduction-Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter.
Analysis of Qualitative Data
Introduction-Essentials of Qualitative Data Analysis-PivotChart or PivotTable Reports.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT–III : Inferential Statistical Analysis Of Data
Introduction-χ 2—Chi-Square Test of Independence for Categorical Data-z-Test and t-Test of Categorical and Interval Data-An Example-ANOVA-Experimental Design.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT–IV : Modeling And Simulation: Part 1 Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT-V : Modeling And Simulation: Part 2
Types of Simulation and Uncertainty-The Monte Carlo Sampling Methodology-A Financial Example—Income Statement-An Operations Example—Autohaus.</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="7">Excel data analysis modelling and simulation, Hector Guerrero, Springer-Verlag Berlin Heiddelberg 2010.</td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="7">http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Know to present and analyze quantitive data.

CLO 2: Know to present and analyze qualitative data.

CLO 3: Know inferential statistical analysis of data.

CLO4: Know modeling and simulation for deterministic data.

CLO5: Know modeling and simulation for non deterministic data.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">TRAINING FOR COMPETITIVE EXAMINATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Skill Enhancement Course – III
Professional Competency Skill Enhancement</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</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">2</td><td colspan="2">-</td><td>4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">1.Training for Competitive Examinations
Mathematics for NET / UGC - CSIR/ SET / TRB Competitive Examinations (2 hours)
2.General Studies for UPSC / TNPSC / Other Competitive Examinations (2 hours)
OR Mathematics for Advanced Research Studies (4 hours)</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">RESEARCH TOOLS AND TECHNIQUES</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SEC-III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>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>2</td><td colspan="2">2</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="7">UNIT- I:
Research Process- Research Design</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- II:
Research Problem-Variables and Their Types</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- III:
Formulation of Hypothesis– Sampling- Tools of Data Collection</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- IV:
Data Analysis- Interpretation of Data</td></tr>
<tr><td colspan="2"></td><td colspan="7">UNIT- V:
Research Methods - Descriptive or Survey Method - Experimental Method</td></tr>
<tr><td colspan="2">Extended Professional Component</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /TNPSC / others to be solved(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency,Professional Communication and Transferrable Skill
Recommended Text	Research Methodology: Tools And Techniques Dr. Prabhat Pandey Dr. Meenu Mishra Pandey © Bridge Center, 2015
Reference Books	1. Ackoff, Russell L. (1961). The Design of Social Research, University of Chicago Press: Chicago. 2. Allen, T. Harrell, (1978). New Methods in Social Research, Praeger Publication: New York. 3. Baker, R.P. & Howell, A.C. (1958). The Preparation of Reports, Ronald Press: New York. 4. Barzun, Jacques & Graff. F. (1990).The Modern Researcher, Harcourt, Brace Publication: New York. 5. Berelson Conard & Colton, Raymond. (1978). Research and Report Writing for Business and Economics, Random House: New York.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.mathpages.com

Title of the Course	**EXTENSION ACTIVITY**						
Paper Number							
Category	Year	**II**	Credits	**1**	Course Code		
	Semester	**IV**					
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total			
	--	--	--	--			
Course Outline	Syllabus will be prepared by the University as a common course to all PG Programmes.						